ICOOPMA 2010

FOURTH INTERNATIONAL CONFERENCE ON OPTICAL, OPTOELECTRONIC AND PHOTONIC MATERIALS AND APPLICATIONS

August 15 – 20, 2010 | Budapest, Hungary

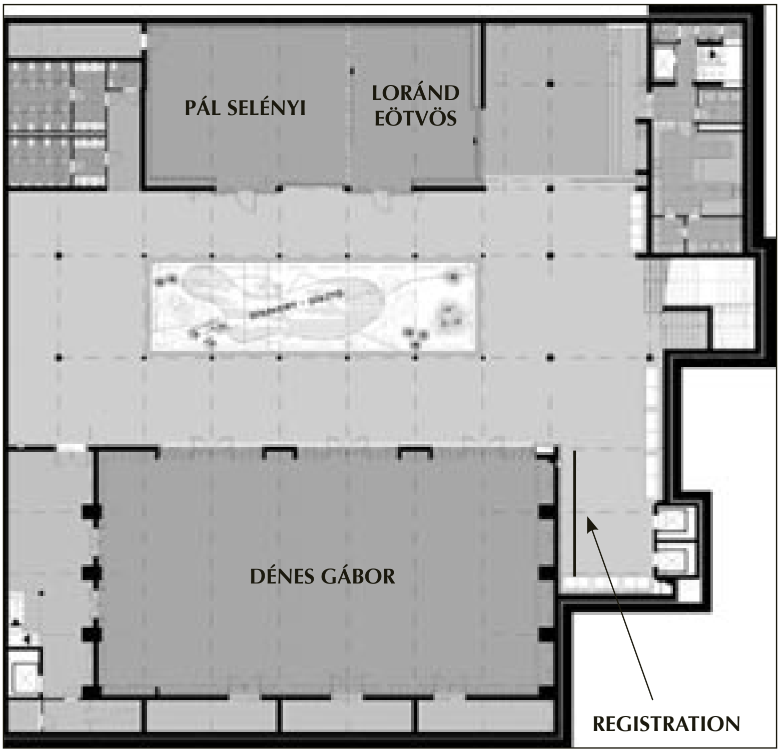
MŰEGYETEM 1782

Debreceni Egyetem
UNIVERSITY OF DEBRECEN

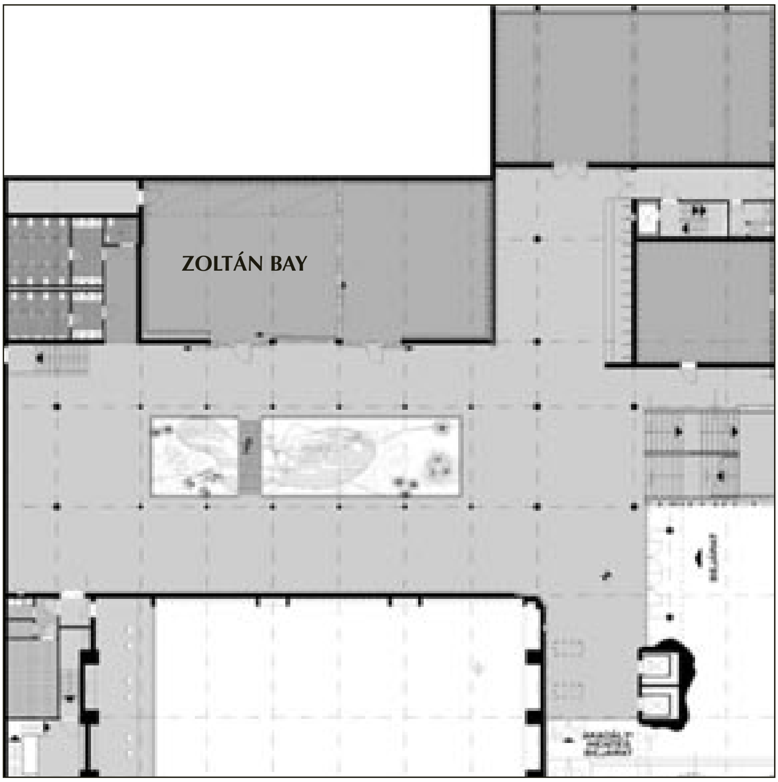
NKTH
National Office for Research and Technology

Program and Abstracts

LEVEL -1 (BASEMENT)



GROUND FLOOR



Welcome Message

Welcome to ICOOPMA 2010, Budapest!

We would like to welcome all of experts and attendees from different countries in the world to ICOOPMA 2010, which will be held on August 15th-20th, 2010 in Budapest, Hungary. We have great honor to organize the International Conference on Optical, Optoelectronic and Photonic Materials and Applications (also known as International Conference on Optical and Optoelectronic Properties of Materials and Applications) which is the fourth in the prestigious ICOOPMA series. The first one was held in Darwin, Australia, in July 2006 and covered a wide range of materials and applications in optics, optoelectronics and photonics. The Second ICOOPMA was held in London, England, 29 July – 3 August, 2007, and the third one in Edmonton, Canada, 20-25 July, 2008. We hope to follow the best traditions of this series and provide discussions between researchers working on different classes of materials that have similar applications or have been characterized by similar techniques.

There are 307 papers accepted for presentation at ICOOPMA 2010, contributed by over 289 authors from more than 30 countries, including Japan, United States, United Kingdom, Canada, Germany, France, Italy, Spain, Russia, Ukraine, Brazil, China, Korea, India, New Zealand and Australia. We have 6 international famous scientists and experts as plenary speakers as well as 48 invited speakers.

We extend our warmest greetings to you and hope you will have a rewarding and exciting stay in Budapest during ICOOPMA 2010.

Sandor Kugler, Chair

Sandor Kokenyesi, Chair

Conference Organization

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Sandor Kokenyesi, University of Debrecen, Hungary

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Sandor Kokenyesi, Co-Chair, University of Debrecen, Debrecen

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Peter Richter, Budapest University of Technology and Economics, Budapest
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Miklos Veres, Secretary, Research Institute for Solid State Physics and Optics, Budapest

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Istvan Barsony, Research Institute for Technical Physics and Materials Science, Hungary
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Gilles Pauliat, Laboratoire Charles Fabry de l'Institut d'Optique, France
Hironori Kaji, Institute for Chemical Research, Kyoto University, Japan
Joaquin Fernández, Escuela Superior de Ingenieria de Bilbao, University of the Basque Country, Spain

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Spyros Yannopoulos, Foundation for Research and Technology Hellas (FORTH), Patras, Greece

CONFERENCE SECRETARIAT

ASSZISZTENCIA Congress Bureau
Szent Istvan krt. 7.
H-1055 Budapest, Hungary
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E-mail: icoopma@asszisztencia.hu
Website: www.icoopma10.org

Participating Countries

- Australia
- Austria
- Belgium
- Brazil
- Bulgaria
- Canada
- China
- Czech Republic
- Egypt
- Estonia
- Finland
- France
- Germany
- Hungary
- India
- Iran
- Iraq
- Ireland
- Israel
- Italy
- Japan
- Korea
- Latvia
- Lithuania
- Mexico
- Moldova
- Morocco
- New Zealand
- Poland
- Portugal
- Republic of South Africa
- Republic of South Korea
- Romania
- Russia
- Serbia
- Spain
- Sweden
- Switzerland
- Turkey
- Ukraine
- United Kingdom
- United States of America

General Information

CONFERENCE DATE

August 15 - 20, 2010 | Budapest, Hungary

CONFERENCE VENUE

Europa Hotels & Congress Center

Pálos utca 2.
H-1021 Budapest
www.europacongress.hu

OFFICIAL LANGUAGE

The official language of the Conference is English; please note that translation facilities will not be provided.

BADGE

Your personal name badge provides access to scientific sessions, exhibition and the welcome reception. Please note that name badges must be worn at all times.

ON-SITE REGISTRATION HOURS

August 15 (Sunday)	**16.00 – 20.00**
August 16 (Monday)	**08.00 – 18.00**
August 17 (Tuesday)	**08.00 – 18.00**
August 18 (Wednesday)	**08.00 – 18.00**
August 19 (Thursday)	**08.00 – 14.00**

LUNCH

From Monday to Thursday a 2-course lunch will be provided for registered participants and accompanying persons in the restaurant of the Hotel Rege located right next to the Conference Venue.

Lunch hours:

August 16 (Monday)	**12.00 – 14.00**
August 17 (Tuesday)	**12.00 – 14.00**
August 18 (Wednesday)	**12.00 – 14.00**
August 19 (Thursday)	**12.00 – 14.00**

TRAVEL AND TOUR INFORMATION

Budapest and the beautiful countryside of Hungary present a wealth of culture and history that will appeal to all participants and accompanying persons attending ICOOPMA 2010. A wide range of full and half-day excursions are available daily throughout the Conference and can be booked during registration hours at the Tour Information Desk.

SLIDE CHECK

Please note that all speakers should upload their finalized MS Power Point presentation to the central computers of the slide check area located in front of the on-site registration desk not less than one hour in advance of their session. Speakers at the morning sessions are required to upload their material not later than 18.00 on the evening before their session is scheduled.

Technicians will be at your service on

August 15 (Sunday)	**16.00 – 19.00**
August 16 (Monday)	**08.00 – 18.00**
August 17 (Tuesday)	**08.00 – 18.00**
August 18 (Wednesday)	**08.00 – 18.00**
August 19 (Thursday)	**08.00 – 14.00**

POSTER EXHIBITION

Poster Exhibition is located in the Dénes Gábor lecture room. Your interest in the posters is highly appreciated.

Poster Sessions will be held on Monday, August 16 and Tuesday, August 17 in two different sessions in the Dénes Gábor lecture room.

POSTER SESSION 1.	**August 16 (Monday)**	**18.00 – 20.00**
POSTER SESSION 2.	**August 17 (Tuesday)**	**18.00 – 20.00**

INSTRUCTION FOR ORAL PRESENTATIONS

- Speakers are kindly requested to be in the assigned lecture room 10 minutes before their presentation.
- Multimedia projector connected to a PC will be provided. Please note that it will not be allowed to present from your own laptop.
- All presenters are requested to prepare a MS Power Point presentation file and take it to the conference venue on CD or pendrive. The latest version of the software will be installed in the presentation PC.
- Please note that all speakers should upload their finalized MS Power Point presentation to the central computers of the slide check area located in front of the on-site registration desk not less than one hour in advance of their session. Speakers at the morning sessions are required to upload their material not later than 18.00 on the evening before their session is scheduled.

INSTRUCTION FOR POSTER PRESENTATIONS

- Poster Sessions will be held on Monday, August 16 and Tuesday, August 17 from 18.00 to 20.00 in Dénes Gábor lecture room.
- Each poster presentation is allotted one poster board. Materials for mounting posters will be available at the poster boards.
- The poster numbers will be marked on the poster boards. For more information about poster boards please see Poster Board Assignment at the back of this Program and Abstract Book.
- During the poster session presenting authors are expected to be at their poster and available to answer questions.

Poster Display

Set-up and removal date and time is as follows:

For presenters whose poster has been scheduled to Poster Session 1.

Set-up: **from 16.00 on Sunday, August 15**
Removal: **Preferably at the end of the Poster Session 1. or the lates until 09.00 on Tuesday, August 17.**

For presenters whose poster has been scheduled to Poster Session 2.

Set-up: **from 11.30 on Tuesday, August 17**
Removal: **until 10.30 on Thursday, August 19.**

Social Program

WELCOME RECEPTION

Date and time: **Sunday, August 15, 2010 | 19.00 - 21.00**
Venue: **Europa Hotels & Congress Center**

The Organizers invite all registered participants and accompanying persons to join the Welcome Reception held from 19.00 hrs to meet new colleagues and greet old friends.
Please come and enjoy the Hungarian Hospitality.

For registered participants and accompanying persons this program is included in the registration fee.

CONFERENCE DINNER

Date and time: **Wednesday, August 18, 2010 | 20.00 - 22.30**
Venue: **Zsófia Event Ship**
Budapest, 5th District, Petőfi Square Boat Station, Port No. 9.

The Organizing Committee invites all congress participants to spend an enchanted evening cruising down the Danube with delicious dinner on board of a riverboat.

This program is an optional extra, price: EUR 60 / person (including bus transfer)

Shuttle bus will pick you up at the Europa Hotels & Congress Center at 19.20 hrs. The shuttle bus will return back from the port to the Conference Venue at 22.30 hrs.

ACCOMPANYING PERSON’S PROGRAM

BUDAPEST SIGHTSEEING TOUR

Date and time: **Tuesday, August 17, 2010 | 09.30 - 13.00**

The group will meet by the Registration Desk at 09.20. The bus will leave sharply at 09.30 from the main entrance of the Conference Venue. The bus will return our guests to the Conference Venue after the program about at 13.00.

For registered accompanying persons this program is included in the registration fee.

Program Overview

SUNDAY, AUGUST 15, 2010		
16.00 - 20.00	**Registration**	
19.00 - 21.00	**Welcome Reception**	

MONDAY, AUGUST 16, 2010				
08.00 - 18.00	**Registration**			
TIME / ROOM	DÉNES GÁBOR	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
09.00 - 09.20	**Opening Ceremony**			
09.20 - 10.20	**Plenary 1**			
10.20 - 10.45	Coffee Break			
10.45 - 12.30		**Session 1** **Luminescence and excitonic processes**	**Session 2** **Photovoltaic materials**	**Session 3** **Nano-optoelectronics and photonics**
12.30 - 14.00	Lunch			
14.00 - 15.30		**Session 4** **Modeling and simulation**	**Session 5** **Photoconductivity and photovoltaic materials**	**Session 6** **Nano-optoelectronics and photonics**
15.30 - 15.50	Coffee Break			
15.50 - 16.50	**Plenary 2**			
16.50 - 17.00	Break			
17.00 - 18.00		**Session 7** **Optical fibers**	**Session 8** **Nonlinear optical properties and applications**	**Session 9** **Nano-optoelectronics and photonics**
18.00 - 20.00	**Poster Session 1**			

TUESDAY, AUGUST 17, 2010

08.00 - 18.00	**Registration**			
TIME / ROOM	DÉNES GÁBOR	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
09.00 - 10.15		**Session 10 Luminescence and applications**	**Session 11 Materials for optoelectronics and photonics**	**Session 12 Optical storage**
10.15 - 10.35	Coffee Break			
10.35 - 11.35	**Plenary 3**			
11.35 - 11.45	Break			
11.45 - 12.30		**Session 10A Luminescence and applications**	**Session 11A Materials for optoelectronic and photonics**	**Session 12A Optical storage and sensing**
12.30 - 14.00	Lunch			
14.00 - 15.30		**Session 13 Optical fibers**	**Session 14 Materials for optoelectronics and photonics**	**Session 15 Photoinduced effects**
15.30 - 15.50	Coffee Break			
15.50 - 17.50		**Session 16 Luminescence and applications**	**Session 17 Terahertz techniques**	**Session 18 Photoinduced effects**
18.00 - 20.00	**Poster Session 2**			

WEDNESDAY, AUGUST 18, 2010

08.00 - 18.00	Registration

TIME / ROOM	DÉNES GÁBOR	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
09.00 - 10.15		**Session 19** **Optoelectronic and photonic devices**	**Session 20** **Nonlinear properties and applications**	**Session 21** **Materials for optoelectronics and photonics**
10.15 - 10.35	Coffee Break			
10.35 - 11.35	**Plenary 4**			
11.35 - 11.45	Break			
11.45 - 12.30		**Session 19A** **Optoelectronic devices**	**Session 20A** **Experimental techniques**	**Session 21A** **Materials for optoelectronics**
12.30 - 14.00	Lunch			
14.00 - 15.30		**Session 22** **Optoelectronic and photonic devices**	**Session 23** **Modeling and simulation**	**Session 24** **Materials for optoelectronics and photonics**
15.30 - 15.50	Coffee Break			
15.50 - 16.50	**Plenary 5**			
16.50 - 17.00	Break			
17.00 - 18.00		**Session 25** **Electro-optic properties and applications**	**Session 26** **Application of materials in photonics**	**Session 27** **Materials for optoelectronics and photonics**

20.00 - 22.30	**Conference Dinner**

THURSDAY, AUGUST 19, 2010

08.00 - 14.00	Registration

TIME / ROOM	DÉNES GÁBOR	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
09.00 - 10.15		**Session 28** **Photoinduced effects**	**Session 29** **Application of materials in photonics**	**Session 30** **Materials for optoelectronics an photonics**
10.15 - 10.35	Coffee Break			
10.35 - 11.35	**Plenary 6**			
11.35 - 11.45	Break			
11.45 - 12.30		**Session 28A** **Photoinduced effects**	**Session 29A** **Application of materials in photonics**	**Session 30A** **Materials for optoelectronics and photonics**
12.30 - 14.00	Lunch			
14.00 - 16.00		**Session 31** **Photoinduced effects and materials for photonics**	**Session 32** **Nano-optoelectronics and photonics**	**Session 33** **Materials and devices for optoelectronics**
16.00 - 16.05	Break			
16.05 - 16.30	**Closing Session**			

Program

SUNDAY, AUGUST 15, 2010

16.00 - 20.00	**Registration**
19.00 - 21.00	**Welcome Reception**

MONDAY, AUGUST 16, 2010

08.00 - 18.00	**Registration**
ROOM	DÉNES GÁBOR
09.00 - 09.20	**OPENING CEREMONY** József GYULAI *President of Section for Engineering Science of Hungarian Academy of Sciences* István BÁRSONY *Director of Research Institute for Technical Physics and Materials Science of Hungarian Academy of Sciences* Safa KASAP *Chair of International Organizing and Advisory Committee of ICOOPMA* Péter RICHTER *Head of the Department of Atomic Physics, Budapest University of Technology and Economics* Sándor KUGLER *Conference Chair of ICOOPMA 2010* Sándor KÖKÉNYESI *Conference Chair of ICOOPMA 2010*
09.20 - 10.20	**PLENARY 1** Chairman: Sandor Kokenyesi (Hungary) **A-0305** **THERE IS LIGHT AT THE BOTTOM** Norbert Kroó (Hungary)
10.20 - 10.45	Coffee Break

ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
10.45 - 12.30	**SESSION 1** **Luminescence and excitonic processes** Chairman: Mitsuo Yamaga (Japan) **A-0214** (invited talk 30') **ADVANCES IN WHITE ORGANIC LIGHT EMITTING DEVICES** Jai Singh (Australia) **A-0142** (invited talk 30') **SECONDARY OPTICAL PROCESSES AND APPLICATION OF X-RAY EXCITED OPTICAL LUMINESCENCE IN MEDICINE** Ramaswami Sammynaiken, G. Beleev, D. Chapman, W. Chen, B. Juurlink, J. Yang, T-K. Sham, A. Zhu (Canada) **A-0141** (15') **OPTICAL PROPERTIES AND JUDD-OFELT PARAMETERS OF Sm^{3+} DOPED BIO$_{1.5}$-WO$_3$-TEO$_2$ GLASSES** Takeshi Fujiwara, T. Hayakawa, M. Nogami, J. R. Duclere, P. Philippe (Japan) **A-0194** (15') **WHITE UPCONVERSION LUMINESCENCE IN NANOCRYSTALLINE (Ho3+,Tm3+,Yb3+): KLU(WO4)2 PHOSPHOR** E. William Barrera, M. C. Pujol, C. Cascales, J. J. Carvajal, X. Mateos, M. Aguiló, F. Díaz (Spain) **A-0190** (15') **FABRICATION OF (Er,Yb):Lu2O3 NANOCRYSTALS EMBEDDED IN POLYMER MICROCOLUMNS USING A SILICON TEMPLATE** Montserrat Galceran, M. C. Pujol, J. J. Carvaja, X. Mateos, P. Formentin, J. Ferre-Borrull, J. Pallares, L. F. Marsal, F. Rotermund, M. Aguiló, F. Díaz (Spain)	**SESSION 2** **Photovoltaic materials** Chairman: Kanatingal Sangunni (India) **A-0084** (invited talk 30') **LOCALIZED-STATE DISTRIBUTIONS AND CHARGE CARRIER MOBILITIES OF ORGANIC BULK HETEROJUNCTION SOLAR CELLS** Hiroyoshi Naito (Japan) **A-0279** (invited talk 30') **PLASMONIC LIGHT-TRAPPING FOR PHOTOVOLTAICS** Darren M. Bagnall, T. Temple, D. N. R. D. Payne, S. A. Boden, F. Djidjeli (UK) **A-0114** (15') **USE OF NOVEL FUNCTIONALIZED NANOPARTICLES IN DYE SENSITIZED SOLAR CELLS** Shubhra Gangopadhyay, S. Mukherjee, M. Yun, S. Bok, V. Korampally, S. Barizuddin, K. Gangopadhyay (USA) **A-0188** (15') **THE GROWTH MECHANISM OF MICROCRYSTALLINE SILICON THIN FILM - MOUNDED SURFACE GROWTH** Fengzhen Liu, H. Zhang, Ch. Li, M. Zhu, Y. Zhou, J. Liu **A-0254** (15') **SPECTROSCOPY AND STRUCTURAL PROPERTIES OF AMORPHOUS AND THERMALLY INDUCED NANOCRYSTALLINE SILICON CARBIDE THIN FILMS** Sylvain Halindintwali, D. Knoesen, B.A. Julies, C. J. Arendse, T. Muller, P. Rudolf, P. H. M. van Loosdrecht (South Africa)	**SESSION 3** **Nano-optoelectronics and photonics** Chairman: Istvan Barsony (Hungary) **A-0154** (invited talk 30') **FABRICATION AND CHARACTERISTICS OF SITE-CONTROLLED (111)B QUANTUM DOTS BY HIGH PURITY MOVPE** Emanuele Pelucchi (Ireland) **A-0010** (invited talk 30') **SELF-ASSEMBLED SILICON-GERMANIUM NANOSTRUCTURES FOR CMOS COMPATIBLE LIGHT EMITTERS** David J. Lockwood (Canada) **A-0168** (15') **HYBRID NANOSTRUCTURES OF SEMICONDUCTOR NANOCRYSTALS AND DYE J-AGGREGATES** Lyubov Nikolenko, S. B. Brichkin, V. F. Razumov (Russia) **A-0014** (15') **NANO-PHOTONICS DEVICES ON ORGANICS AND SILICA MATERIALS OBTAINED WITH VARIOUS THIN LAYER PROCESSES** Bruno Bęche, D. Duval (France) **A-0187** (15') **NONISOTERMIC HIGH-TEMPERATURE SYNTHESIS OF CDSE SPHERICAL NANOCRYSTALS AND TETRAPODS** Denis Nikolenko, S. B. Brichkin, V. F. Razumov (Russia)
12.30 - 14.00	Lunch		

MONDAY, AUGUST 16, 2010

ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
14.00 - 15.30	**SESSION 4** **Modeling and simulation** Chairman: Jai Singh (Australia) **A-0226** (invited talk 30') **CRYSTALLISATION KINETICS OF PHASE-CHANGE MATERIALS** Krisztian Kohary, Y. Liu, M. Aziz, A. Marmier, R. J. Hicken, C. D. Wright (UK) **A-0048** (invited talk 30') **GENERALIZED ONSAGER-FRENKEL RECOMBINATION OF OPTICALLY GENERATED ELECTRON-HOLE PAIRS** Sergei Baranovski (Germany) **A-0003** (15') **SYMMETRIC STRUCTURE RESPONSE OF LONG RANGE POLARITON PLASMONS** Ashok Vaseastha, R. Mokdad, A. Benfdila (USA)	**SESSION 5** **Photoconductivity nd photovoltaic materials** Chairman: George Belev (Canada) **A-0266** (invited talk 30') **RECENT ADVANCES IN X-RAY PHOTOCONDUCTORS: SELECTED EXAMPLES ON PBO AND A-SE** Alla Reznik (Canada) **A-0088** (15') **HOLE-BLOCKING MECHANISM IN HIGH-GAIN AVALANCHE RUSHING AMORPHOUS PHOTOCONDUCTOR (HARP) FILM** Kenji Kikuchi, Y. Ohkawa, K. Miyakawa, T. Matsubara, K. Tanioka, M. Kubota, N. Egami (Japan) **A-0138** (15') **HEAT TREATMENT TO PREVENT IMAGE DEFECT OCCURRENCE IN AMORPHOUS SELENIUM DOPED WITH TELLURIUM AVALANCHE MULTIPLICATION PHOTOCONDUCTIVE FILM** Yuji Ohkawa, K. Miyakawa, T. Matsubara, K. Kikuchi, K. Tanioka, M. Kubota, N. Egami, A. Kobayashi (Japan) **A-0060** (15') **ULTRAHIGH-SENSITIVITY HARP PICKUP TUBES USING AVALANCHE MULTIPLICATION IN AMORPHOUS SELENIUM PHOTOCONDUCTIVE TARGETS AND THEIR APPLICATIONS** Kenkichi Tanioka (Japan) **A-0007** (15') **SINGLE-CRYSTALLINE CADMIUM SULFIDE NANOBELTS FOR ULTRAHIGH QUANTUM-EFFICIENCY PHOTODETECTORS** Liang Li, X. S. Fang, T. Y. Zhai, Y. Bando, D. Golberg (Japan)	**SESSION 6** **Nano-optoelectronics and photonics** Chairman: Anthony Kenyon (UK) **A-0099** (invited talk 30') **PHOTONIC AND RELATED APPLICATIONS OF QUANTUM-SIZED NANOSILICON** Nobuyoshi Koshida, T. Ohta, R. Mentek, B. Gelloz (Japan) **A-0064** (invited talk 30') **PHOTOLUMINESCENCE FROM SIOX LAYERS CONTAINING AMORPHOUS SILICON NANOPARTICLES** Diana Nesheva (Bulgaria) **A-0234** (15') **TUNING LIGHT-MAGNETO-OPTICAL MATERIAL INTERACTION BY MAGNETOPHOTONIC CRYSTALS** Alexander Baryshev, S. M. Baek, T. Goto, M. Inoue (Japan) **A-0026** (15') **LITHIUM NIOBATE PHOTONIC CRYSTAL CAVITY FOR CHEMICAL DETECTION** Jean Dahdah, N. Courjal, F. Baida (France)
15.30 - 15.50	Coffee Break		

ROOM	DÉNES GÁBOR		
15.50 - 16.50	**PLENARY 2** Chairman: Safa Kasap (Canada) **A-0267** **REVERSING THE ARROW OF TIME VIA PHOTNICS USING POLYMER-DYE INTERACTIONS** Mark G. Kuzyk, N. Dawson, S. K. Ramini (USA)		
16.50 - 17.00	Break		
ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
17.00 - 18.00	**SESSION 7** **Optical fibers** Chairman: Raman Kashyap (Canada) **A-0235** (invited talk 30') **RECENT ADVANCES IN HIGH POWER OPTICAL FIBERS** Yoonchan Jeong, C. A. Codemard, J. Ji, L. A. Vazquez-Zuniga, G. van der Westhuizen, S. Yoo, A. J. Boyland, M. N. Petrovich, F. Poletti, J. K. Sahu, J. Nilsson, D. J. Richardson, D. N. Payne (UK) **A-0074** (15') **ACTIVE FIBER DEVICES WITH NANO-WATT OPERATIONS IN ELECTRO-OPTIC CRYSTALLIZED GLASS** Takumi Fujiwara, S. Ohara, H. Masai, Y. Takahashi, R. Ihara (Japan) **A-0111** (15') **EFFECTS OF THE CLADDING ON THE EMISSION OF DOPED PLASTIC OPTICAL FIBERS** Iñaki Bikandi, M. A. Illarramendi, G. Aldabaldetreku, J. Zubia, L. Bazzana (Spain)	**SESSION 8** **Nonlinear optical properties and applications** Chairman: Kalai Saravanamuttu (Canada) **A-0249** (invited talk 30') **OPTICAL PARAMETRIC PROCESSES IN NONLINEAR DISORDERED MEDIA** Wieslaw Krolikowski, W. Wang, K. Kalinowski, D. Neshev, Y. Kivshar, V. Roppo, C. Cojocaru, J. Trull, R. Vilaseca (Australia) **A-0259** (15') **SYSTEMATIC 'SMART MATERIAL' DESIGN: DATA-MINING REVEALS NEW CLASSES OF HIGH-PERFORMANCE ORGANIC NON-LINEAR OPTICAL MOLECULES** Jacqueline M. Cole, Ze F. Weng (UK) **A-0182** (15') **RAMAN SPECTRA AND THIRD-ORDER NONLINEAR OPTICAL Z-SCAN PROPERTIES OF MO-NB2O5-TeO2 (M=Zn, Mg, Ca, Sr, Ba)** Tomokatsu Hayakawa, T. Suhara, T. Fujiwara, M. Nogami, P. Thomas, (Japan)	**SESSION 9** **Nano-optoelectronics and photonics** Chairman: Emanuele Pelucchi (Ireland) **A-0224** (invited talk 30') **NANOSILICON: A NEW PLATFORM FOR PHOTONICS** Paolo Bettotti, L. Pavesi (Italy) **A-0027** (15') **THIN FILMS OF LSMO AS ELECTRODE IN SPINTRONICS DEPOSITED BY PULSED LASER ABLATION** Maurizio Martino, A. P. Caricato, M. Cesaria, G. Maruccio, A. Cola, D. Berling (Italy) **A-0152** (15') **DEWETTING-ASSISTED FORMATION OF NOVEL FLUORESCENT AGGREGATES OF RHODAMINE DYES AND THEIR CONTROLLED SWITCHING TO DEQUENCHED STATE** Akihiro Tomioka, T. Takeuchi, K. Iwamoto, T. Anzai (Japan)
ROOM	DÉNES GÁBOR		
18.00 - 20.00	**POSTER SESSION 1** Chairmen: Miklos Veres (Hungary), Kanatingal Sangunni (India), Koichi Shimakawa (Japan) For list of the poster presentations refer to page 29		

TUESDAY, AUGUST 17, 2010

08.00 - 18.00	**Registration**		
ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
09.00 - 10.15	**SESSION 10** **Luminescence and applications** Chairman: Dirk Poelman (Belgium) **A-0129 (15')** **RADIO-LUMINESCENCE AND OPTICALLY STIMULATED LUMINESCENCE STUDY OF Mn2+ AND Eu2+ DOPED FLUOROPEROVSKITES** Grant Williams, S. G. Raymond, My. T. T. Do, C. Varoy, C. Dotzler (New Zealand) **A-0134** (15') **SENSITIZATION MECHANISMS OF 1 UM LUMINESCENCE IN TB3+-YB3+ CO-DOPED BORATE GLASSES** Jumpei Ueda, S. Tanabe (Japan) **A-0127** (15') **SENSITISED RARE EARTH DOPED LAF3 NANOPARTICLES** Stefaan Janssens, D. Clarke, G. V. M. Williams (New Zealand) **A-0208** (invited talk 30') **OXYGEN IN CSBR: EU2+: ITS INFLUENCE ON PHOTOSTIMULATED LUMINESCENCE** Heinz von Seggern, G. Appleby, J. Zimmermann (Germany)	**SESSION 11** **Materials for optoelectronics and photonics** Chairman: Andrei Sazonov (Canada) **A-0220** (invited talk 30') **HIGHLY ORDERED ZnO NANOSTRUCTURES FOR NOVEL PHOTONIC DEVICES** János Volk, Z. Szabo, R.Erdélyi, I. E. Lukács (Hungary) **A-0237** (15') **A NEW TRANSPARENT CONDUCTING ZINC OXIDE FILM CO-DOPED WITH BORON AND ALUMINUM FOR THIN FILM SOLAR CELL APPLICATIONS** Dong-Won Kang, J. S. Woo, S. J. Kim, T. H. Moon, S. W. Ahn, M. K. Han (South Korea) **A-0198** (15') **COBALT DOPED ZNO NANORODS AND NANOTUBES FOR ENHANCED OPTICAL SENSITIVITY IN THE VISIBLE RANGE** Parameswar Hari, D. Spencer, A. Hor, H. Liang, K. Roberts and D. Teeters (USA) **A-0105** (15') **PROCESS CONTROL IN PULSED-DC REACTIVE SPUTTERING OF VANADIUM OXIDE THINS FILMS FOR UNCOOLED INFRARED IMAGING** Chandrasekaran Venkatasubramanian, W. Drawl, S. S. N. Bharadwaja, M. W. Horn, S. Ashok (USA)	**SESSION 12** **Optical storage** Chairman: Maria Mitkova (USA) **A-0059** (invited talk 30') **LIGHT - SENSITIVE ORGANIC RECORDING MEDIA FOR 3D OPTICAL MEMORY** Valery A.Barachevsky, M. M. Krayushkin, V. V. Kyiko, E. P.Grebennikov (Russia) **A-0049** (15') **OPTICAL FUNCTIONALISM OF AZOPOLYMERS OF DIFFERENT GENERATIONS: PHOTOINDUCED ORIENTATION AND HARMONIC GENERATION** Roland Tomašiunas, G. Seniutinas, G. Navickaite, R. Petruškevicius, B. Sahraoui, V. Getautis, V. Kampars (Lithuania) **A-0047 (15')** **HIGH DENSITY "LIPPMANN" DATA STORAGE IN THICK HOLOGRAPHIC MATERIALS** Gilles Pauliat, K. Contreras (France) **A-0034** (15') **APPLICATION OF CARBAZOLE-CONTAINING POLYMER MATERIALS AS RECORDING MEDIA** Andrei Andriesh, E. Achimova, A. Meshalkin, A. Prisacari, S. Sergeev, S. Robu, L. Vlad (Moldova)
10.15 - 10.35	Coffee Break		
ROOM	DÉNES GÁBOR		
10.35 - 11.35	**PLENARY 3** Chairman: Keiji Tanaka (Japan) **A-0205** **DOPING ISSUES FOR OPTOELECTRONIC TRANSPARENT CRYSTALLINE AND AMORPHOUS OXIDE** Hideo Hosono (Japan)		
11.35 - 11.45	Break		

ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
11.45 - 12.30	**SESSION 10A** **Luminescence and applications** Chairman: Ramaswami Sammynaiken (Canada) **A-0070** (15') **INFLUENCE OF DEFECTS ON RADIATIVE DISTANT-PAIR RECOMBINATION IN AMORPHOUS SILICON (a-Si:H)** Takeshi Aoki, K. Ikeda, N. Ohrui (Japan) **A-0090** (15') **LIGHT-INDUCED EFFECTS ON THE RADIATIVE RECOMBINATION RATE OF ELECTRON-HOLE PAIRS IN a-Si:H** Chisato Ogihara, Y. Inagaki, K. Morigaki (Japan) **A-0030** (15') **DIODE LASER PUMPED LaF3:Er3+/Yb3+ NANO-PHOSPHOR AS OPTICAL HEATER** Kaushal Kumar, A. K. Singh, S. B. Rai, A. C. Pandey (India)	**SESSION 11A** **Materials for optoelectronic and photonics** Chairman: Lluis Marsal (Spain) **A-0258** (invited talk 30') **SILK PHOTONICS: BIOPOLYMER OPTOFLUIDICS AND APPLICATIONS** Peter Domachuk, J. J. Amsden, R. Cademartiri, M. Cronin-Golomb, D. L. Kaplan, F. G. Omenetto (Australia) **A-0158** (15') **POLYMER-POLYMORPHOUS NATURE OF RELAXATION PROCESSES IN LIQUID AND GLASSY SiO2** Viktor Minaev, S.P. Timoshenkov, V.V. Kalugin (Russia)	**SESSION 12A** **Optical storage and sensing** Chairman: Oleh Shpotyuk (Ukraine) **A-0005** (15') **GEOSPATIAL REMOTE SENSING USING ADVANCED SENSOR SYSTEMS** Ashok Vaseashta (USA) **A-0069** (15') **LOCAL- AND INTERMEDIATE-RANGE STRUCTURE OF AMORPHOUS GE2SB2TE5 BY ANOMALOUS X-RAY SCATTERING** Shinya Hosokawa, A. Höhle, D. Szubrin, W.-C. Pilgrim, J.-F. Bérar, N. Boudet, K. Maruyama, G. Bruns, M. Wuttig (Japan) **A-0055** (15′) **TWO-PHOTON MATERIALS FOR MULTILAYER OPTICAL DATA STORAGE** Ilya Sh. Steinberg, V. V. Shelkovnikov, P. E. Tverdokhleb (Russia)
12.30 - 14.00	Lunch		

TUESDAY, AUGUST 17, 2010

ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
14.00 - 15.30	**SESSION 13** **Optical fibers** Chairman: Michael Fokine (Sweden) **A-0212** (invited talk 30') **CHALCOGENIDE GLASS PHOTONIC CRYSTAL FIBERS** Jean-Luc Adam, J. Troles, L. Brilland, Q. Coulombier (France) **A-0191** (15') **THERMAL HOLOGRAPHY AND MICRO-STRUCTURING AT A WAVELENGTH OF 10.6 MICRONS** Aïssa Harhira, I C. S. Carvalho, F. Guay, R. Kashyap (Canada) **A-0216** (15') **COMPUTATIONAL ANALYSIS OF THE AMPLIFICATION FEATURES OF ACTIVE PLASTIC OPTICAL FIBERS** Igor Ayesta, J. Arrue, F. Jimenez, M. A. Illarramendi, J. Zubia (Spain) **A-0206** (15') **A NOVEL MULTIPLEXED FIBER BRAGG GRATING SENSOR WITH APPLICATION IN MATERIALS HEALTH MONITORING** Mojtaba Kahrizi, M. Etezabrojerdi, K. Khorasani (Canada)	**SESSION 14** **Materials for optoelectronics and photonics** Chairman: Ashok Vaseashta (USA) **A-0250** (invited talk 30') **TEMPLATE-ASSISTED FABRICATION AND CHARACTERIZATION OF PHOTOLUMINESCENT CONDUCTING POLYMER NANOPILLARS** Lluis F. Marsal, R. Palacios, A. Santos, P. Formentín, E. Martínez-Ferrero, J. Pallarčs, J. Ferre-Borrull (Spain) **A-0121** (15') **OPTICAL SPECTRA AND DIELECTRIC SUSCEPTIBILITY OF INDIUM NITRIDE AND RELATED ALLOYS** Dimiter Alexandrov, S. Butcher (Canada) **A-0275** (15') **METHODS AND PROCESS FLOWS FOR CMOS COMPATIBLE PHOTONIC INTEGRATION: WAVEGUIDES,** **COUPLERS, RX AND TX** Steve Moffatt, G. L. Wojcik, A. Goebel (USA) **A-0023** (15’) **OPTIMIZATION OF Ge-As-Se GLASSES FOR ALL-OPTICAL SIGNAL PROCESSING** Barry Luther-Davies, D.A.P. Bulla, R. Wang, S. Madden, D-Y Choi, A. Prasad, X. Gai, A. Smith (Australia)	**SESSION 15** **Photoinduced effects** Chairman: Spyros Yannopoulos (Greece) **A-0045** (invited talk 30') **APPLICATION OF THIN FILMS OF CHALCOGENIDE VITREOUS SEMICONDUCTORS IN THE OPTICAL RECORDING SYSTEMS** Andriy Kryuchyn (Ukraine) **A-0213** (invited talk 30') **PHOTO-DEFORMATIONS IN As2S3 GLASS: FROM ATOMIC, NANO, TO MACROSCOPIC** Keiji Tanaka (Japan) **A-0217** (15') **PHOTO-INDUCED DICHROISM AND THE LACK OF A FIELD EFFECT** Robert E. Johanson, M. Kowalyshen, S. O. Kasap (Canada) **A-0201** (15') **PHOTOSTABILITY FOR PLD FILMS BASED ON Ge-As-Se FOR NON LINEAR OPTICAL PROPERTIES** Virginie Nazabal, P. Nemec, S. Zhang, G. Boudebs, K. Fedus, C. Cassagne, M. Cathelinaud, M. Chauvet, J. L. Adam (France)
15.30 - 15.50	Coffee Break		

ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
15.50 - 17.50	**SESSION 16** **Luminescence and applications** Chairman: Heinz von Seggern (Germany) **A-0195** (invited talk 30') **NEW MATERIALS AND STRUCTURES FOR OPTICAL DETECTION OF IONISING RADIATION** Andrew Edgar (New Zealand) **A-0091** (invited talk 30') **BROADBAND SENSITIZATION OF NEAR INFRARED EMISSION THROUGH ENERGY TRANSFER FROM TRANSITION METAL TO RARE-EARTH IONS IN LIYBMO2O8 PHOSPHORS** Q. Y. Zhang, S. Ye, X. Y. Huang, J. R. Qiu (China) **A-0092** (15') **PERSISTENT LUMINESCENCE IN RARE EARTH DOPED OXYNITRIDES** Dirk Poelman, J. Botterman, K. Van den Eeckhout, P. F. Smet, A. J. J. Bos, E. van der Kolk, P. Dorenbos (Belgium) **A-0022** (15') **HYDROTHERMAL SYNTHESIS OF HEXAGONAL-PHASE NaYF4:Er3+, Dy3+ PHOSPHOR** Liang Lei, Y. Ren, Y. Yang, G. Chen (China) **A-0037** (15') **THE EFFECT OF B2O3 ON THE REDUCTION OF Eu3+ TO Eu2+ IN ALUMINOSILICATE GLASSES** Zhenyu Lin, H. Zeng, X. Liang, Y. Yang, G. Chen (China) **A-0073** (15') **THE INFLUENCE OF Cd2+ AND Mg2+ ON THE ELECTRICAL AND THERMAL PROPERTIES OF MANGANESE MERCURY THIOCYANATE CRYSTALS AND ITS LEWIS BASE ADDUCTS - FUTURE MATERIALS FOR PHOTONICS DEVICE FABRICATION** Joseph P. Ginson, R. K. Santhosh, G. Sreekanth, G. S. George (India)	**SESSION 17** **Terahertz techniques** Chairman: Robert Johanson (Canada) **A-0024** (invited talk 30') **OBSERVATION OF AMPLIFIED STIMULATED TERAHERTZ EMISSION FROM OPTICALLY PUMPED GRAPHENE** Taiichi Otsuji V. Ryzhii (Japan) **A-0200** (invited talk 30') **OPTICAL RECTIFICATION FOR TERAHERTZ GENERATION** Roger Lewis (Australia) **A-0035** (15') **INTRA-CAVITY-GENERATED TERAHERTZ EMISSION AND ITS TRANSMISSION THROUGH AN ACTIVELY-BIASED TERAHERTZ QUANTUM CASCADE LASER WITH A METAL-METAL WAVEGUIDE** Dayan Ban, A. Lee, S. Kumar, Q. Hu, M. C. Hoffmann (Canada) **A-0166** (15') **MICRO-MACHINED FLUIDIC DEVICES FOR TERAHERTZ TIME-DOMAIN SPECTROSCOPY** Adam Baragwanath, G. P. Swift, D. Dai, D. Zeze, A. Gallant, J. M. Chamberlain (UK) **A-0162** (15') **ELECTRON AND TRAP DYNAMICS IN GABIAS LAYERS** Vaidas Paèebutas, K. Bertulis, R. Butkutė, A. Bièiūnas, A. Krotkus (Lithuania) **A-0240** (15') **IMAGING POLARIZATION DYNAMICS AT GHZ FREQUENCIES: NON-CONTACT ELECTROSTATIC SCANNING PROBE MICROSCOPY WITH PARAMETRIC EXCITATION** Derek R. Oliver, I. Yahyaie, E. Anema, D. J. Thomson, G. E. Bridges (Canada)	**SESSION 18** **Photoinduced effects** Chairman: Koichi Shimakawa (Japan) **A-0256** (invited talk 30') **PHOTOPLASTIC EFFECT, GIANT PHOTODEFORMATION AND MASS TRANSPORT PHENOMENA IN AMORPHOUS CHALCOGENIDES** Michael Trunov (Ukraine) **A-0243** (invited talk 30') **PHOTOINDUCED MASS TRANSFER IN SOFT MATERIALS** Janis Teteris, U. Gertners, M. Reinfelde (Latvia) **A-0232** (15') **COLOSSAL PHOTOSTRUCTURAL CHANGES IN CHALCOGENIDE GLASSES. ATHERMAL PHOTOINDUCED POLYMERIZATION IN ASXS100-X BULK GLASSES REVEALED BY NEAR-BANDGAP RAMAN SCATTERING** Spyros N. Yannopoulos, F. Kyriazis (Greece) **A-0008** (15') **SOLAR-CHEMICAL BATTERY: PHOTO-CHARGING AND DISCHARGING CHARACTERISTICS IN AGASS2 FILMS** Nobuaki Terakado, K. Tanaka (Japan) **A-0144** (15') **KINETICS OF PHOTODARKENING AT ROOM AND LIQUID HE TEMPERATURES IN A-AS45SE55 THIN FILM** Kumaran Nair Valsala Devi Adarsh, A. R. Barik, R. Naik, R. Ganesan, K. S. Sangunni, D. Zhao, H. Jain (India) **A-0202** (15') **LIGHT INDUCED 2D CHIRAL STRUCTURE ON THE SURFACE OF AZO-POLYMER FILMS** Sohrab Ahmadi-Kandjani, R. Barille, J. -M. Nunzi (Iran)
ROOM	DÉNES GÁBOR		
18.00 - 20.00	**POSTER SESSION 2** Chairmen: Diana Nesheva (Bulgaria), Mikhail Brik (Estonia), Miklos Veres (Hungary) For list of the poster presentations refer to page 36		

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08.00 - 18.00 **Registration**

ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
09.00 - 10.15	**SESSION 19** **Optoelectronic and photonic devices** Chairman: Stephen Sweeney (UK) **A-0228** (invited talk 30') **QUANTUM DOT PHOTONIC DEVICES FOR ULTRAFAST SIGNAL TRANSMISSION AND PROCESSING SYSTEMS** Osamu Wada (Japan) **A-0011** (15') **SINGLE-CRYSTALLINE ZNS NANOBELTS AS ULTRAVIOLET (UV)-LIGHT SENSORS** Xiaosheng Fang, Y. Bando, U. K. Gautam, T. Zhai, L. Li, M. Liao, D. Golberg (Japan) **A-0016** (15') **COMPARISON OF DIFFERENT MODELS OF NON-LOCAL IMPACT IONIZATION FOR LOW NOISE APDS** John S Marsland (UK) **A-0087** (15') **ELECTROLUMINESCENT DEVICES FABRICATED FROM CARBON-IMPLANTED SILICON** Michael Patrick Bradley, M. Risch, P. R Desautels (Canada)	**SESSION 20** **Nonlinear properties and applications** Chairman: Gilles Pauliat (France) **A-0164** (15') **CONTROLLING THE MICROSTRUCTURE AND PROPERTIES OF MATERIALS THROUGH NONLINEAR LIGHT PROPAGATION** Kalaichelvi Saravanamuttu, L. Qiu, K. Kasala, A. B. Villafranca, W. E. Shimmell, M. R. Ponte, N. J. Wood, I. Liko (Canada) **A-0260** (15') **STRUCTURE-PROPERTY RELATIONSHIP STUDY OF TWO-DIMENSIONAL CHARGE-TRANSFER NONLINEAR OPTICAL MOLECULE: 9-DIAZO-2,4,5,7-TETRANITRO-9H-FLUORENE** Tze-Chia Lin, Z. F. Weng, J. M. Cole (UK) **A-0145** (15') **NON-LINEAR OPTICAL PROPERTIES AND STRUCTURE OF WIDE BAND GAP NON-CRYSTALLINE SEMICONDUCTORS** Vladimir Mitsa, M. Veres, M. Koós, R. Holomb, I. Fekeshgazi, A. Marton, L. Himics, V. Milenin (Hungary) **A-0178** (15') **EFFICIENT SINGLE PASS 565 NM GREEN LIGHT SECOND HARMONIC GENERATION Rb1-xBaxTi1-y-zYbyNbzOPO4/RbTiOPO4 WAVEGUIDE** Jaume Cugat, R. Solé, J. J. Carvajal, M. C. Pujol, X. Mateos, F. Díaz, M. Aguiló (Spain) **A-0057** (15') **SPACE POLARIZATION AND NONLINEAR ABSORBABILITY OF HYROTROPIC CADMIUM DIPHOSPHIDE CRYSTALS** I. V. Fekeshgazi, T. S. Sidenko, V. Czitrovsky, N. Veresh (Ukraine)	**SESSION 21** **Materials for optoelectronics and photonics** Chairman: Takeshi Aoki (Japan) **A-0153** (15') **SENSITIZATION OF ERBIUM PHOTOLUMINESCENCE IN ERBIUM DOPED SILICON-RICH SILICA WITH LOW SI EXCESS** Maciej Wojdak, I. Ahmad, H. Saleh, and A. J. Kenyon, C. J. Oton, M. P. Temple, and W. H. Loh (UK) **A-0167** (15') **OPTICAL ABSORPTION and SPECTROSCOPIC PROPERTIES OF THULIUM DOPED TeO2-Nb2O5-TiO2 GLASSES** Idris Kabalci, T. Tay, G. Özen (Turkey) **A-0290** (invited talk 30') **COLOR CONVERSION LEDS USING NANOPHOSPHORS OF COLLOIDAL SEMICONDUCTOR QUANTUM DOTS** Hilmi Volkan Demir (Turkey) **A-0264** (15') **ON THE APPLICATION OF A DIMENSIONLESS JOINT DENSITY OF STATES FORMALISM FOR THE QUANTITATIVE CHARACTERIZATION OF THE OPTICAL RESPONSE OF HYDROGENATED AMORPHOUS SILICON** Stephen K. O'Leary, J. J. Thevaril (Canada)

ROOM	DÉNES GÁBOR		
10.35 - 11.35	**PLENARY 4** Chairman: David Lockwood (Canada) **A-0301** **ENHANCED LIGHT-MATTER INTERACTION WITH PHOTONIC NANOSTRUCTURES** Thomas F. Krauss (UK)		
11.35 - 11.45	Break		
ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
11.45 - 12.30	**SESSION 19A** **OPTOELECTRONIC DEVICES** Chairman: Shubhra Gangopadhyay (USA) **A-0123** (15') **OXIDIZED GOLD ELECTRODES FOR FLEXIBLE ORGANIC OPTOELECTRONICS** Michael G. Helander, Z. B. Wang, M. T. Greiner, J. Qiu, Z. H. Lu (Canada) **A-0184** (15' **CUBR BLUE LIGHT EMITTING ELECTROLUMINESCENT THIN FILM DEVICES** Francis Olabanji Lucas, A. Cowley, S. Daniels, P. J. McNally (Ireland) **A-0236** (15') **THE DISORDERING EFFECT OF PERIODICALLY POLED NONLINEAR CRYSTALS ON PARAMETRIC DOWN CONVERSION** Reza Kheradmand, M. Rezaie, M. Nemati, G. Y. Kryuchkyan, A. Razmi (Iran)	**SESSION 20A** **Experimental technics** Chairman: Andrew Edgar (New Zealand) **A-0222** (invited talk 30') **OPTICAL WAVEGUIDE BIOSENSORS FOR PROTEINS AND CELLS** Robert Horvath (Hungary) **A-0086** (15') **SEMICONDUCTOR SCINTILLATOR BASED ON PHOTON RECYCLING** Serge Luryi (USA)	**SESSION 21A** **Materials for optoelectronics** Chairman: Rui Almeida (Portugal) **A-0106** (15') **RELATIONSHIPS BETWEEN STRUCTURE AND PROPERTIES OF SILICATE GLASSES IMPLANTED WITH Au+ IONS** Blanka Svecova, P. Nekvindova, A. Mackova, P. Malinsky, J. Pesicka, M. Slouf, W. Husinsky, V. Machovic, J. Spirkova (Czech Republic) **A-0307** (invited talk 30') **NEW WORK PROGRAMME FOR PHOTONICS IN EU** Markus Korn (Belgium)
12.30 - 14.00	Lunch		

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ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
14.00 - 15.30	**SESSION 22** **Optoelectronic and photonic devices** Chairman: Asim Ray (UK) **A-0221** (invited talk 30') **RECENT ADVANCES IN ER-DOPED FIBRE AND PLANAR DEVICES** Gin Jose, M. Irannejad, Z. Zhao, P. Steenson, Z. Ikonic, A. Jha, J. Lousteau, T. T. Fernandez, S. Eaton, G. Della Valle, R. Osellame, P. Laporta, Q. Jiang, Z. Zhang, R. A. Hogg, J. Dong, I. White, R. V. Penty (UK) **A-0269** (invited talk 30') **LIGHT-INDUCED ELECTRICAL INSTABILITY IN NC-SI THIN FILM TRANSISTORS** A. Nathan, M. Bauza, A. Ahnood, Y. Vygranenko, M. Esmaeili-Rad, G. Chaji, A. Sazonov, J. Robertson, W. I. Milne (UK) **A-0025** (15') **ALL-OPTICAL SIGNAL PROCESSING AT TBAUD RATES IN As2S3 GLASS NONLINEAR WAVEGUIDES** Barry Luther-Davies, T. D. Vo, H. Hu, M. Galili, E. Palushani, J. Xu, L. K. Oxenløwe, S. J. Madden, D.-Y. Choi, D. A. P. Bulla, X. Gai, M. D. Pelusi, F. Luan, J. Schröder, B. J. Eggleton (Australia) **A-0252** (15') **CONTROL OF DISCRETE CAVITY SOLITONS IN COUPLED CAVITIES** Reza Kheradmand, K. M. Aghdami, R. Karimi (Iran)	**SESSION 23** **Modeling and simulation** Chairman: Krisztian Kohary (UK) **A-0203** (invited talk 30') **STRETCHED EXPONENTIAL RELAXATION PROCESSES IN HYDROGENATED AMORPHOUS SILICON AND HYDROGENATED POLYMORPHOUS SILICON** Kazuo Morigaki, H. Hikita (Japan) **A-0100** (15') **ELECTRONIC AND OPTICAL PROPERTIES OF CuXS2 (X = Al, Ga, In) AND AgGAS2 SEMICONDUCTORS FROM FIRST-PRINCIPLES CALCULATIONS** Mikhail G. Brik (Estonia) **A-0132** (15') **MAGNETICALLY DRIVEN EFFECTIVE REFRACTIVE INDEX OF THREE DIMENSIONAL ARRAYS OF SEMICONDUCTOR QUANTUM DOT MOLECULES** Oleksandr Voskoboynikov, L. M. Thu (Taiwan) **A-0018** (15') **PHOTONIC BAND PARAMETERS OF ZnX (X =O, S, Se, Te)** Utku Erdiven, Y. Ufuktepe (Turkey) **A-0231** (15') **TEMPERATURE DEPENDENCE OF THE THRESHOLD CURRENT DENSITY OF A GAN BASED QUANTUM DOT LASER** Asghar Asgari Tokaldani (Iran)	**SESSION 24** **Materials for optoelectronics and photonics** Chairman: Valery Barachevsky (Russia) **A-0131** (invited talk 30') **MULTIPHASE SEMICONDUCTOR QUANTUM DOTS IN GLASSES** Jong Heo, C. Liu, S. M. Shim, K. Xu, Y. K. Kwon (South Korea) **A-0227** (invited talk 30') **CHEMICAL VAPOR DEPOSITED DIAMOND - THE MATERIAL FOR OPTICS AND OPTOELECTRONICS** Viktor Ralchenko, V. Konov, A. Kaminskii, A. Bolshakov, A. Popovich, I. Vlasov, A. Khomich, G. Sharonov (Russia) **A-0192** (invited talk 30') **ERBIUM DOPED GLASS CERAMIC MATERIALS AND WAVEGUIDES** Simone Berneschi, G. C. Righini, A. Chiappini, M. Ferrari (Italy)
15.30 - 15.50	Coffee Break		

ROOM	DÉNES GÁBOR		
15.50 - 16.50	**PLENARY 5** Chairman: Asim Ray (UK) **A-0083** **ELECTRONIC AND OPTO-ELECTRONIC DEVICES BASED ON THIN ORGANIC FILMS** Michael. Petty (UK)		
16.50 - 17.00	Break		
ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
17.00 - 18.00	**SESSION 25** **Electro-optic properties and applications** Chairman: Martin Mika (Czech Republic) **A-0225** (15') **APPLICATION OF THE PHOTOMODULATED REFLECTION TECHNIQUE TO THE MONITORING OF METAL LAYERS** Gábor Dobos, A. Somogyi, S. Lenk, A. Pongrácz, F. Újhelyi, Zs. Szita, N. Szalóki, G. Battistig, L. Kocsányi (Hungary) **A-0036** (15') **ANOMALOUS OPTICAL CONDUCTIVITY IN EXOTIC METALS** Koichi Shimakawa, S. O. Kasap, H. Naito (Japan) **A-0072** (15') **HIGHLY CONDUCTIVE TITANIUM OXIDE FILMS BY RF MAGNETRON SPUTTERING** Yoshinori Hatanaka, K. Sakaguchi, M. Fukazawa, K. Shimakawa (Japan) **A-0147** (15') **OPTOELECTROACTIVE SPECIES IN CONDUCTING THIN FILMS WITH ORDERED MESOPOROSITY: FLUORESCENCE AND ELECTROCHROMIC PROPERTIES** Britta Seelandt, T. von Graberg, B. Smarsly, M. Wark (Germany)	**SESSION 26** **Application of materials in photonics** Chairman: Ralph Whaley (USA) **A-0210** (invited talk 30') **PROPERTIES AND APPLICATIONS OF SOL-GEL DERIVED ACTIVE PHOTONIC CRYSTALS** Rui M. Almeida, Y. Li, L. M. Fortes, M. C. Gonçalves (Portugal) **A-0193** (15') **HIGHLY VERSATILE, NOVEL ORGANOSILICATE NANOPARTICLE BASED FILMS FOR PHOTONIC APPLICATIONS** Keshab Gangopadhyay, V. Korampally, C. Darr, L. P. Parada, S. Gangopadhyay (USA) **A-0019** (15') **FIRST KAONS MEASUREMENT WITH SCINTILLATING FIBERS READ BY MPPC AT THE DAFNE E+/E- COLLIDER** Alessandro Scordo (Italy)	**SESSION 27** **Materials for optoelectronics and photonics** Chairman: Joaquin Fernández (Spain) **A-0257** (invited talk 30') **TELLURIDE FILMS AND WAVEGUIDES FOR IR INTEGRATED OPTICS** Annie Pradel, E. Barthelemy, C. Vigreux, A. Piarristeguy (France) **A-0183** (15') **EFFECT OF CsBr ADDITION ON STRUCTURAL AND LUMINESCENCE PROPERTIES OF Ge-S-Ga: Er GLASSES** Jiri Zavadil, Z. G. Ivanova, E. Cernoskova, Z. Cernosek (Czech Republic)
20.00 - 22.30	**Conference Dinner**		

THURSDAY, AUGUST 19, 2010

08.00 - 14.00	**Registration**		
ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
09.00 - 10.15	**SESSION 28** **Photoinduced effects** Chairman: Diana Nesheva (Bulgaria) **A-0028** (invited talk 30') FEMTOSECOND LASER ABLATION AND MICROMACHINING OF SEMICONDUCTORS AND DIELECTRICS Harold Haugen (Canada) **A-0215** (invited talk 30') PHOTOINDUCED AG DIFFUSION IN CHALCOGENIDE GLASSES - COMPARISON OF VISIBLE, X- AND GAMMA IRRADIATION Maria Mitkova, A. Kovalskiy, H. Jain, P. Chen (USA) **A-0179** (15') SILVER DOPED AS2S3 CHALCOGENIDE FILMS - A DIFFUSION STUDY Adam Lorinczi, M. Popescu, F. Sava, A. Velea, I. D. Simandan (Romania)	**SESSION 29** **Application of materials in photonics** Chairman: Janos Veres (UK) **A-0065** (invited talk 30') THE HISTORICAL AND CONCEPTUAL ROOTS OF ACTIVE MATRIX TECHNOLOGY P3e Peter Brody (USA) **A-0244** (invited talk 30') ACOUSTO-OPTIC MATERIALS FOR SPECIAL APPLICATIONS WITH ULTRA-SHORT OPTICAL PULSES Pál Maák, M. Veress, R. Szipőcs, B. Rózsa, P. Richter (Hungary)	**SESSION 30** **Materials for optoelecronics an photonics** Chairman: Jean-Michel Nunzi (Canada) **A-0296** (15') A SIMPLE PATHWAY TO ACHIEVE EFFICIENT ORGANIC LIGHT EMITTING DIODES Zhibin Wang, M. G. Helander, M. T. Greiner, J. Qiu, Z. H. Lu (Canada) **A-0297** (invited talk 30') ULTRAFAST ALL-OPTICAL SWITCHING AND DISPERSION OF THE PROTEIN BACTERIORHODOSIN Karoly Osvay, A. Dér, L. Fábián, Z. Heiner, M. Kiss, M. Mero (Hungary) **A-0033** (15') LASER GAIN IN DILUTE NITRIDE Ga(NAsP) SEMICONDUCTOR QUANTUM WELL STRUCTURES ON SILICON SUBSTRATE - A MICROSCOPIC ANALYSIS Christina Bückers, S. W. Koch, J. Hader, J. V. Moloney, B. Kunert, S. Liebich, K. Volz, W. Stolz, N. Koukourakis, N. C. Gerhardt, M. R. Hofmann (Germany)
10.15 - 10.35	Coffee Break		
ROOM	DÉNES GÁBOR		
10.35 - 11.35	**PLENARY 6** Chairman: Sandor Kugler (Hungary) **A-0293** MICROSCOPIC SIMULATION OF SEMICONDUCTOR LASER DEVICES Stephan W. Koch (Germany)		
11.35 - 11.45	Break		

ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
11.45 - 12.30	**SESSION 28A** **Photoinduced effects** Chairman: Keiji Tanaka (Japan) **A-0157** (15') **NOVEL FLUORESCENCE EXCITATION KINETIC PROTOCOL FOR FURTHER STUDIES OF PLANT PHOTOSYNTHETIC ACTIVITY** Sándor Lenk, A. Barócsi, L. Kocsányi, I. Péczeli, P. Richter, S. Konanz and C. Buschmann (Hungary) **A-0271** (15') **ON THE PHOTO INDUCED VOLUME CHANGES OF OBLIQUELY DEPOSITED CHALCOGENIDE GLASSES** Rozalia Lukacs, K. Shimakawa, S. Kugler (Hungary) **A-0143** (15′) **LASER COOLING OF SOLIDS TO CRYOGENIC TEMPERATURES** Alberto Di Lieto, M. Tonelli, D. V. Seletskiy, S. D. Melgaard, M. Sheik-Bahae (Italy)	**SESSION 29A** **Application of materials in photonics** Chairman: Dagou Zeze (UK) **A-0294** (invited talk 30') **NOVEL III-V SEMICONDUCTORS FOR NEXT GENERATION PHOTONIC DEVICES** Stephen J. Sweeney (UK) **A-0302** (invited talk 30') **ORDERED AND DISORDERED BIOLOGICAL AND BIOMIMETIC PHOTONIC NANOARCHITECTURES** Géza I. Márk, Z. Vértesy, K. Kertész, Zs. Bálint, L. P. Biró (Hungary)	**SESSION 30A** **Materials for optoelecronics and photonics** Chairman: Hiroyoshi Naito (Japan) **A-0173** (15') **ANALYSIS OF PHASE SEPARATION BEHAVIOR BETWEEN P3HT AND PCBM BY SOLID-STATE NMR** Tatsuya Fukushima, H. Kimura, Y. Shimahara, H Kaji (Japan) **A-0170** (15') **ORGANIC LIGHT-EMITTING DIODES PREPARED FROM Tris(8-HYDROQUINOLINE) ALUMINUM(III) (Alq3) IN DIFFERENT CRYSTALLINE POLYMORPHS** Hironori Kaji, T. Fukushima, K. Takami (Japan) **A-0223** (15') **LIGHT EMISSION DUE TO IMPULSIVE DEFORMATION OF POLYMERS** Rajendra Kumar Kuraria, S. R. Kuraria, B. P. Chandra (India)
12.30 - 14.00	Lunch		

THURSDAY, AUGUST 19, 2010

ROOM	PÁL SELÉNYI	LORÁND EÖTVÖS	ZOLTÁN BAY
14.00 - 16.00	**SESSION 31** **Photoinduced effects and materials for photonics** Chairman: Janis Teteris (Latvia) **A-0280** (invited talk 30') **NANO-CAVITIES IN DIAMOND FOR QUANTUM ELECTRODYNAMIC EXPERIMENTS** Joseph Salzman, I. Bayn (Israel) **A-0288** (invited talk 30') **PSEUDO-SELF-ADAPTIVE TOPOLOGICAL PHASES IN GLASSY SELENIDES FOR IR PHOTONICS** Oleh Shpotyuk, R. Golovchak (Ukraine) A-0125 (15') **OPTICAL LINESHAPES FOR POLYMETHINE DYES AND THEIR AGGREGATES: NOVEL THEORY OF QUANTUM TRANSITIONS AND ITS CORRELATION WITH EXPERIMENT** Vladimir Egorov (Russia) **A-0172** (15') **WHITE LIGHT ENGINEERING OF PHOSPHOR-CONVERTED SOLID STATE LIGHTING SOURCES** Franz Peter Wenzl, C. Sommer, F. Reil, J. R. Krenn, P. Hartmann, P. Pachler, S. Tasch (Austria) **A-0029** (15') **POLARIZATION OF OPTICAL SPECTRA IN TRANSPARENT CONDUCTIVE OXIDE Ga2O3** Mitsuo Yamaga, T. Ishikawa, M. Yoshida, T. Hasegawa, E. G. Villora, K. Shimamura (Japan)	**SESSION 32** **Nano-optoelectronics and photonics** Chairman: Mauro Tonelli (Italy) **A-0278** (invited talk 30') **THE STUDY OF OPTOELECTRONIC NANOSCALE DEVICES MADE FROM POLARITONIC AND PHOTONIC NANOWIRES** Mahi R. Singh, J. Cox and C. Racknor (Canada) **A-0281**(invited talk 30') **CARRIER TRANSPORT IN MOLECULAR BEAM EPITAXIALLY GROWN GaAs/INAs CORE-SHELL NANOWIRES** Harry Ruda, J. Salfi, I. Saveliev, M. Blumin (Canada) **A-0286** (15') **OPTICALLY INDUCED ANISOTROPY OF LOCAL PLASMON IN ISOTROPIC NANOCOMPOSITE** Andriy Dmytruk, I. Dmitruk, I. Blonskyi, I. Pavlov, O. Yeshchenko, A. Alexeenko, P. Korenyuk, V. Kadan, M. Zubrilin (Ukraine) **A-0270** (15') **METAL SURFACE PLASMON ENHANCED ELECTROLUMINESCENCE OF ORGANIC LIGHT EMITTING DIODES** Jean-Michel Nunzi, F. Liu, E. Buncel (Canada) **A-0165** (15') **EPITAXIAL LITHIUM NIOBATE THIN FILMS GROWN BY CHEMICAL BEAM EPITAXY ON SAPPHIRE** Yury Kuzminykh, A. Dabirian, S. Harada, S. C. Sandu, E. Wagner, G. Benvenuti, P. Brodard, S. Rushworth, C. L. Sones, S. Mailis, P. Muralt, P. Hoffmann (Switzerland)	**SESSION 33** **Materials and devices for optoelectronics** Chairman: Hironori Kaji (Japan) **A-0253** (invited talk 30') **ORGANIC SEMICONDUCTORS AND LIGHT EMITTING DIODES IN APPLICATIONS** Janos Veres (UK) **A-0295** (invited talk 30') SUB-MICRON SILICON PHOTONIC DEVICE STRUCTURES Jonathan K. Doylend, A. P. Knights (Canada) **A-0107** (15') **LUMINESCENCE PROPERTIES OF Er: LINBO3 THIN LAYERS FABRICATED BY ION IMPLANTATION** Pavla Nekvindova, J. Cajzl, B. Svecova, A. Mackova, P. Malinsky, J. Oswald, A. Kolitsch and J. Spirkova (Czech Republic) **A-0262** (15') **OPTICAL AND THERMO-OPTICAL PROPERTIES OF SILICA ANTIREFLECTIVE FILMS FORMED IN SOL-GEL PROCESSES** Edyta Skoczek, J. Jaglarz, P. Karasiński (Poland) **A-0017** (15') **A HELIUM SCINTILLATION FISSION CHAMBER NEUTRON DETECTOR** Zhang Xiaodong, Q. Mengtong, Z. Jianfu, X. Liangbin, Z. Xianpeng, C. Liang (China)
16.00 - 16.05	Break		
16.05 - 16.30	**Closing Session**		

Poster Session 1

Chairmen: Miklos Veres (Hungary), Kanatingal Sangunni (India), Koichi Shimakawa (Japan)

01. EXCITONIC PROCESSES

A-0140
WELL-WIDTH DEPENDENCE OF EXCITONIC PROPERTIES IN ORGANIC-INORGANIC HYBRID QUANTUM WELL MATERIALS
Takemasa Miura, Y. Takeoka, M. Sato, H. Kunugita, K. Ema (Japan)

A-0268
CORRELATION BETWEEN THE TYPE OF F-CENTER AND OXYGEN IMPURITY SITE IN THE STORAGE PHOSPHOR BAFBR:EU2+
Jörg Zimmermann, S. Hesse, G. A. Appleby, H. von Seggern (Germany)

02. LUMINESCENCE, PHOSPHORS AND APPLICATIONS

A-0039
WHITE LIGHT GENERATION IN RARE EARTH DOPED GERMANIUM BISMUTH TELLURITE GLASSES AND OPTICAL FIBERS
Danilo Manzani, Y. Ledemi, S. J. L. Ribeiro, Y. Messaddeq (Brazil)

A-0041
SYNTHESIS OF EU2+-ACTIVATED MSI2N2O2 (M=BA, SR, CA) PHOSPHORS USING M3SIO5:EU2+ AND SI3N4 BY SOLID STATE REACTION
Chang Hae Kim, K. S. Choi, J. P. Lee, H. S. You, S. D. Jee (South Korea)

A-0046
SPECTRAL-LUMINESCENT PROPERTIES OF NOVEL SALICYLIDENEIMINOSPIROPYRANS
I. R. Mardaleishvili, L. S. Koltsova, N. L. Zaichenko, A. I. Shiyonok, P. P. Levin, A. S. Tatikolov (Russia)

A-0052
LUMINESCENCE AND OPTICAL ABSORPTION STUDIES OF SULPHUR-IMPLANTED CU6PS5X (X=I, BR) SUPERIONIC CONDUCTORS
Ihor Studenyak, V. Yu. Izai, V.O. Stephanovich, V. V. Panko, P. Kúš, A. Plecenik (Ukraine)

A-0054
APPLICATION OF SCINTILLATOR IN ABSOLUTE MEASUREMENT OF PULSED GAMMA-RAY
Xia Liangbin, O. Xiaoping, H. Hetong, Z. Kan, Z. Wenyu, S. Zhaohui (China)

A-0056
OPTICAL PROPERTIES AND PHOTO- AND X-RAY LUMINESCENCE OF SM3+-DOPED CHALCOGENIDES
Kouji Maeda, R. Tsudaome, M. Ido, S. Kasap (Japan)

A-0085
PREPARATION, SPECTROSCOPIC AND CRYSTAL FIELD STUDIES OF ZN2SIO4 POWDERS DOPED WITH NI2+ AND CO2+ IONS
Radenka M. Krsmanovic, Z. Antic, M. Mitric, M. D. Dramicanin, M. G. Brik (Serbia)

A-0093
SEEING THE LIGHT: NEW STANDARDS FOR QUANTIFYING SPECIFICATIONS OF LOW LEVEL LIGHT SOURCES
Dirk Poelman, K. Van den Eeckhout, P. F. Smet (Belgium)

A-0096
FABRICATION OF WIDEBAND NEAR-INFRARED PHOSPHOR COMBINING SM3+-DOPED GLASS AND YB3+, ND3+ CO-DOPED GLASS PHOSPHORS
Shingo Fuchi, Y. Takeda (Japan)

A-0124
PHOTOLUMINESCENCE STUDY OF EUROPIUM DOPED ANATASE TIO2 NANOPARTICLES
Miroslav D. Dramićanin, Z. Antic, M. Nikolic, R. Krsmanovic (Serbia)

A-0133
PHOTOSTIMULATED LUMINESCENCE FROM POLYCRYSTALLINE, TRANSLUCENT, RARE EARTH DOPED CAESIUM BROMIDE
Nicola M. Winch, A. Edgar (New Zealand)

A-0136
PHOTO- AND THERMALLY STIMULATED LUMINESCENCE OF BOROSILICATE GLASS-EMBEDDED CDS1-XSEX NANOCRYSTALS
Yuriy Azhniuk, A. M. Solomon, M. V. Prymak, V. V. Lopushansky, K. P. Popovich, D. B. Goyer, A. V. Gomonnai, D. R T. Zahn (Ukraine)

A-0155
LUMINISCENCE AND LIGHT STABILITY OF EUROPIUM COMPLEX AND ITS MIXTURES WITH LANTHANUM OR GADOLINIUM COMPLEX IN POLYMER FILMS
Irine R. Mardaleishvili, P. P. Levin, N. I. Zaichenko, L. S. Koltsova, A. I. Shienok, V. A. Optov, V. B. Ivanov (Russia)

A-0156
OPTICAL AND ELECTRICAL CHARACTERIZATION OF SOL-GEL-DERIVED SNO2: EU,SB
Valter Kiisk, T. Kangur, T. Tätte, M. Paalo, I. Sildos (Estonia)

A-0171
LUMINESCENCE SPECTROSCOPY OF NANOCRYSTALLINE MAGNESIUM OXIDE
E. Feldbach, M. Kirm, A. Maaroos, H. Mändar, V. Sammelselg, J. Kozlova, R. Saar (Estonia)

A-0196
EXAMINATION OF VALENCY CONVERSION OF RARE-EARTH IONS IN VARIOUS DIVERSE MATERIAL SYSTEMS UNDER EXPOSURE TO HIGH DOSE SYNCHROTRON RADIATION (X-RAYS)
George. Belev, K. Koughia, D. Tonchev, G. Okada, T. Wysokinski, D. Chapman, C. R. Varoy, A. Edgar, S. O. Kasap (Canada)

A-0255
SYNTHESIS AND PROPERTIES OF NA3YSI2O7:EU3+ PHOSPHOR FOR FLUORESCENT LAMP
Tatsuya Sakamoto, S. Kousaka, K. Uematsu, T. Ishigaki, K. Toda, M. Sato (Japan)

A-0291
LUMINESCENCE OF COLLOIDAL NAYF4 DOPED WITH DY3+ SYNTHESIZED VIA THERMAL DECOMPOSITION OF FLUORACETATES PRECURSORS
Marek A. Gusowski, H.C. Swart (South Africa)

A-0298
PHOTOLUMINESCENCE OF EUROPIUM DOPED LIINO2 POWDER
Ljubica Djacanin, M. D. Dramicanin, M. Nikolic, M. Mitric, D. Petrovic, S. R. Lukic (Serbia)

A-0303
TEMPERATURE SENSITIVE VISIBLE AND NEAR-INFRARED LUMINESCENCE OF ERBIUM IONS IN LIYF4 CRYSTAL
Taiju Tsuboi, K. Shimamura (Japan)

A-0304
A GENERALIZED RULE OF AVERAGE FOR THERMOLUMINISCENCE OF TERNARY IONIC CRYSTALS
Ricardo Rodriguez-Mijangos, G. Moroyoqui, R. Perez-Salas (Mexico)

A-0306
SYNTHESIS OF EU2+ DOPED A-SITE AND OXYGEN DEFICIENT PEROVSKITE HOST FOR PHOTO LUMINESCENT MATERIALS
Ishigaki Tadashi, H. Tomoki, S. Tatsuya, U. Kazuyoshi, T. Kenji, S. Mineo (Japan)

A-0308
OPTICAL ABSORBTION AND POTOLUMINESCENCE OF LUMONOPHORE NANOCOMPOSITES
V. I. Verlan, M.S. Iovu, A. M. Andriesh, S.A. Buzurniuc, Yu. H. Nistor, I. Culeac, L. A. Malahov, C. I. Turtaa, V. E. Zubarevaa, M. Rusua (Moldova)

03. PHOTOINDUCED EFFECTS

A-0032
BIFUNCTIONAL PHOTOSENSITIVE MOLECULES FOR OPTICAL PROCESSES - SYNTHESIS AND PROPERTIES
Natalia L. Zaichenko, A. I. Shienok, L. S. Koltsova, I. R. Mardaleishvili, A. S. Tatikolov, P. P. Levin (Russia)

A-0109
NOVEL PHOTOCHROMIC HYDRAZONES BASED ON 3,3-DIMETHYLSPIRO-[2H-1-BENZOPYRAN-2,1-[2]-OXAINDAN]
L. D. Popov, A. O. Bulanov, P. A. Belikov, E. Y. Shasheva, V. A. Barachevsky, I. N. Shcherbakov (Russia)

A-0150
PLASMON ENHANCED OPTICAL RECORDING IN AS-SE LAYERS
Stepan Charnovych, Sandor Kokenyesi (Hungary)

A-0175
STUDY OF INCUBATION EFFECTS DURING SURFACE ABLATION USING PICOSECOND PULSES AT A WAVELENGTH OF 800 NM
Patrik Holmberg, V. Pasiskevicius, M. Fokine (Sweden)

A-0272
PHOTO-INDUCED CHANGES IN THE OPTICAL PROPERTIES OF THERMALLY EVAPORATED AS40SE50SB10 FILMS
Ramakanta Naik, Arpitha Jain, H. Vardhan, Vinod. E.M, R. Ganesan, K. S. Sangunni (India)

A-0277
PHOTOINDUCED SURFACE PATTERNING OF POLYMER-DYE THIN FILMS
Jaana Vapaavuori, A. Priimagi, M. Kaivola (Finland)

A-0285
INDUCED VOLUMECHANGE AND INTERDIFFUSION ANTICORRELATION IN SE/AS2S3 NANOLAYERED SAMPLES
Viktor Takáts (Hungary)

A-0287
SURFACE RELIEF MODULATION PHENOMENA BY LIGHT INDUCED INTERFERENCE
Ugis Gertners (Latvia)

04. ELECTRO-OPTIC PROPERTIES AND APPLICATIONS

A-0081
TRANSPORT AND RECOMBINATION OF PHOTO-CARRIERS UNDER POTENTIAL FLUCTUATION IN TIOX FILMS PREPARED BY RF MAGNETRON SPUTTERING METHOD
Koichi Sakaguchi, K. Shimakawa, Y. Hatanaka (Japan)

A-0139
ORGANIC NEAR-INFRARED PHOTODIODES CONTAINING A WIDE-BANDGAP POLYMER AND AN N-TYPE DOPANT IN THE ACTIVE LAYER
Naoki Ohtani, K. Nakajima, K. Bando (Japan)

A-0218
FLUORINE DOPED ZINC OXIDE THIN FILMS DEPOSITED BY CHEMICAL SPRAY: EFFECT OF THE AGING TIME OF THE STARTING SOLUTION
Maria de la Luz Olvera, A. Maldonado (Mexico)

A-0219
PHYSICAL PROPERTIES OF AL-DOPED ZINC OXIDE THIN FILMS DEPOSITED BY CHEMICAL SPRAY
Maria de la Luz Olvera, A. Maldonado (Mexico)

05. NONLINEAR OPTICAL PROPERTIES AND APPLICATIONS

A-0066
INFLUENCE OF ELECTRON IRRADIATION ON OPTICAL PROPERTIES OF LANTHANUM-GALLIUM TANTALATE CRYSTALS
Nina S. Kozlova, A. M. Musalitin, A. A.Musalitin, N. A. Siminel (Russia)

A-0149
CONTROL OF MACROSCOPIC RESPONSE OF RABI OSCILLATIONS IN A QUANTUM DOT ENSEMBLE
Mitsutake Satoshi, M. Kujiraoka, J. Ishi-Hayase,, K. Akahane, N. Yamamoto, K. Ema, M. Sasaki (Japan)

A-0233
OPTICAL LIMITING PROPERTIES OF NOVEL COII, CUII AND DOUBLE-DECKER LUIII PHTHALOCYANINES
Fulya Bagci, S. Saydam, E. Yilmaz, H. G. Yaglioglu, A. Elmali, B. Salih, O. Bekaroglu (Turkey)

A-0289
ECOLOGICAL CRYSTAL GLASS FABRICATED FROM THAILAND RESOURCES DOPED WITH ZIRCONIA
Pisutti Dararutana, K. Won-in, S. Pongkrapan (Thailand)

06. MATERIALS FOR OPTOELECTRONICS AND PHOTONICS

A-0004
SIMPLE FABRICATION OF EPOXY NOVOLAK RESIN OPTICAL WAVEGUIDES ON SILICON SUBSTRATE
Vaclav Prajzler, O. Lyutakov, I. Huttel, J. Spirkova, J. Barna, V. Jerabek (Czech Republic)

A-0009
PHOTOCHROMIC AND LUMINESCENT PROPERTIES OF HETARYLHYDRAZONES AND THEIR METALCOMPLEXES
Sergey Melkozyorov, V. A Barachevsky, G. N. Lipunova, I. G. Pervova, I. N. Lipunov (Russia)

A-0013
FABRICATION AND CHARACTERIZATION OF CRYSTALLINE CORE OPTICAL FIBERS
John Ballato, S. Morris, T. Hawkins, P. Foy, C. McMillen, R. Stolen, R. Rice (USA)

A-0031
CONTROL OF PHOTOLUMINESCENCE INTENSITY BY HF VAPOR SELECTIVE ETCHING OF POROUS NC-SI-SIOX STRUCTURES
Ivan Indutnyi, V. Dan’ko, V. Bratus, I. Lisovskyy, S. Zlobin, K. Michailovska, P. Shepeliavyi (Ukraine)

A-0043
SRMOO4: ND3+ CRYSTAL: AN EFFICIENT MEDIUM FOR SELF-RAMAN LASER
Liudmila Ivleva, M. Doroshenko, S. Vasilyev, P. Lykov, T. Basiev (Russia)

A-0050
ON THE URBACH RULE AND DISORDERING PROCESSES IN AS2S3 THIN FILMS
Ihor Studenyak, M. Kranjcec, M. M. Pop (Ukraine)

A-0051
STRUCTURAL AND TEMPERATURE DISORDERING STUDIES OF CU6PS5I SUPERIONIC THIN FILMS
Ihor Studenyak, V. Yu. Izai, A. A. Chomolyak, M. Vorohta, V. Matolin (Ukraine)

A-0068
LOCAL- AND INTERMEDIATE-RANGE STRUCTURE OF AS-SE GLASSES BY ANOMALOUS X-RAY SCATTERING
Shinya Hosokawa, I. Oh, W.-C. Pilgrim, J.-F. Bérar, N. Boudet, S. Mamedov, P. Boolchand, S. Kohara (Japan)

A-0071
FORMATION OF ALPHA AND BETA PHASES IN POLYFLUORENE AND IRIDIUM-COMPLEX CONTAINING POLYFLUORENES
Taiju Tsuboi, H-F. Shi, Q. Zhao, W. Huang, Y. Nakai (Japan)

A-0076
NEGATIVE REFRACTION PROPERTIES IN MAGNETIC FILM UNDER FERROMAGNETIC RESONANCE CONDITIONS
Tao Geng, Songlin Zhuang, Jiabi Chen (China)

A-0077
NONRELATIVISTIC REVERSED DOPPLER SHIFTS IN NEGATIVE-INDEX MATERIALS
Jiabi Chen, Yan Wang, Tao Geng, Songlin Zhuang (China)

A-0095
COMPARISON OF STRUCTURAL TRANSFORMATION IN BULK AND AS EVAPORATED OPTICAL MEDIA DURING POLYCHORMATIC AND ENERGY DEPENDENT MONOCHROMATIC ILLUMINATION
V. Mitsa, R. Holomb, M. Veres, M. Vlcek, A. Stronski (Ukraine)

A-0098
NEW HYBRID PHOTOCHROMIC MATERIALS FOR OPTICAL SWITCHING
Andrey A. Khodonov, A. V. Laptev, K. V. Zvezdin, A. Yu. Lukin, N. E. Belikov, M. A. Fomin, V. I. Shvets, S. B. Brichkin, D. Yu. Nikolenko, V. F. Razumov, V. A. Barachevsky, S. D. Varfolomeev, O.V. Demina (Russia)

A-0104
INFLUENCE OF THE OXIDATION TEMPERATURE ON PHOTOLUMINESCENCE AND ELECTRICAL PROPERTIES OF AMORPHOUS THIN FILMS SIC:H:O + TB
S.O. Gordienko, A.N. Nazarov, A.V. Rusavsky, A.V. Vasin, Yu. V. Gomeniuk, V. S. Lysenko, S. Ashok (USA)

A-0108
THIN FILMS OF LINBO3 CREATED USING LASER DEPOSITION
Pavla Nekvindová, M. Jelínek, T. Kocourek, J. Remsa, (Czech Republic)

A-0110
COMPARISON OF SPECTROSCOPIC PROPERTIES OF SILICATE AND PHOSPHATE GLASSES DOPED WITH RARE EARTH IONS
Blanka Svecova, P. Nekvindova, V. Kubecek, P. Szotkowski, J. Oswald, M. Mika and J. Spirkova (Czech Republic)

A-0126
PHOTOSTABILITY STUDIES OF NONLINEAR OPTICAL CHROMOPHORES IN AMORPHOUS POLYCARBONATE
Stefaan Janssens, G. V. M. Williams, My. T. T. Do, K. Yasar, S. G. Raymond, M. D. H. Bhuiyan, N. Denton (New Zealand)

A-0130
OPTICALLY TUNABLE DIFFRACTION GRATINGS IN PHOTOCHROMIC POLYMER THIN FILMS
Grant Williams, My. T. T. Do, A. Middleton, S. G. Raymond, G. Wen, M. D. H. Bhuiyan (New Zealand)

A-0135
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Yuriy Azhniuk, M. V. Prymak, A. M. Solomon, V. M. Krasilinets, V.V. Lopushansky, A. V. G

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Jana Panke, M. Wark (Germany)

A-0151
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Hana Malichova, S. Stara, J. Spirkova, M. Mika, Z. Potucek (Czech Republic)

A-0161
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Mirjana V. Iljegović, S. R. Lukić-Petrović, D. D. Trbac (Serbia)

A-0169
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Idris Kabalci, N Öztürk Körpe, Tugba Duran, M Özdemir (Turkey)

A-0181
BISMUTH-GERMANATE OXIDE GLASSES CONTAINING SILVER NANOPARTICLES
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A-0186
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A-0204
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Tatiana Uvarova; A. Pushkar; A. Uvarova (Russia)

A-0207
SOLID PHASE SYNTHESIS IN AMORPHOUS CHALCOGENIDE MULTILAYERS FOR OPTOELECTRONICS
Ivan Voynarovych, M. Shiplyak, V. Pynzenik, I. Makauz, V. Chereshnya, S. Kokenyesi (Ukraine)

A-0209
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Cyril Koughia, G. Belev, G. Soundararajan, G. Okada, D. Tonchev, S. Kasap, A. Edgar, C. R. Varoy, H. von Seggern (Canada)

A-0241
M_NOVEL SILICATE GLASSES FOR 1,3 REGION
Stanislava Stará, J. Špirková, H. Malichová, M. Míka, J. Oswald, Z. Potůèek (Czech Republic)

A-0245
LINEAR AND NONLINEAR OPTICAL PROPERTIES OF AS-GE-SE THIN FILMS
Igor D. Tolmachov, H. Pribylova, A.V. Stronski, M. Vlcek (Ukraine)

A-0246
ZNO NANOWIRES DEPOSITED BY THE METHOD OF ARC DECHARGE
Doriana Dimova-Malinovska, N. Koprinarov, M. Konstantinova, H. Nichev, Tz. Tzacheva, P. Andreev (Bulgaria)

A-0247
SENSITIVE ELEMENTS FOR LUMINESCENT CHEMICAL SENSORS BASED ON NANOCOMPOSITE STRUCTURES BACTERIORHODOPSIN-SEMICONDUCTOR QUANTUM DOTS CDSE/ZNS
Joseph Sharkany, I. I. Trikur, I. I. Sakalosh, J. J. Ramsden (Ukraine)

A-0261
THE CRYSTALLIZATION EFFECTS IN OPTICAL TELLURIDE GLASSES DOPED WITH RARE EARTH IONS
Bożena Burtan, J. Jaglarz, M. Reben, A. Chrzanowska (Poland)

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Natalia Shostka (Ukraine)

A-0044
DIFFERENTIAL EVANESCENT LIGHT INTENSITY IMAGING OF NANOTHIN FILMS: SIMULATION OF EXTRACTION POWER
Michael Gankin, S. A. Popescu, B. Apter, N. Mirchin, I. Lapsker, A. Peled (Israel)

A-0063
RAMAN SCATTERING CHARACTERIZATION OF ZNSE/ZN0.6CD0.4SE MULTILAYERS PREPARED BY THERMAL VACUUM EVAPORATION
Diana Nesheva, Z. Aneva, M. J. Scepanovic, Z. Levi, Z. V. Popovic (Bulgaria)

A-0174
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Mihkel Rähn, M. Pärs, V. Palm, V. Hizhnyakov (Estonia)

A-0176
SPECTRAL FEATURES OF SPECULAR REFLECTION FROM NANOPARTICLE FILMS
Michael Fokine, H. Jang, P. M. P. Gouvęa, A. M. B. Braga, I. C. S. Carvalho (Sweden)

A-0211
MULTILAYER WAVEGUIDE POLYMERIC OPTICAL STRUCTURES FOR PERSPECTIVE NANOPHOTONIC DEVICES
Grigory E. Adamov, E. P. Grebennikov, P. S. Shmelin (Russia)

A-0251
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Akihiro Tomioka, T. Anzai, K. Iwamoto (Japan)

A-0274
SELF-ORGANIZATION OF SILICA NANOPARTICLES INDUCED BY THE ION BEAM
Stjepan Lugomer, Z. Zolnai, A. L. Tóth, I. Bársony (Hungary)

A-0282
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Mahi R. Singh, J. Cox, C. Racknor (Canada)

A-0283
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Ákos Nemcsics, J. Balázs, B. Põdör, J. Makai, A. Stemmann (Hungary)

08. PHOTOCONDUCTIVITY

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Alla Reznik, M. Simon (Canada)

09. OPTICALLY INDUCED PROCESSES

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A-0115
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Douglas Marcel Gonçalves Leite, J. H. Dias da Silva, T. Devillers, A. Grois, B. Faina, A. Navarro-Quezada, Tian Li, A. Bonanni (Brazil)

10. OPTICAL FIBERS

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Alexey Veselov, C. Thür, A. Efimov, M. Guina, H. Lemmetyinen, N. Tkachenko (Finland)

A-0038
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Danilo Manzani, I. Skripachev, Y. Messaddeq, S. J. L. Ribeiro (Brazil)

A-0284
SELF-ASSEMBLED MONOLAYERS (SAMS) OF PORPHYRIN DEPOSITED INSIDE HOLLOW-CORE PHOTONIC BANDGAP FIBER (HCPBGF) AND POLARIZATION MAINTAINING FIBER (PMF)
Alexey Veselov, C. Thür, A. Efimov, A. Chamorovskiy, M. Guina, O. Okhotnikov, H. Lemmetyinen, N. Tkachenko (Finland)

11. MATERIALS FOR OPTICAL STORAGE

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Valery A. Barachevsky, T. M. Valova, A. O.Ait, K. S. Levchenko, M. M. Krayushkin, V. N. Yarovenko, V. V.Kyiko, E. P. Grebennikov (Russia)

A-0079
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Petr Nemec, V. Nazabal, J. Prikryl, M. Frumar (Czech Republic)

A-0082
PHOTOREFRACTIVE COLLINEAR HOLOGRAPHIC DATA STORAGE BY PHASE SHIFT RECORDING
Masanori Takabayashi, A. Okamoto, K. Sato (Japan)

A-0097
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Sergey Kozyukhin, V. Kudoyarova, H. P. Nguyen, A. Smirnov, V. Lebedev (Russia)

A-0103
STUDY OF FUNCTIONAL PROPERTIES OF THERMALLY IRREVERSIBLE PHOTOCHROMIC DIARYLETHENES IN VARIOUS AGGREGATE STATES
Irina V. Platonova, V. A. Barachevsky, V. N. Yarovenko, L. V. Christoforova, M. M. Krayushkin (Russia)

A-0122
PHOTOSENSITIVE CHROMONE DERIVATIVES FOR RECORDING MEDIA OF ARCHIVAL THREE-DIMENSIONAL OPTICAL MEMORY
Vladimir Nikolaevich Yarovenko, K. S. Levchenko, M. M. Krayushkin, O. I. Kobeleva, T. M. Valova, V. A. Barachevsky (Russia)

A-0180
PHASE-CHANGE MATERIALS FOR OPTICAL RECORDING: GLASSES AND THIN FILM CHALCOGENIDES WITH SILVER
Alin Velea, M. Popescu, F. Sava, I. D. Simandan (Romania)

A-0185
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Lukas Strizik, J. Gutwirth, T. Wagner, P. Bezdicka, M. Frumar (Czech Republic)

A-0199
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Mikhail Krayushkin, S. Luyksaar, S. Shorunov, A. akharov, I. Sedishev, Y. Pyankov, V. Barachevsky, E. Adamov, E. Grebennikov, Ě. Irie (Russia)

A-0265
STUDIES ON GE2SB2TE5 FILMS AT STRUCTURAL TRANSITIONS
E. M. Vinod, K. S. Sangunni, M. Harsha Vardhan, R. Ganesan (India)

12. PHOTOVOLTAIC MATERIALS

A-0067
CU2ZNSN(S,SE)4: NOVEL ABSORBER LAYERS FOR IN-FREE HIGH EFFICIENCY THIN FILM SOLAR CELLS
António Ferreira da Cunha, J. Malaquias, P. M. P. Salomé, P. A. Fernandes (Portugal)

A-0094
INVESTIGATIONS OF THE COMPLEX IMPEDANCE OF PHOTOVOLTAIC CELLS UNDER ILLUMINATION
Erika Kancsar, M. Drapalik, J. Schmid, V. Schlosser (Austria)

A-0101
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A. Nadtochiy, A. Podolian, O. Korotchenkov, J. Schmid, E. Kancsar, V. Schlosser (Ukraine)

A-0117
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António Ferreira da Cunha, A. F. Sartori, L. C. Costa a (Portugal)

A-0163
OBTAINING ZNO/CUINSE2 HETEROSTRUCTURES BY SEQUENTIAL ELEMENTAL EVAPORATION
Irena Mihailova, V. Gerbreders, E. Tamanis, V. Akmene, E. Sledevskis (Latvia)

A-0177
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Marie Netrvalova, L. Prušáková, J. Mullerova, P. Šutta (Czech Republic)

A-0189
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Fengzhen Liu, W. Guo, Y. Ma, M. Zhu, W. Liu, Y. Zhou, J. Liu (China)

A-0238
THERMAL IONIZATION ENERGY OF DEFECT CENTRES IN COPPER BASED TERNARY CHALCOPYRITE PHOTOVOLTAIC MATERIALS
Bálint Pödör (Hungary)

A-0263
OPTICAL PROPERTIES OF MULTILAYER SILICON NITRIDE WITH SILICON QUANTUM DOTS
Janusz Jaglarz, M. Lipinski, K. Hejduk, A. Chrzanowska (Poland)

A-0273
TIME-RESOLVED INVESTIGATIONS OF ERBIUM IONS IN ZBLAN GLASSES AND GLASS CERAMICS
Manuela Miclea, U. Skrzypczak, A. Stalmashonak, B. Ahrens, B. Henke, G. Seifert, J. A. Johnson, S. Schweizer (Germany)

14. EXPERIMENTAL TECHNIQUES

A-0160
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Petr Nemec, D. Vesely, A. Kalendová (Czech Republic)

15. TERAHERTZ MATERIALS, DEVICES AND TECHNIQUES

A-0112
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Ionel Tifrea, C. Campbell (USA)

16. OPTOELECTRONIC AND PHOTONIC DEVICES

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Ali Soltani Vala, N. Hoseini, E. Rezai, J. Barwestani (Iran)

A-0021
DETAILED STUDY OF FLAT BANDS IN METALLIC PHOTONIC CRYSTALS
Ali Soltani Vala, N. Hoseini, A. A. Sedghi (Iran)

A-0040
OPTICAL DESIGN OF HIGH EFFICIENCY PHOSPHORESCENT ORGANIC LIGHT EMITTING DEVICES BASED ON THE IMPROVEMENT OF LIGHT EXTRACTION TECHNIQUE
Akiyoshi Mikami, T. Koyanagi, Y. Sawatari (Japan)

A-0058
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Taiju Tsuboi, T. Kishimoto, K. Wako, K. Matsuda, H. Iguchi (Japan)

A-0113
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Vitezslav Jerabek, I. Hüttel, V. Prajzler, K. Busek, J. Arciniega (Czech Republic)

A-0159
PRESSURE AND TEMPERATURE TUNING OF RED LASER DIODES TOWARDS YELLOW AND GREEN
Roland Bohdan, M. Mrozowicz, W. Trzeciakowski (Poland)

A-0248
THRESHOLD INTEGRAL-OPTIC CHEMICAL SENSOR WITH SENSITIVITY CONTROLLED BY EXTERNAL ILLUMINATION
Igor Sakalosh, Y. P. Sharkany, J. J. Ramsden, N. B. Zhitov (Ukraine)

A-0292
FABRICATION, CHARACTERIZATION AND TESTING OF THE THERMALSTABILITY OF ZNO-BASED SCHOTTKY ULTRAVIOLET PHOTODETECTORS
Ghusoon M. Ali, P. Chakrabarti (India)

17. OPTICAL COMPONENTS FOR TELECOMMUNICATIONS

A-0080
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Yuta Wakayama, A. Okamoto, A. A. Grabar (Japan)

A-0120
ULTRAVIOLET HOLOGRAPHIC RECORDING IN PHOTOPOLYMERS
Jelena Aleksejeva, J. Teteris (Latvia)

18. MODELING AND SIMULATIONS

A-0078
MODELING OF OPTICAL PROPERTIES OF CDI2 CRYSTALS DOPED WITH NI2+ IONS
Mikhail G. Brik, I. V. Kityk, K. Ozga, A. Slezak (Estonia)

A-0089
SIMULATION STUDY OF THE CUBIC PHASE STRUCTURE OF GE.2SB.2TE.5 BY RMC MODELING ON EXAFS AND DIFFRACTION DATASETS
L. Temleitner, S. Kohara, S. Shamoto, N. Yamada, T. Matsunaga, M. Takata, (Japan)

A-0102
ELECTRONIC AND OPTICAL PROPERTIES OF ZNCR2SE4 AS EXPLORED BY FIRST PRINCIPLES AND CRYSTAL FIELD CALCULATIONS
Nicolae Avram, M.G. Brik, I. Sildos (Romania)

A-0116
MODELING OF CDS/CDTE THIN FILM SOLAR CELLS
M. Zahangir Kabir, Md S. Anjan, S. A. Mahmood (Canada)

A-0119
ANDERSON LOCALIZATION OF COUNTERPROPAGATING BEAMS IN OPTICALY INDUCED PHOTONIC LATTICES
Dragana Jovic, M. Belic (Serbia)

A-0229
NUMERICAL INVESTIGATION OF SLOW LIGHT IN THE COUPLED RESONATOR OPTICAL WAVEGUIDES USING THE LOCALIZED FOURIER MODAL METHOD
Junghyun Park, H. Kim, B. Lee (South Korea)

A-0239
AN EIGENVALUE-BASED TRANSMISSION-LINE METHOD FOR SIMULATING HIGH-CONTRAST PHOTONIC CRYSTALS
Derek R. Oliver, D. E. Schaub (Canada)

19. APPLICATIONS OF MATERIALS IN PHOTONICS AND OPTOELECTRONICS

A-0053
CONTACT METAL AND PHOTOCONDUCTOR THICKNESS DEPENDENCE OF DARK CURRENT IN MULTILAYER STABILIZED AMORPHOUS SELENIUM PHOTOCONDUCTORS USED IN X-RAY IMAGE DETECTORS
Joel B. Frey, G. Belev, D. Tonchev, S. O. Kasap (Canada)

A-0061
PHOTOCHROMIC ORGANIC SYSTEMS BASED ON NEW NAPHTHOPYRANS FOR OPTICAL METAL SENSING AND LIGHT MODULATION
Alexander Gorelik, O. I. Kobeleva, T. M. Valova, V. A. Barachevsky, A. O. Ayt (Russia)

A-0075
SYNTHESIS OF POLY (3, 4 ETHYLENEDIOXYTHIOPHENE) NANO POWDER USING REVERSE MICREMULSION POLYMERISATION
S. Sindhu, C. R. Siju, R. Renjitha , E. S. R. Gopa, K. N. Rao (India)

A-0137
MASKING PHOTOCHROMIC FILMS FOR NANOLITHOGRAPHY TECHNOLOGY
Anton Azt, V. Barachevsky, O. Kobeleva, T. Valova, A. Gorelik, M. Krayushkin, M. Komlenok, V. Kononenko (Russia)

A-0299
SB2S3-SENSITIZED INORGANIC-ORGANIC HETEROJUNCTION SOLAR CELLS
Sang Il Seok, J. A. Chang, J. H. Rhee, S. H. Im, Y. H. Lee, H-J. Kim (South Korea)

A-0309
TECHNOLOGY OF MIXED AMORPHOUS AS2(SXSE1-X)3 FROM CHEMICAL SOLUTIONS AND OPTICAL CHARACTERIZATIONS
V. Verlan, S. Buzurniuc, L. Malahov (Moldova)

Origin of lecture room names

Dénes Gábor (1900-1979) was born in Budapest. He studied at the Budapest University of Technology and Economics from 1918, later in Germany, at the Charlottenburg Technical University in Berlin. He wrote his Ph.D. thesis concerning the cathode ray tube in 1927, and worked on plasma lamps. Dénes Gabor, a Jew, fled from Nazi Germany in 1933, and was invited to Britain to work at the development department of the British Thomson-Houston company in Rugby, Warwickshire. He became a British citizen in 1946, and while working at British Thomson-Houston he invented holography, in 1947. The earliest hologram however was only realized in 1964 following the 1960 invention of the laser, the first coherent light source. After this time, holography became commercially available. Gabor published his theories of re-holography in a series of papers between 1946 and 1951. From 1958 Gabor was professor of Applied Physics at the Imperial College London until his retirement in 1967. Besides the Nobel Prize (1971) he received numerous awards.

Pál Selényi (1884-1954) invented the electro graphic process which is the conceptual basis of the Xerox copying machines. Pál Selényi studied physics and mathematics at the Budapest University. After his studies, Selényi started to work for the newly created Applied Physics Department of the same University. From his early works, Selényi was engaged in studying the nature of light. One well-known result of this period is Selényi's wide-angle interference experiment. Chester Carlson read one of Selenyi's papers in the 1930s and was very greatly impressed; subsequently, he put a big effort to develop xerography. That is the reason why Selenyi is known as the "father of xerography" by some people.

Loránd Eötvös (1848-1919) was appointed to the chair of theoretical physics at Budapest University in 1872. Eötvös is remembered today for his experimental work on gravity, in particular his study of the equivalence of gravitational and inertial mass (the so-called weak equivalence principle) and his study of the gravitational gradient on the Earth's surface. The weak equivalence principle plays a prominent role in relativity theory and the Eötvös experiment was cited by Albert Einstein in his 1916 paper The Foundation of the General Theory of Relativity. The CGS unit of gravitational gradient is named as the eotvos in his honor.

Zoltán Bay (1900-1992) developed the pioneer patent for electroluminescence in 1939. After the war he was the first to build equipment to detect radar echoes from the Moon. These experiments are now considered to be pioneer accomplishments of radar astronomy. All modern radar astronomy systems are based on Bay's design. In 1948, just before the total takeover of Hungary by the Communists, Bay left for the United States. He continued his fast coincidence work at the George Washington University. After the advent of lasers, around 1960, Bay's interest turned towards the new possibility of measuring the speed of light. His experimental proof, that the universal system of measuring time and length based on the speed of light was, in fact, valid, represented a breakthrough in measurement science.

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ABSTRACTS

A-0002

PHOTOCHEMICAL PROPERTIES OF PORPHYRIN FILMS COVERING SURFACES OF TAPERED OPTICAL FIBERS

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For light propagation in an optical fiber, the power fraction in the evanescent field is significantly expanded when the fiber is tapered to a diameter of a few microns. Therefore, the use of fiber tapers as substrates for organic films enables efficient interaction between the evanescent field and organic molecules thus giving more advantages over traditional spectroscopy methods.

Free-base porphyrin is an attractive candidate as a sensory molecule due to its high fluorescence efficiency [1]. The self-assembled monolayer (SAM) method has been applied as the deposition technique of porphyrin molecules in these studies [2]. Absorption and emission spectra of SAMs covering tapered optical fibers, having tips diameter 15 µm and various lengths of conical and adiabatic parts, were measured. Absorbances of free-base porphyrin SAM on tapered optical fibers are at least 60 times higher than those for porphyrin SAM covering glass plate. Emission spectrum of free-base porphyrin SAM covering tapered fiber was obtained, which is in a good agreement with that of porphyrin SAM deposited over glass plate. Emission spectra of free-base porphyrin SAM covering tapered fiber, which was dipped into different concentrations of hydrochloric acid and water, were obtained. The results of these measurements allowed to plot the dependence of pH value on the ratio between two emission maxima at 650 and 710 nm for different concentrations of hydrochloric acid. The reproducible pH value range which can be measured with tapered fiber covered with free-base porphyrin SAM is within 0.6 and 2.6.

Measurements on the geometry optimization of conical parts of tapers, covered with porphyrin SAMs were carried out. These studies revealed that in order for the tapered fibers to be used as sensors, their coned part diameter can be made within 40 and 50 µm range, i.e. maximum change of porphyrin fluorescence was achieved in this region. This result is in a good agreement with the theory presented in work [3].

The obtained results show that porphyrins can be deposited on a tapered fiber using the SAM technique, while optimal tapered fiber diameter, regarding interaction of light with the deposited molecules, being within the range of 40 and 50 µm. Results of emission distribution along tapered fiber can be qualitatively described basing on ray optics [3]. With such a structure the evanescent field at the fiber surface can be probed. Furthermore, the absorbance of the films is significantly higher in such structure compared to that of reference glass plates, which is the ultimate challenge to use the molecular films in as chemical sensors. One of the possible applications is to apply tapered fibers covered with porphyrin SAMs for the detection of HCl in different concentrations.

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A-0003

SYMMETRIC STRUCTURE RESPONSE OF LONG RANGE POLARITON PLASMONS

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The present work deals with the study a symmetric structure response generating a plasmons polariton of long range using a simplified geometrical structure consisting on a gold thin film set between two layers of PMMA. Surface plasmons are considered as typical mode of the metal-dielectric interface. This aims an optimization of the parameters affecting the surface plasmons ranges, such as the multilayer structure thickness, incidence angle and the wave length.

Keywords: Plasmonics, surface plasmons, wave guide, numerical methods, long range

A-0004

SIMPLE FABRICATION OF EPOXY NOVOLAK RESIN OPTICAL WAVEGUIDES ON SILICON SUBSTRATE

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Optical waveguides play a key role in optical communication networks and optical sensor systems. Up to now many different waveguides materials have been used. Some of the key materials for optical communications components are dielectric materials, optical glasses and semiconductors. These materials and applied techniques for fabrication of optical waveguides are expensive and too complicated. Therefore new technologies and materials are investigated and it seems that polymers are cost effective waveguide material with attractive properties [1, 2].

In this paper we report about polymer optical waveguides fabricated on silica on silicon. The presented waveguide design is based upon modification of concept proposed by Fischbeck [3] which was deduced by Marcatili [4]. This concept is based on idea that geometric dimension of the single mode polymer waveguide is specified by silica layer. The design of the presented waveguides was also proposed applying RSoft software using beam propagation method. The waveguide refractive indices of the optical layers were measured by ellipsometry in spectral range from 400 nm to 1600 nm before the proposal. The obtained values were used for theoretical design to make the simulation accurate. The design of the waveguides was done for two wavelength 650 nm and 1310 nm respectively. These two wavelengths were used due to 650 nm is red light usually used for laboratory purpose and 1310 nm is used because this wavelength is most often used in telecommunication system.

We used Epoxy Novolak Resin (ENR) polymer fabricated by spin coating as core waveguide layer and silica layer was used as buffer layer and it was fabricated by thermal oxidation on silicon substrate. Dimension of the waveguides is etched by standard photolithography process. Polymethylmethacrylate (PMMA) was used as protection cover layer and cover PMMA protection layer was deposited by spin coating.

Surface quality of the fabricated waveguides was examined using optical microscope (Olympus DX60) and output field of the fabricated sample was obtained by using beam propagation analyzer BP104IR for wavelength 1310 nm. Propagation of optical loss measurements was carried at 650 nm and 1310 nm using the cut-back

method. The channel waveguides had optical losses lower than 5.5 dB/cm at 650 nm and below 3.0 dB/cm at 1310 nm. The best samples had optical losses lower than 1.35 dB/cm at 650 nm and 0.3 dB/cm at 1310 nm.

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A-0005

GEOSPATIAL REMOTE SENSING USING ADVANCED SENSOR SYSTEMS

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Increased demand on monitoring, surveillance, and communication has necessitated satellites with high resolution, accuracy, speed, and authenticity. Phenomenon of plasmonic interactions in nanomaterials has further expanded the realms of possibilities available so far with conventional opto-electronic devices. The nanophotonics structures coupled with lightweight structures and advanced nanotechnology based sensors have resulted in launching of nanosatellites by several countries. The use of nanophotonics in conjunction with integrated micro/nano optoelectronic technologies in space will reduce susceptibility of the system to EMI, weight/volume of cables, and propagation loss while enhancing signal processing speed, spatial resolution near-field imaging, information transmission and storage capacity, and security encryption capabilities. Use of nanomaterials based advanced sensor systems in satellites and aerial remote sensing science and methodologies to improve performance, resolutions, and security is investigated.

Keywords: Nanophotonics, satellite, sensors systems

A-0006

OPTICAL BOTTLE BEAMS IN INCOHERENT LIGHT: GENERATION AND DIAGNOSTIC OF THEIR PROPERTIES

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We report the creation of periodical arrays of optical bottle beams from incoherent light, using periodical structure hologram and it is shown that the parameters of incoherent bottle beams can be efficiently controlled by varying the beam focusing conditions.

Trapping and manipulation of particles with optical tweezers was first demonstrated more than two decades ago and it remains a very active field of research nowadays. Optical tweezers utilize the gradient optical forces (or radiation pressure) to confine transparent particles as well as atoms, molecules, cells, colloidal suspensions, etc. Depending on the relative refractive index of a particle and the surrounding medium, the particles are trapped

either in the intensity minima or maxima of the beam. Typically, optical tweezers manipulate microscopic objects in a planar geometry, and the particles are confined in a thin layer defined by the focal area of the beam. In order to create an optical potential well and achieve fully three dimensional trapping, the so-called optical bottle have been proposed. Latter on the term “optical bottle beam” was introduced to describe a beam with a finite axial region of low (and even zero) intensity surrounded in all dimensions by light . Such bottle beams could be used to confine and transport a large number of particles or atoms.

A number of different techniques have been proposed to generate bottle beams. This includes mechanical angular scanning of a laser beam and the use of optical diffractive elements such as holograms and phase plates to form a desired hollow axial structure. Many of these techniques involve vortices, i.e. optical beams carrying phase singularities.

Most of the realizations of optical tweezers and bottle beams employ coherent light being sensitive to phase distortions and leading to deterioration of the trapping. This problem can be remedied by the use of light with partial spatial and temporal coherence.

Recently, it was shown that focusing of the spatially partially incoherent light beam by an axicon leads to the formation of a bottle beam. Also, it was suggested that angular momentum carrying bottle beam could be formed by using a partially coherent vortex beam.

So we show method of generation periodical incoherent bottle beam. The idea of this method is creation of system multi color bottle beams by periodical structure hologram.

A-0007

SINGLE-CRYSTALLINE CADMIUM SULFIDE NANOBELTS FOR ULTRAHIGH QUANTUM-EFFICIENCY PHOTODETECTORS

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As important II-V semiconductors, CdS nanostructures are particularly interesting research targets for advanced optoelectronic applications. Previously reported CdS 1D nanostructured photodetectors suffered from very low quantum efficiencies (less than 100) and slow response speeds (higher than 700 µs). It is a challenge to develop an effective CdS photodetector with the high-performance characteristics, e.g. fast response time, high stability, good reproducibility, and high quantum efficiency

.Here the long and single-crystalline CdS nanobelts have been fabricated using a facile physical evaporation process. CdS nanobelts were assembled into nanoscale visible light photodetectors, which showed good sensitivity and wavelength selectivity. Ultrafast response time (20 us) and ultrahigh quantum efficiency (1.9 x 10^7 Percent) are not only the best among the available CdS-nanostructure photodetectors, but their performance also rivals that of detectors made of other 1D semiconductors. These unique properties are attributed to the high-quality of the samples which were confirmed to be single-crystals, large surface-to-volume ratios, short electrode separation, good physical contacts between the nanobelts and electrodes, and surface trapping related with the typical adsorption-desorption process of oxygen.

Our results imply that the present CdS nanobelts are excellent candidates for high-performance photodetectors in the future.

A-0008

SOLAR-CHEMICAL BATTERY: PHOTO-CHARGING AND DISCHARGING CHARACTERISTICS IN AGASS$_2$ FILMS

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It is known that amorphous chalcogenides containing substantial amounts of Ag, such as Ag-As(Ge)-S(Se), exhibit interesting photo-electro-ionic phenomena; photodoping [1], photo-surface deposition [2], and photo-chemical modification (PCM) [3]. In these phenomena, photoinduced migration of Ag ions plays an important role, which may be applied to a novel solar cell, solar-chemical battery, i.e. a device being charged up by sunlight, discharged, and recharged. Actually, Yoshida et al. have demonstrated that Ag-As-S films having coplanar Ag electrodes exhibit persistent voltage after non-uniform illumination [4].

However, discharging and recharging characteristics could not be investigated due to high electric resistances. Here, we report the characteristics in Ag-As-S films having asymmetric sandwich electrodes.

Al(10 nm)/AsS_2(400 nm)/Ag(200 nm) stacks were prepared onto glass substrates by vacuum evaporation. The top Al film was semitransparent, through which monochromatic light (500 nm and 20 mW/cm^2) was incident, and the bottom thick Ag film worked as a source of photodoping and also as an electrode. Photocurrents and persistent currents were measured using an electrometer.

When exposed to the light, the three-layer sample showed current responses due to photodoping, which produced a structure Al/$AgAsS_2$/Ag. This structure gave, after termination of illumination, persistent currents (~0.1 nA and ~10^{-6} C for a 1 mm^2 sample), which can be ascribed to a relaxation process of the PCM effect. And, the persistent current could be re-induced by successive illumination. This photo-charging and discharging operation demonstrates the principle of a solar-chemical battery. However, an efficiency of the photo-charging, i.e. the number ratio of moved Ag ions to absorbed photons is very small, ~10^{-4} %, at present. We are now trying to increase this efficiency.

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A-0009

PHOTOCHROMIC AND LUMINESCENT PROPERTIES OF HETARYLHYDRAZONES AND THEIR METALCOMPLEXES

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The di- and tritopic ligands, for example, hetarylhydrazones are of intense interest for design of photosensitive regulated (macro)molecular and multicomponent systems, because their mononuclear metalcomplexes are applicable as components for the recording layers that are sensitive to radiation in the spectral range 350-450 nm, and optical disks.

Research was carried out for study of photochromic and luminescent properties of hydrazones having different nature of the heterocyclic functional groups situated in positions at N1 and □3.

It is found that photochemical properties of hydrazones are determined by the nature of heterocyclic fragment R2. So, at an irradiation of pyridine-2-carboxaldehyde benzothiazolyl and benzoimidazolylhydrazones takes place a gradual bathochromic shift on 18 nm of the absorption maximum with a slight decrease in optical density. At heating to 70°□ there is a restoration of colouring of the initial form. Photochromism of these compounds is due to the transition aminoform of hydrazone (with the transfer of a proton) in the imino and E Z isomerization of the double bond N = C in hydrazone chain. In the spectra of 2-furylaldehyde (I, IV) and thiophene-2-arboxaldehyde (II, V) hydrazones is observed photoinduced hypsochromic shift of the absorption band of the initial form, and its recovery does not occur in darkness, or when heated. The foundation of the irreversible photoreaction is the process photocyclization in annelated triazolobenzazoly.

The hetarylsubstituent R1 at N1 has a decisive influence at the luminescent properties of hydrazones (VII-X). The largest photon emission in the spectral range 455-545 nm was shown for salicylaldehyde benzoimidazolylhydrazone (IX), while benzothiazolylhydrazone (X) has no luminescence. The preparation of optically active systems with zinc (II) ions was favourable to increasing the luminescence efficiency of hydrazone complexes (VIII-IX) in 2,5 times, the appearance of photon emission for the complex of ligand (X). It should be noted the disappearance of fluorescent properties for zinc complex of salicylaldehyde (4-methyl-6-hydroxypyrimidin-2-yl)hydrazone (VII).

A-0010

SELF-ASSEMBLED SILICON-GERMANIUM NANOSTRUCTURES FOR CMOS COMPATIBLE LIGHT EMITTERS

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With the microprocessor clock speed approaching 10 Gbps, optical interconnects are now being considered for on-chip interconnects as an alternative to conventional metal wires. Major avenues toward this goal include the hybrid approach with densely packaged III-V optoelectronic components and the all-group-IV approach (mainly Si, Ge and SiGe), where all the major components, e.g., light emitters, modulators, waveguides and photodetectors, are monolithically integrated into the CMOS environment. For almost five decades, the efforts on obtaining light emission from group-IV semiconductors have been mainly focused on porous silicon, silicon/silicon dioxide superlattices, silicon nanoprecipitates in silicon dioxide, erbium in silicon, silicon/germanium quantum wells, and iron disilicide. However, no approach has so far been applied commercially. There are several reasons, including the lack of a genuine or perceived compatibility with conventional CMOS technology, the long carrier radiative lifetime in Si-based nanostructures, and, especially in the case of near-infrared emitters, the significant thermal quenching of the luminescence quantum efficiency. In this invited talk, we review the basic light emitting properties of three-dimensional Si/SiGe nanostructures. These nanostructures emit light at the technologically important 1.3-1.6 µm wavelength region, and the highest photoluminescence (PL) and electroluminescent (EL) quantum efficiency is found in SiGe clusters with a ~50% Ge composition near the cluster core. The highest luminescence efficiency is observed at low excitation intensity, and the PL quantum efficiency decreases as the excitation intensity increases, due to competition with faster non-radiative Auger recombination. Using time resolved PL measurements, it is found that within the broad PL band, the part of the PL spectra at higher photon energies exhibits a ~100 times faster radiative transition, which is explained by radiative recombination occuring between holes occupying excited states within the SiGe clusters and electrons mostly localized at the Si/SiGe interfaces. This fast PL is less susceptible to Auger-induced intensity saturation as the excitation intensity increases. In addition, this PL exhibits an improved intensity temperature dependence: the PL can easily be extended up to room temperature. The EL in Si/SiGe nanostructures is very similar to the PL in its physical nature and it can also be extended up to room temperature. At higher excitation intensity Auger recombination is not only responsible for the quick saturation of the SiGe cluster PL intensity, but it also effectively injects holes into the Si barriers. This hole “Auger fountain”, presumably enhanced by the relaxation of the momentum conservation selection rules at the Si/SiGe hetero-interface, facilitates the efficient formation of electron-hole droplets (EHDs) and an exciton/EHD phase transition in the nanometer-thick Si layers. These experimental observations suggest that by controlling and modifying the composition of Ge-rich SiGe clusters (and possibly other types of two-dimensional and three-dimensional Si/SiGe nanostructures) it is possible to fabricate a more efficient SiGe light-emitting device. Despite the many challenges associated with integration into the traditional CMOS environment, the proven compatibility between planar Si/SiGe and conventional CMOS technology suggests that this task for three-dimensional nanostructures is not an impossible one.

A-0011

SINGLE-CRYSTALLINE ZNS NANOBELTS AS ULTRAVIOLET (UV)-LIGHT SENSORS

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Zinc sulfide (ZnS), is one of the first semiconductors discovered and one of the most important materials in the electronics with a wide range of applications, including LEDs, electroluminescence, flat panel displays, infrared windows, sensors, lasers, and biology etc. The research on nanostructured ZnS have recently stimulated great interest due to their potential value for understanding fundamental physical concepts and for applications in constructing nanoscale electric and optoelectronic devices. ZnS provides a novel prospective alternative for UV detectors that would particularly serve well within the UV-A band.

We have demonstrated an effective approach for the synthesis of single-crystalline ZnS nanobelts possessing sharp UV emission at RT via right selection of source materials and controlling their evaporation and agglomeration rates. The individual ZnS nanobelt-based UV-light sensor and multiple ZnS nanobelts-based sensor were successfully fabricated, these showed a high potential as visible-blind UV-light photodetectors and ultra-fast optoelectronic switches. The sensor characteristics, including a spectral response, I-V curves under various light illuminations, and a time response were studied. The photoresponsivity of ZnS nanobelt-based UV-light sensors exhibited over three orders of magnitude gain under the UV light illumination as compared to a visible light. The high spectral selectivity combined with high photosensitivity and fast time response (< 0.3 s) make the present single-crystalline ZnS nanobelts particularly valuable for new “visible-blind” UV-light photodetectors, especially in the UV-A region.

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A-0012

DEVELOPMENT OF SUBMICROMETER-GRAINED TRANSPARENT ER:Y_2O_3 CERAMICS

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Er:Y_2O_3 transparent ceramics have recently received a great deal of attention as potential high power solid state laser hosts. In this presentation, we present the development of transparent Er:Y_2O_3 ceramics with an average grain size of 0.3 um by pressure-assisted two-step sintering. These submicrometer-grained ceramics exhibited equivalent transmission to single crystalline Y_2O_3 for wavelengths greater than 1200nm. The microhardness and fracture toughness of the modified two-step sintered ceramics exceeded those of conventionally sintered ceramics by 25% and 70%, respectively. The single-crystal-like transmittance of the submicrometer-grained yttria ceramics in the visible and IR region with high mechanical properties is an important advancement for the use of these materials in more extreme environments, including high power laser systems where reduction of scattering and thermal shock resistance are critical.

A-0013

FABRICATION AND CHARACTERIZATION OF CRYSTALLINE CORE OPTICAL FIBERS

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Crystalline semiconductor core glass clad optical fibers have recently been emerging due to the potential advantages they may provide in optoelectronics and optical sensing applications, including Raman fiber devices, mid- and long-wave infrared sensing and power delivery, and terahertz guided wave structures. Unary semiconductors, such as silicon and germanium, provide several key advantages over current IR and mid-IR glasses used in the biomedical industry and sensing and security communities. Cladding glass compositions have been developed in an attempt to match fiber cladding draw temperatures to the melting point of the core as well as matching thermal expansion coefficients (CTE) between the core and cladding materials. Long lengths of both silicon and germanium core fibers have been fabricated using fiber draw techniques, possessing an approximately 15 micrometer core within a 150 micrometer diameter glass cladding. X-ray diffraction and Raman spectroscopy confirmed the core material to be phase-pure, highly crystalline, and with a nominal amount of oxygen diffused into the core from the cladding.

A-0014

NANO-PHOTONIC DEVCES ON ORGANICS AND SILICA MATERIALS OBTAINED WITH VARIOUS THIN LAYER PROCESSES

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We report a novel and practical concept based on reproducible fluidic mechanisms coupled with silica nano-particles for the development of nano-optical-connections directly on organic integrated photonic chips. Silica nano-rib waveguides have been shaped with various widths ranging between 50 nm and 300 nm and about a hundred µm in length respectively. An effective nano-photonic coupling mechanism has been demonstrated and a sub-wavelength propagation regime obtained between two organic rib tapers and waveguides with a perpendicular and a parallel configuration respectively. The specific silica nano-rib-waveguides structures show off optical losses propagation ranging around [37-68] Db/mm at visible and infra-red (IR) wavelengths. Such flexible devices offer a versatile fabrication control by changing respectively nano-particles and surfactant concentrations. Thus, they present great potential regarding future applications for shaping nano-connections and high-density network integrations between original optical segmented circuits such as plots, lines or any pre-formed photonics structures.

A-0016

COMPARISON OF DIFFERENT MODELS OF NON-LOCAL IMPACT IONIZATION FOR LOW NOISE APDS

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The complete understanding of multiplication and noise in avalanche photodiodes (APDs) requires that the non-local nature of impact ionization is taken into account. The long standing McIntyre [1] theory overestimates the excess noise factor by assuming that the ionization coefficient is a function of the local electric field only. Excess noise factors significantly smaller than the lower limit predicted by McIntyre [1] have been measured in a number of materials e.g. [2, 3]. Very low excess noise factors can be predicted when the non-local effects, dead space and resonance, [4] are included in the model. A common assumption in many non-local models is that carriers can not undergo impact ionization in the dead space but then ionize at a constant rate thereafter. This approximation is known as the hard dead space model (HDSM) by Tan et al [5] or the hard-threshold dead-space multiplication theory (HDSMT) by Kwon et al [6]. However it can be observed from numerous Monte Carlo simulations e.g. [7] that the impact ionization rate has a soft turn on after the dead space. This has led to three mathematical descriptions of the ‘soft’ dead space; (a) using an ionization pathlength pdf given by a fast rising exponential starting immediately after the dead space followed by a slower decaying exponential [8], (b) using a Gaussian function [5] and (c) assuming that the dead space length is a random variable uniformly distributed between two limits [6].

In this paper the interelationship between these three mathematical descriptions is investigated. They are compared with Monte Carlo simulations of non-local ionization co-efficients and used to make predictions for the performance of various ultra low noise APDs.

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A-0017

A HELIUM SCINTILLATION FISSION CHAMBER NEUTRON DETECTOR

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High purity Helium can serve as scintillation detection media of charged particles. The Helium scintillator has advantages over solid or liquid scintillators: it has the same scintillation efficiency for different ions, and has lower stopping power for electrons. These advantages make Helium suitable for detecting fission fragments.

A prototype Helium scintillation fission chamber neutron detector was developed. A thin 235UO2 target foil was used as a radiator, which could produce fragments when it undergoes fission reactions with incoming neutrons. Helium in the gas chamber could be excited by the charged particles from a fission event, and emitted visible light photons, which were detected by a photomultiplier. The sensitivity to neutrons of this detector was about 10-15C• cm^2, and the sensitivity to gamma ray was about 10-17C•cm^2. The good gamma suppression ability of the detector makes it suitable for pulsed neutron detection with the presence of gammas.

A-0018

PHOTONIC BAND PARAMETERS OF ZNX (X =O, S, SE, TE)

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Dielectric photonic band gap materials have received broad attention due to their distinguished performance in optical devices, microwave generation and laser acceleration. We have theoretically studied band structure parameters of ZnX (X = O, S, Se, Te). The photonic band structure calculations are performed using the MIT photonic-bands package (MPB) to calculate fully vectorial definite-frequency eigenmodes of Maxwell's equations with periodic boundary conditions in a plane-wave basis. Model calculations are based on two-dimensional periodic crystal structure. The lattices consist of cylindrical tubes and gaps between the tubes filled with air. Single-site zinc blende lattices are considered. For the two-dimensional case we numerically differentiate the group velocity to accurately calculate the dispersion relation. In order to get "gap maps" we have calculated the gaps as a function of radius of the tubes. Our results are in good agreement with previous experimental data.

A-0019

FIRST KAONS MEASUREMENT WITH SCINTILLATING FIBERS READ BY MPPC AT THE DAFNE E+/E- COLLIDER

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Multi-Pixel Photon Counters (MPPC) consist of hundreds of micro silicon Avalanche PhotoDiodes (APD) working in Geiger mode. The high gain, low noise and low voltage values needed for

operating these relatively new devices, together with their good behaviour in magnetic field, make them ideal for the readout of scintillat ing fibers as front-end/trigger detectors in particle and nuclear physics experiments.

A prototype setup consisting in 5 SciFi read out by 10 MPPCs was mounted inside the DAFNE collider to measure the back-to-back K+K- delivered in the phi-decay processes. Such a system will be used as a trigger system in the AMADEUS experiment.

The same experimental set-up was also tested with a Sr90 source in the laboratory for characterization and calibration.

The results of the measurements, together with future plans, will be presented.

A-0020

TUNING OF SURFACE STATES IN 2D SQUARE LATTICE PHOTONIC CRYSTAL

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In recent years, much attention has been given to tunablity in photonic crystal (PC) structures due to their practical applications. It is shown that for 3D-PC formed with nematic liquid crystal (NLC) inclusions, the band gap can be effectively controlled by varying the alignment of the NLC directors [1]. Recently, we have reported on the tuning of defect modes in 2D PCs in which defect is formed with NLC inclusion [2]. It is well known that when an ideal PC is truncated, the localized surface state can appear on the truncation surface of PC. The surface states generated in PCs have potential application in a wide variety of areas such as waveguides and slow light in PCs [3-4]. In this study we consider a 2D square lattice PC of circular air holes in an alumina background in which one line of the outermost air holes is infiltrated by the NLC. The alignment of the NLC directors can be modified by applying the external static electrical field. Here, it has been assumed that the external field is along the axis of cylinders. The distribution of NLC directors plays an important role on the position of surface states inside photonic band gap. Therefore, we have obtained this distribution by minimization of the free energy of NLC [5]. In order to obtain the surface states in 2D PCs, the supercell method that is based on the plane wave expansion has been applied. Numerical results show that position of surface states inside the band gap can be effectively controlled by applying the external field.

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A-0021

DETAILED STUDY OF FLAT BANDS IN METALLIC PHOTONIC CRYSTALS

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It has been difficult to compute the band structures of photonic crystals with metallic components. The existence of modes of surface plasmon polariton presents the major difficulty due to the localized nature of the modes. In this study, the detailed feature of the dispersionless bands in a two-dimensional square lattice with metallic cylinders has been studied by using of the Dirichlet-to-Neumann (DtN) map method, a method which has recently been developed [1]. The DtN map method is proven to be more efficient and stable compared to the other methods such as the scattering matrix method, the Finite-difference time-domain (FDTD) method and multiple multipole methods which are usually used in simulation of the metallic photonic crystals. We have obtained fine band structure for H polarization around the flat band region which has not been reported to the best of our knowledge. Our numerical results show that the H field distributions are highly localized around interface of metallic cylinder with air. The field pattern of these modes which are composed of nodes and anti-nodes are spread in circle. By approaching frequency of modes to the surface plasmon frequency, the numbers of anti-nodes are increased considerably and in one of the flat bands the field pattern turns almost to a complete ring.

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A-0022

HYDROTHERMAL SYNTHESIS OF HEXAGONAL-PHASE NAYF$_4$:ER^{3+}, DY^{3+} PHOSPHOR

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In the present paper we concentrate on crystal structure and absorption spectra of NaYF4: Er3^{+}, Dy^{3+} phosphors. The hexagonal-phase NaYF$_4$:Er$^{3+,}$ Dy^{3+} phosphors were synthesized by hydrothermal method. Effects of Dy^{3+} ions co-doping on structural stress and lattice defects of phosphors were investigated. In particular, NaYF$_4$:Er$^{3+,}$ Dy^{3+} phosphors show the broad absorption bands in the near infrared region which have the potential for application to solar cells.

A-0023

OPTIMIZATION OF GE-AS-SE GLASSES FOR ALL-OPTICAL SIGNAL PROCESSING

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The Ge-As-Se glass system displays an unusually wide range of glass forming compositions and is, therefore, interesting for elucidating composition-property relations in covalently bonded ternary chalcogenides. Our particular interest is to use these glasses to fabricate nanowire waveguides for all-optical signal processing. This requires glasses that have high third order optical nonlinearity, low linear and nonlinear losses; good film forming properties and high stability, particularly to infrared light at continuous levels around 100MW/cm^2.

We wanted to answer a series of questions: how do parameters such as the linear and nonlinear index of refraction; the optical losses; the energy gap; the glass transition temperature; etc., vary with MCN. Would such data provide guidance as to which glasses would have the best properties and the best stability for all-optical processing? We were also interested in creating films and determining how their properties differed from those of their parent glasses and how they were affected by MCN.

To answer these questions a wide range of measurements were made. These included glass densities and indices of refraction; third order nonlinearities; Tauc gaps; chemical compositions via EDX and LA-ICP-MS; Raman and XPS spectra to diagnose the chemical bonds; elastic modulii via laser ultrasonic pulse interferometry; amorphicity via XRD; thermal and photo-stability; etc. Measurements were carried out on the glasses produced by melt-quenching and thin films produced by thermal evaporation.

One of the most striking conclusions is the strong correlation that exists between many physical properties and MCN. The glass density; refractive index; elastic moduli; and Tauc gap all show abrupt changes in their MCN-dependence at both MCN around 2.4 and 2.67 [4,5]. An example being the refractive index of both thermally evaporated films and bulk glasses. Since the index of refraction is related to both glass density and Tauc gap it is perhaps not surprising that these parameters also display analogous changes as do the elastic moduli. Similar transitions could be found in Raman data where bands associated with Se-Se bonds disappear for MCN around 2.4-2.5 and new bands associated with defect bonds appear for MCN>2.7. In this presentation I will provide a summary of our conclusions and identify glasses that appear to be the best for all-optical devices and represent a small island "strong" amongst the continuum of "fragile" glass formers which generally characterize the system.

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A-0024

OBSERVATION OF AMPLIFIED STIMULATED TERAHERTZ EMISSION FROM OPTICALLY PUMPED GRAPHENE

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Graphene is a single-layer carbon-atomic honeycomb lattice crystal. Electrons and holes in graphene hold a linear dispersion relation with zero bandgap, resulting in peculiar features like negative-dynamic conductivity in the terahertz (THz) spectral range under optical pumping [1,2]. In this paper, we'll show the theory and experimental results of THz amplified coherent emission from optically pumped epitaxial graphene heterostructures.

Due to a very short time of the optical phonon emission (less than ps), the photogeneration of electrons and holes leads to the emission of a cascade of optical phonons, so that the photoelectrons and photoholes occupy the states with the energies close to but not equal to the Dirac point. As a consequence, photoelectrons/holes recombine to radiate THz photons [1]. The incident photon spectra will reflect on the THz photoemission spectra as a proof of occurrence of such a process

.We measured the carrier relaxation and recombination dynamics in optically pumped epitaxial graphene-on-silicon (GOS) heterostructures using THz time-domain spectroscopy based on a optical pump/THz&optical probe technique. An ultra-thin graphene layer was grown by the thermal decomposition of an 80-nm-thick 3C-SiC film heteroepitaxially grown on a B-doped Si(110) substrate [3]. Its 2D-band Raman spectra proven the existence of monolayer and bilayer of graphene, and the G-band spectra at 1595 cm-1 corresponds to the optical phonon energy of 198 meV [3]. A 1545-nm, 20-MHz, 80-fs pulsed fibre laser beam was impinged to the sample and a CdTe crystal placed on the sample. The THz probe pulse, which is supplied by emission of coherent-phonon-polariton (dominant LO phonon at 5.1 THz and weak TO and soft TO phonons at 4.3 and 2.1 THz, respectively) or optical rectification in the CdTe, stimulate the emission of THz photons from the GOS.

Time-resolved electric-field intensity originated from the THz photon emission was electrooptically sampled by in total-reflection geometry [4]. The emission spectrum from the CdTe only (without the GOS) shows a dominant peak around 5 THz and weak side-lobe extended down to below 1 THz. On the other hand, the result with graphene fairly traces the above-mentioned THz photon spectrum estimated from the pumping photon spectra and includes an additional peak around 5 THz. It is interpreted that the THz emission from graphene is stimulated by the coherent THz probe radiation originated from the CdTe excited by the pump laser beam, and exhibited an amplification owing to the photoelectron/hole recombinations in the range of the THz negative dynamic conductivity. The result demonstrated here will lead to a new type of THz lasers.

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A-0025

ALL-OPTICAL SIGNAL PROCESSING AT TBAUDRATES IN AS$_2$S$_3$ GLASS NONLINEAR WAVEGUIDES

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All-optical signal processing allows the baud rate in a single channel optical transmission system to far exceed that determined by the speed of electronics (40Gb/s). Tbaud transmission is now being actively investigated for applications such as Tb/s ethernet, and combined with advanced formats leads to unprecedented capacity per channel with effective bandwidth utilization. In such high-speed systems much of the primary processing such as demultiplexing, wavelength conversion, etc. must be performed in the optical domain using highly nonlinear waveguides. All-optical schemes are also required for performance monitoring with THz bandwidth that will be essential to maintain the integrity of the optical signal in the face of environmental fluctuations in the link. Of the few nonlinear waveguide devices that can be used for Tbaud all-optical devices, those fabricated from chalcogenide glass offer instantaneous nonlinear response free from nonlinear absorption or free carrier effects that become a serious limitation in materials such as silicon and III-V semiconductors.

Here I describe the state-of-the-art in highly nonlinear As_2S_3 waveguides designed for all-optical processing. We fabricate dispersion-engineered waveguides from thermally evaporated As_2S_3 thin films. Post deposition, the films are stabilized by a combination of thermal and photo-annealing to create homogeneous films with properties close to those of bulk As_2S_3 glass. We use a combination of optical lithography and dry etching with CHF_3 to create rib waveguides in 850nm thick As_2S_3 core layers. The waveguide design is chosen to produce near zero dispersion for TM mode at 1550 allowing colourless device operation over the full telecommunication c-band. Protective coatings and optimised processes are applied to minimise roughness of the surfaces of the fabricated devices. Typically waveguides with mode areas 1.2μm^2 have losses 0.3dB/cm, a nonlinear parameter $10W^{-1}m^{-1}$ and anomalous dispersion 30ps/nm/km. Anti-reflection coatings and surface passivation is used to enhance the continuous wave power handling and stability of the resulting waveguides so that they can withstand average optical power exceeding 0.3W (in waveguide) which is equivalent to a CW intensities of 250MW/cm^2.

These waveguides have been demonstrated to operate successfully for wavelength conversion; ultra-fast demultiplexing of data streams at up to 1.28Tb/s; optical phase conjugation of DPSK signal allosing dispersion compensation via mid-span spectral inversion; and impairment monitoring. In most experiments measurements of bit error rates for data subjected to all-optical processing lead to maximum power penalties of at most a few dB indicating error free operation was obtained.

In this talk I will summarise these results and outline the prospects for further improvements in device performance that we expect in the next year though the use of smaller nanowires with enhanced nonlinearity.

A-0026

LITHIUM NIOBATE PHOTONIC CRYSTAL CAVITY FOR CHEMICAL DETECTION

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We present a single hole defect (SHD) cavity based on lithium niobate substrate (LiNbO3) for sensing applications. The physicochemical reaction between the gas and a sensitive absorbent layer induces not only refractive index and thickness layer variations, but also a variation in the sensitive layer's absorption. Plane wave expansion (PWE) and finite difference time domain (FDTD) simulations were performed to study the effect of the absorption on the transmission spectrum of the cavity.

The proposed structure consists of a biperiodic triangular lattice of circular air holes on a lithium niobate substrate, in which a defect is introduced by reducing the center pore radius. A third medium, corresponding to the porphyrin sensitive layer is introduced as a ring-shaped intermediate layer around the holes. The optical properties (refractive index, absorption) of the Porphyrin layer are modified in presence of benzene molecules, which induces intensity variation of the transmitted light through the cavity. In view of enhancing the intensity variation, the parameters of the cavity are determined to make the resonance peak of the cavity coincides with the absorption peak of the sensitive layer at l=420 nm.

The sensitivity of the structure to changes in the thickness of the porphyrin was evaluated by the PWE-Supercell method. The results show that a variation in thickness of 1 nm of the sensitive layer implies a shift of 0.5 nm of the resonance peak, at the operating wavelength of 419.5 nm

2D-FDTD calculations based on a homemade code were performed to analyze the resonant mode. From this study we can conclude that the resonance peak encounters a variation in transmittivity of 23% when the Porphyrin layer is exposed to 50ppm of benzene, which corresponds to a variation of the refractive index of 10-7 and a variation of 6×10-4 for the extinction coefficient. Consequently the sensitivity of the device is estimated to be about 3 ppm.

In order to validate the feasibility of the device, we have developed and fabricated different cavities on a lithium niobate substrate at l=1.55nm operating wavelength, which is a preliminary step before the development of cavities operating at 419.5nm wavelength. The cavities were patterned on a proton exchanged waveguide by FIB milling.

The resulting experimental transmission spectrum through the PhC cavity were performed and compared to the FDTD-2D theoretical transmission through the same structure. A good agreement is obtained between theoretical and experimental results, confirming the existence of two gaps lying in the wavelength ranges [720nm-830nm] and [1280nm-1900nm] respectively. Complementary experimental results will be presented, which show the sensitivity of the transmitted spectrum to geometrical variations of the PhC structure.

A-0027

THIN FILMS OF LSMO AS ELECTRODE IN SPINTRONICS DEPOSITED BY PULSED LASER ABLATION

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Spintronics is a new and interesting topic in the nanoscience field, it demands for transparent electrodes with ferromagnetic features and La(1□x)Sr_xMnO_3 (LSMO) seems to be a promising material. Thin films of LSMO were =193□ deposited by means of pulsed laser ablation using an ArF excimer laser (nm) on silica substrate heated at 600 C. The depositions were performed at different oxygen pressures to study their influence on the structural, optical, electrical and magnetic properties. Fort his aim the deposited layers were characterized by different techniques: spectrophotometry, four-point probe, R(T), MOKE, TEM, SEM, AFM.

A-0028

FEMTOSECOND LASER ABLATION AND MICROMACHINING OF SEMICONDUCTORS AND DIELECTRICS

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A summary of our research activities on laser ablation and micromachining of semiconductors and dielectrics using femtosecond laser pulses will be presented. An outline will be given of the general experimental aspects, including laser techniques and materials analysis. A key emphasis of our experiments is the post-mortem analysis of laser-irradiated materials using advanced methods of electron microscopy. In order to provide a broader perspective and a background for the on-going experiments, selected highlights of earlier work will be presented. Examples will then be taken from recent and current experiments which include, for example, work on ultrafast laser ablation of single crystal diamond, carbon nanotube forests, ion-irradiated silicon, as well as nano-particle production from doped dielectric laser crystals. The presentation will conclude with comments on future research possibilities.

We would like to thank the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Canadian Institute for Photonic Applications - CIPI (within the Network of Centres of Excellence) for their generous support. The facilities and staff of the Canadian Centre for Electron Microscopy within the Brockhouse Institute for Materials Research have also been instrumental in the laser ablation studies.

A-0029

POLARIZATION OF OPTICAL SPECTRA IN TRANSPARENT CONDUCTIVE OXIDE GA$_2$O$_3$

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Ga_2O_3 is attracting much attention for its potential use in optoelectronic devices in the near ultraviolet (UV) wavelength region, for example, one of transparent conductive oxides (TCO). Ga_2O_3 exhibits the band gap of 4.8 eV, resulting in a transparency from the visible into the UV regions. The n-type conductivity of Ga_2O_3 seems to be attributed to an oxygen deficit [1,2]. In order to identify the structure of donors, we have examined polarization of optical absorption, excitation and luminescence spectra observed in pure and Si-doped Ga2O3 single crystals.

The optical absorption spectrum observed in the range of 100-300 nm for the pure Ga_2O_3 crystal, which is due to the band-to-band transitions, is strongly polarized along b and c axes of the crystal [3]. The result reflects the structure of the valence band of Ga_2O_3. The UV luminescence spectrum from the pure Ga_2O_3 crystal excited below 260 nm consists of two broad bands with peaks at 360nm and 390 nm. The luminescence intensities are independent of the polarization of the excitation. On the other hand, the absorption spectrum for the Si-doped Ga_2O_3 crystal has a tail around the band edge (260 nm) observed in the pure crystal. Although the UV excitation below 250 nm for the Si-doped Ga_2O_3 crystal produces the same luminescence as the pure crystal, the excitation around 260-280 nm produces green luminescence with a peak at 540 nm. The excitation spectrum of the UV luminescence for the Si-doped Ga_2O_3 is also due to the same band-to-band transitions as the pure Ga_2O_3 crystal. Therefore, the UV luminescence observed in the pure and Si-doped Ga_2O_3 crystals has been attributed to an intrinsic transition (self-trapped excitons) [2]. The excitation spectrum of the green luminescence for the Si-doped Ga_2O_3 crystal consists of a single band around 270 nm and is strongly polarized along the c axis. The green luminescence spectrum is also polarized along the b and c axes. Taking into account both the polarization of the absorption and luminescence spectra and the crystal structure of Ga_2O_3, we discuss the origin of the green luminescence observed in the Si-doped Ga_2O_3 crystal.

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A-0030

DIODE LASER PUMPED LAF3:ER3+/YB3+ NANO-PHOSPHOR AS OPTICAL HEATER

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The inorganic luminescent materials with lanthanide ions have been extensively studied because of their immense potential applications. The current interest in this field is focused on synthesizing nano phosphor materials using improved techniques and look for their applications. Out of various phosphors, $Er^{3+/}Yb^{3+}$ doped upconversion (UC) nanophosphors have been found highly efficient and have been successfully used in different applications along with bioimaging.

In this work, we report $LaF_3:Yb^{3+}/Er^{3+}$ nano-particles which can be used for producing heat in the nanoparticles and its surrounding nano volume. The Yb^{3+}/Er^{3+} co-doped LaF_3 nano-phosphor has been synthesized through liquid pulsed laser ablation technique and UC fluorescence has been recorded by pumping the sample with 976 nm radiation. In addition to a strong UC fluorescence a substantial heating up to several hundred Kelvin has also been observed. The value of which has been calculated using fluorescence intensity ratio (FIR) of the UC bands 2H11/2□4I15/2 and 4S3/2□4I15/2 of Er^{3+} ion. The prepared nano-particles have also been dispersed in polymer matrix and it was found that nano-particles can create nanoholes in the matrix.

A-0031

CONTROL OF PHOTOLUMINESCENCE INTENSITY BY HF VAPOR SELECTIVE ETCHING OF POROUS NC-SI-SIO$_X$ STRUCTURES

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Thin-film structures containing Si nanocrystals (nc-Si) embedded in the SiO_x matrix attract the attention of many researchers, because of their promising applications in advanced electronic and optoelectronic devices.
In this work the effect of treatment in vapors of hydrofluoric acid (HF) on the PL spectra of porous light-emitting nc-Si-SiO_x structures, are studied. Such structures are synthesized by thermal evaporation of silicon monooxide in a vacuum and oblique deposition onto silicon substrate. The angle of incidence between the vapor stream and the substrate normal was 60 and 75 degrees. The deposited SiO_x films have a porous (inclined column-like) structure with the column diameters of 10-100 nm. Then the obtained porous SiO_x films were annealed in vacuum at 975 C, that results in formation in the films silicon nanocrystals. Annealed nc-Si– SiO_x samples were placed in closed cell with HF vapor flow at temperature 30 C. Treatment in HF vapor results in selective etching of SiO2 inclusions in porous heterogeneous nc-Si-SiO_x structure.
The PL spectra were recorded at room temperature in the wavelength range from 440 to 900 nm using 337 nm line of a nitrogen laser as excitation source. These spectra were normalized to the spectral sensitivity of the experimental system. The structure of the obliquely deposited SiOx films was studied by ZEISS EVO 50XVP high-resolution electron microscope. FTIR measurements were carried out with Perkin-Elmer Spectrum BXII spectrometer. EPR spectra have been studied at room temperature by the X-band spectrometer with modulation of the magnetic field at 100 kHz.
In annealed samples at a room temperature the PL peak with maximums at 820-900 nm is observed. These peak are explained in terms of radiating recombination of carriers which are excited in nc-Si. As a result of HF vapor treatment of nc-Si-SiO_x structures these PL peak exhibit strong blueshift with an increase of etching time (maximum blueshift on 300 nm up to 590 nm). Besides, during first period of vapor treatment the intensity of PL peak increased near two order of magnitude. At the further etching PL intensity diminishes gradually with decreasing of film thickness. The IR absorption bands related to Si–H and Si-O-H bonds is presented in the spectrum of HF treated nc-Si-SiOx structures. A nearly symmetric EPR line, attributed to dangling bonds of Si atoms in amorphous precipitates, has been detected for annealed nc-Si–SiOx samples. No EPR signal has been found after HF vapor treatment testifying complete passivation of dangling bonds.
It is expected that evolution of PL spectrum is caused by decreasing of nc-Si sizes in consequence of the oxide etching and following oxidizing of nc-Si. The increase of PL intensity by the HF vapor treatment is most probably due to the hydrogen and oxygen passivation of nonradiative defects (Si dangling bonds). The obtained results show, that by the HF vapor treatment of light-emitting porous nc-Si-SiO_x structures it is possible to control PL intensity and peak position in a wide spectral range.

A-0032

BIFUNCTIONAL PHOTOSENSITIVE MOLECULES FOR OPTICAL PROCESSES - SYNTHESIS AND PROPERTIES

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Hybrid photosensitive molecules are perspective compounds for creation of molecular logic devices on their base. A series of novel photochemically bifunctional compounds (PBC) was synthesized by one-pot reaction of 5- amino-1.3.3-trimethyl-3-methyleneindoline with two equivalents of different ortho-hydroxysubstituted aromatic aldehydes. Obtained PBC molecules combine the photochromic spiropyran fragment with substituted salicylideneimine one. The last can undergo intramolecular proton transfer in the electron-excited state (ESIPT). There is no conjugation between azomethine and pyran fragments in the initial state of the molecule. Photolysis products were detected using pulse photolysis technique in toluene and methanol solutions. Nitrogen and dye lasers were used for excitation with radiation wavelengthes 337, 425 and 470 nm. In most cases two photolysis products with absorption maximums at 500 and 600 nm were observed. Photoproduct with absorption maximum at 500 nm corresponds to trans-keto form of FBC molecules having closed spiro-form. Photoproduct with absorption maximum at 600 nm represents merocyanine form having enol structure of salicylideneimine fragment. The spectral kinetics characteristics of photoproducts were studied, their quantum yields were measured. The obtained kinetic data indicate unambiguously that two final photoproducts are not transformed into each other but return to the initial form of the molecule during dark reaction. Thus, two photoprocesses, i.e. ring opening in spiropyran fragment and ESIPT in salocylideneimine one occur independently. Substituents and solvent nature and the wavelength of the exciting light affect the photoproducts ratio and decay rates. It was found in the case of PBC containing spironaphthopyran and hydroxynaphthylmethyleneimine fragments the exciting pulse wavelength has a dominant influence on the number of photoproducts. This compound in methanol solution represents a model of fully photonic molecular logic device.

A-0033

LASER GAIN IN DILUTE NITRIDE GA(NASP) SEMICONDUCTOR QUANTUM WELLSTRUCTURES ON SILICON SUBSTRATE – A MICROSCOPIC ANALYSIS

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For the design and improvement of semiconductor laser devices a detailed, quantitative analysis of their optical properties is demanded to identify and characterize the underlying physical processes. Such an analysis is of significant importance to explore the application potential of novel material systems and to design optimized structural layouts. For this purpose, we have developed a many-particle theory enabling us to simulate the material properties of semiconductor quantum well systems which are the basic building blocks in common semiconductor lasers. Based on systematically derived microscopic equations, we compute the electro-optical properties including the microscopic interaction effects explicitly. In this manner, the absorption and the optical gain of laser structures can be quantitatively predicted.

In this presentation, the application of our microscopic many-particle approach to the Ga(NAsP) material class is discussed. The novel dilute nitride material offers a direct band gap and furthermore, it can be grown nearly

lattice-matched on silicon. Thus, a monolithic integration of active laser material on silicon substrates may be realized providing unique functionalities in silicon photonics.

In order to analyze the optical properties and to clarify the lasing performance of the Ga(NAsP) material system we extend our 8x8 kp model to determine the eigenenergies and the eigenstates of specific dilute nitride structures. The incorporation of nitrogen in Ga(AsP) particularly leads to a drastic band gap reduction which can be understood by the anticrossing of the conduction band and the nitrogen impurity level. Therefore, we expand our kp band structure calculation to a 10x10 model including dispersion-less nitrogen bands. The knowledge of the band structure then allows us to compute absorption and laser gain spectra microscopically, and thus, main characteristics of the laser device such as the emission wavelength and the threshold behaviour can be predicted.

The comparison of the calculated laser gain spectra to experimental results for a series of Ga(NAsP) quantum well structures on silicon substrates shows an agreement of the main features, verifying the validity of our approach to describe the Ga(NAsP) material system. In particular, our microscopic model enables us to investigate the influence of critical material and structural parameters, such as the impact of the barrier composition on the laser gain properties.

A-0034

APPLICATION OF CARBAZOLE-CONTAINING POLYMER MATERIALS AS RECORDING MEDIA

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Polymer materials attract attention for application as recording media due to their specific structure, low cost, and easy fabrication. In order to extend the class of carbazole-containing polymer materials for photo- and electron beam recording, new copolymers were synthesized: (i) epitiopropylcarbazole with epoxypropylcarbazole (T-PEPC:PEPC); (ii) carbazolylalkylmethacrylate with octylmethacrylate (CAM:OMA); and (iii) carbazolylethyl methacrylate with methylmethacrylate (CEM:MMA). The thin films of 1-2 μm thicknesses prepared from these copolymers were used for holographic and e-beam recording of diffraction gratings with the period of 1 μm.

For holographic recording all synthesized polymers were sensitized with iodoform CHI3. The maximum photosensitivity was determined to be achieved at the concentration of CHI3 about 10 mass%. Irradiation of the T-PEPC:PEPC (1:1) films by UV-light resulted in appearing of the absorption band at 0.65 μm in the visible range. Under the dark storage of the irradiated films the intensity of the appeared optical band increased. This post-recording effect yielded the enhancement of absorption diffraction gratings formed by holographic recording in T-PEPC:PEPC films. After selective etching the diffraction efficiency of gratings recorded in T-PEPC:PEPC thin films reached the value about 26% and was approximately 3 times greater than the one for gratings formed in the PEPC films.

The absorption gratings were formed in CAM:OMA (60:40 mol.%.) films as well. It was shown that additional activation of CAM:OMA films by chloranyl allowed to reach the value of photosensitivity of 10-3 cm2/J. Selective etching of the holographically recorded gratings led to the increase of their diffraction efficiency up to 20%. For gratings formed by the e-beam recording CAM:OMA films, the post-recorded effect resulted in the efficiency increase. Diffraction efficiency as much as 34% has been obtained for the relief gratings recorded by the e-beam method and formed by chemical etching. Single (N=1) and superimposed crossed (N=2 and N=3) diffraction gratings of 1 μm period were formed on CEM:MMA layers (30:70 mol%) by e-beam recording.

Diffraction efficiency as much as 8-10% was obtained for single gratings formed by the direct e-beam in CEM: MMA films. The SEM study of the surface morphology confirmed that high efficiencies were produced by relief gratings. The threshold character of e-beam recording, yielding the relief gratings of a relatively high efficiency, was revealed for both fresh and aged layers. The value of the diffraction efficiency increased up to 30-34% after chemical etching.

Diffraction structures of superimposed gratings produced multi-beam light diffraction. It was shown that the diffraction efficiency of superimposed gratings exceeded that of single gratings when beam current values were nearby the threshold value of the e-beam current.
Relief grating structures formed by the direct e-beam recording exhibited high stability upon both prolonged dark storage and white light illumination.

A-0035

INTRA-CAVITY-GENERATED TERAHERTZ EMISSION AND ITS TRANSMISSION THROUGH AN ACTIVELY-BIASED TERAHERTZ QUANTUM CASCADE LASER WITH A METAL-METAL WAVEGUIDE

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Terahertz (THz) time-domain spectroscopy (TDS) was employed to probe the multiple-quantum-well active region of terahertz quantum cascade lasers (QCLs), in which the ultra-short THz pulses were generated by a separate low-temperature-grown (LTG) GaAs photoconductive antenna [1, 2]. The coupling of the externally-generated THz pulses into the active region of the QCL via one of the device facets is rather inefficient because of the mode mismatch at the coupling facet, and even prohibitively inefficient in some cases such as coupling into a QCL with a metal-metal waveguide due to its sub-wavelength dimensions. We report in this paper a new approach of generating ultra-short THz pulses - intra-cavity THz pulse generation - by focusing the femtosecond optical pulses from a mode-lock Ti:Sapphire laser directly onto one of the facets of an actively-biased QCL with a metal-metal waveguide. The lasing frequency of the QCL device is 2.1 THz. The device lases up to 90 K in continuous wave mode. The incoming optical photons are absorbed by the GaAs material of the QCL, generating electrons in the conduction-band minibands. The electrons are subsequently accelerated in the high electric field between the top and bottom metal contacts of the externally-biased device, emitting broad-band terahertz radiation. Our experimental results show that ultra-short THz pulses are generated on the QCL facet and immediately coupled into the device ridge waveguide. The THz pulses propagate through the QCL cavity, exit the other facet of the device and are detected using a free-space LTG GaAs photoconductive antenna. The oscillations of the electric field of the THz pulses are observed, which can be attributed to the interaction of the propagating THz pulses with the narrow-band gain medium of the multiple-quantum-well active region of the device. As the device is under different bias voltages, the initial THz pulses could be absorbed or amplified as propagating through the laser cavity.

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A-0036

ANOMALOUS OPTICAL CONDUCTIVITY IN EXOTIC METALS

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Optical conductivities in the near infrared region in some "exotic" metals do not follow the classical Drude's law. The real and imaginary parts of the dielectric constant in the near infrared range exhibit a very complex behavior. In metallic polymers, for example, double zero-crossing in the real part of the dielectric constant has been often reported. We discuss an origin for the anomalous free carrier absorption in metallic states of some oxides, polymers, high-Tc superconductors etc. It is suggested that the coexistence of "localized" and "extended" states for carriers may lead to anomalies in free carrier absorption for this class of materials. It is first shown that an electrical circuit analog using CRL components for conduction processes in exotic metals is useful in understanding the anomalies of optical conductivity: C originates from localized electrons, whereas L and R represent free electrons that experience scattering events. We then show how one can obtain the analytical expressions for the optical conductivity of exotic metals.

By fitting the analytical expressions to the experimental data we have extracted the essential important physical parameters, such as, the numbers of free and localized carriers, the scattering time of free carriers, hopping time of localized carriers, and the Drude dc conductivity of the system. The treatise presented herein sheds light on the anomalous behavior of free carriers in electronically random systems.

A-0037

THE EFFECT OF B_2O_3 ON THE REDUCTION OF EU^{3+} TO EU^{2+} IN ALUMINOSILICATE GLASSES

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We report the luminescent properties of the Eu-doped aluminosilicate glasses. The glass samples were prepared by melt-quenching method. The whole synthesis procedures were performed at 1480 ~ 1550 °C in air condition. The spectroscopic characterization of the glass samples has been made by infrared spectroscopy and fluorescent spectra. Infrared spectroscopy revealed that varieties of the structure of the glasses with the Al_2O_3 replaced by B_2O_3. Emission spectra showed a broad emission band ascribed to the 5d-4f transition of Eu^{2+} ions and sharp emission peaks assigned to the transitions of 5D0□7FJ (J=1,2) of Eu^{3+} ions. The results exhibited that Eu^{3+} ions were partly reduced to Eu^{2+} ions in the glass samples synthesized in air condition. Meanwhile, the emission intensity ratio of Eu^{2+}/Eu^{3+} firstly increased, and then decreased with the increasing B_2O_3 content. In addition, the increase in the content of B_2O_3 resulted in a blue shift of emission wavelength of Eu^{2+} ions.

A-0038

PRODUCTION OF PHOTONIC CRYSTAL FIBER BASED ON HEAVY OXIDE GLASSES FOR NON LINEAR APPLICATIONS

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Photonic crystal fiber (PCF) or microstructured fibers, has been studied widely, either to obtain a high nonlinearity, due the enhancement of optical nonlinearity in PCF achieved by high confinement of light. High nonlinearity fibers achieved by the synergism between the fiber microstructuration and glass composition. In this work, vitreous preforms have been prepared and characterized in the systems based on tellurite, phosphate and lead phosphate glasses, containing high concentration of heavy oxide atoms, such bismuth, lead and tungsten. For the design of performs, an alternative process to the stack and draw is proposed in order to avoid the excess of losses due to this technique. Microstructured performs have been developed by drilling technique, with two different clad microstructuration (hexagonal and triangular shapes), both with a solid core. We will describe elaboration and optical characterizations of oxide glasses photonic crystal fibers, and then discuss about the conditions to be considered to reach low loss highly non-linear oxide glasses fibers, especially concerning the elaboration of performs and the control of the dispersion. The attenuation was obtained and will be presented with a discrete measurement at 1.06 and 1.55 μm as well as a spectral attenuation curve in the near infrared.

A-0039

WHITE LIGHT GENERATION IN RARE EARTH DOPED GERMANIUM BISMUTH TELLURITE GLASSES AND OPTICAL FIBERS

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Recently, upconversion multicolor (red, green and blue) and white fluorescences have been extensively investigated in glasses by doping with different combinations of rare earth ions. In this work, we report the infrared to visible upconversion of Tm^{3+}/Yb^{3+}/ Ho^{3+} Btriply doped germanium bismuth tellurite glasses by exciting with a laser diode at 980 nm. The composition of the host matrix chosen for this study is $65TeO_2$-$15GeO_2$-$10Bi_2O_3$-$5K_2O$-$5Li_2O$. The glass samples were investigated by DSC, Raman scattering, FT-IR and m-line technique to measure the refractive index The glass samples obtained showed high thermal stability against crystallization and good optical properties. Finally, step index optical fibers with triply doped core have been successfully obtained from this system using“sucking method”. Attenuation and fluorescence spectra for optical fiber were obtained.. The dependence of the Tm^{3+}, Ho^{3+}, Yb^{3+} concentrations and ratios on their visible and infrared emissions upon excitation at 980 nm has been studied. Colour tunability as a function of pump power is also reported.

A-0040

OPTICAL DESIGN OF HIGH EFFICIENCY PHOSPHORESCENT ORGANIC LIGHT EMITTING DEVICES BASED ON THE IMPROVEMENT OF LIGHT EXTRACTION TECHNIQUE

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Organic light-emitting diodes (OLEDs) are now widely recognized as a potential application for high quality flat panel displays and general lighting. The internal quantum efficiency of these devices has been achieved near 100% using phosphorescent materials with proper management of singlet and triplet excitons. However, the external quantum efficiency (EQE) of conventional device remains nearly 20% because of losses due to the poor light extraction efficiency. In this paper, it will be shown that the total emission flux out of the OLED is significantly enhanced by proper optical design bases on the multi-scale optical analysis. Namely, three kinds of light extraction techniques were introduced, weak micro-cavity structure, high refractive index substrate and textured micro-lens array in order to transfer the light energy from thin film waveguide mode to substrate mode and eventually to external mode. Surface plasmon-polariton resonance effect induced by near-field evanescent wave was also strictly calculated and controlled to depress optical energy losses in metal cathode.
Our device basically consists of ITO/PEDOT:PSS/□-NPD/CBP:Ir(ppy3)/PBD/LiF/Al thin films. We used two kinds of substrates, one is normal refractive index glass (nS=1.52 @ 550nm) and the other is high refractive index glass (nS=2.02 @ 550nm). The micro-lens array was formed on the backside of the surface as a light extraction layer, which was prepared by wet-etching process. The calculation of optical mode intensity was done by using original simulation software based on wave optics concerning radiation field of electric-dipole. In the case of optimized device with normal index glass, waveguide, substrate and external optical modes were 25 %, 34 % and 41 %, respectively. In contrast, they are significantly changed to 20 %, 65 % and 15 % in the case of high refraction substrate. Although the external mode becomes a little bit lower, but the sum of both external and substrate mode is increased from 59% to 85% by changing the refractive index of substrate. If we can extract out the light trapped in the high index of refraction substrate by employing the mico-lens array, EQE will be rather improved.
In results, the power efficiency of phosphorescent green OLED can be successfully enhanced by these light extraction techniques. The optically optimized device showed maximum EQE of 57% and power efficiency over 200-lm/W. In addition, there is a good agreement between EQE obtained in the experiments and out-coupling efficiency in optical simulation. Detail optical analysis of light extraction technique will be presented by using multi-scal optical simulation method.

A-0041

SYNTHESIS OF EU^{2+}-ACTIVATED MSI$_2$N$_2$O$_2$ (M=BA, SR, CA) PHOSPHORS USING M$_3$SIO$_5$:EU^{2+} AND SI$_3$N$_4$ BY SOLID STATE REACTION

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(Oxy-)Nitride phosphors have received attention as the luminescent materials for white light-emitting diodes (LEDs). This has its origin in the tendency of a metal-nitrogen bond with a high level of covalent bonding. Therefore, a host crystal, including nitrogen and being activated with Eu^{2+} or Ce^{3+}, has the absorption and emission at relatively long wavelengths compared with oxides. Many nitride and oxynitride-based phosphors have already been reported, for example, alpa-Sialon, beta-Sialon, M2Si5N8, $CaAlSiN_3$, (Sr,Ca)AlSiN, $MSi_2O_2N_2$ (M = Ca,Sr,Ba), $LaSi_3N_5$, and $MSiN_2$.
We have been interesting in the development of luminescent materials for white LEDs. In this paper, we report

a synthetic method for a oxynitride phosphor, Eu^{2+}- $MSi_2N_2O_2$ (M=Ba, Sr, Ca). Europium-activated oxynitride phosphors, $BaSi_2N_2O_2$:Eu, $SrSi_2N_2O_2$:Eu and $CaSi_2N_2O_2$:Eu were synthesized using reactants such as M_3SiO_5: Eu (M=Ba, Sr, Ca) and Si_3N_4 by solid state reaction. In general, the phosphor has previously been synthesized MCO_3, Eu_2O_3 and Si_3N_4. The phosphors show green photoluminescence under excitation with blue light and have a potential use for color conversion in white light-emitting diodes. The characterization of the structure, morphology, luminescence, and thermal quenching of the phosphors is investigated.
As a result, we have developed a solid-state reaction approach for which silicate phosphor and silicon nitride can be used as the starting materials. These phosphors absorb near-UV light around 460 nm and emit in the yellowish-green to yellow and are expected to be a luminescent material for the InGaN LEDs that emit light at 400 to 470 nm. Under the excitation of 450nm, $BaSi_2N_2O_2$:Eu, $SrSi_2N_2O_2$:Eu and $CaSi_2N_2O_2$:Eu have the emission peak at 496 nm, 532nm and 560nm, respectively. The relative intensity of the phosphor decreases in the order of Ba, Sr and Ca.

A-0042

PHOTO-INDUCED CHANGES IN ARSENIC SULPHIDE AND DISPERSE RED 1 COMPOSITES

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The method of preparation of thin polymer-photochrome-chalcohenide composite films is described, and some features of photoinduced changes of optical properties and holographic recording in these materials were studied.
Films of composite were obtained from solution of arsenic sulphide, Disperse Red 1 and polymer «Disperbyk-161» (produced by BYK-Chemie GmbH) in organic solvents. The solution was spread on glass substrates and dried at 150 C temperature. The dry film thickness was 4-9 microns, correlation of arsenic sulphide, Disperse Red 1 and polymer in films was according to (in weight. %) 35 ÷ 5 ÷ 60.
The photoinduced changes of optical reflection and transmission of the films was observed and compared with As_2S_3-Disperbyk 161. The surface relief formation under direct influence of light (532 nm) through cylindric lens was studied. The graph of relief height dependence on exposure was made.
The holographic recording of diffraction gratings was performed by laser lines of 532 and 442 nm. During recording the diffraction efficiency of holographic recording was measured simultaneously in transmission and reflection mode. Four-star holographic record was performed and surface relief after that was observed. The profile of the gratings was analyzed by AFM microscope.

A-0043

SRMOO$_4$:ND$_3$+ CRYSTAL: AN EFFICIENT MEDIUM FOR SELF-RAMAN LASER

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An attractive approach to the LD-pumped Raman laser design is the use of the same crystal as the laser active medium and the nonlinear Raman shifter (so-called self-Raman lasers). Our spectroscopic measurements have shown that $SrMoO_4:Nd^{3+}$ crystal has the pump absorption coefficient and the peak emission cross-section favorable for passive Q-switching mode of operation and comparable with those of the $YAG:Nd^{3+}$ crystal. On the other hand, the Raman gain in the $SrMoO4:Nd^{3+}$ crystal (5.7 cm/GW) is competitive with that of YVO_4 and $GdVO_4$ crystals. The performed computer simulations of the passively Q-switched self-Raman operation have

shown that such combination of laser and Raman characteristics of the $SrMoO_4:Nd^{3+}$ crystal is favorable for highly efficient self-Raman lasing.
The growth technique based on Czochralski method was developed to obtain scheelite crystals of high optical quality. The peculiarities of formation of highly doped strontium molibdate single crystals were investigated. The $SrMoO_4:Nd^{3+}$ laser elements with the Nd concentration of 2 wt.% were prepared for spectroscopic and laser experiments. LD pumped laser oscillations in the new $SrMoO_4:Nd^{3+}$ crystal in free-running, passive Q-switched and pulsed self-Raman regimes were obtained and characterized. It was shown that optimal combination of laser and Raman characteristics of $SrMoO_4:Nd^{3+}$ crystal (relatively low laser transition cross-section, long upper level lifetime, high enough SRS gain, and availability of high optical quality crystals) allows to achieve record high performance in self-Raman regime with 20x10-6 J pulse energy and estimated 200 ps pulse duration at 1163 nm, the first Stokes wavelength. Comparison of laser and self-Raman laser characteristics of the SrMoO4: Nd3+ crystal with those of YVO4:Nd^{3+}, $GdVO_4:Nd^{3+}$ and $PbMoO_4:Nd^{3+}$ crystals in the same experimental conditions was performed.

A-0044

DIFFERENTIAL EVANESCENT LIGHT INTENSITY IMAGING OF NANOTHIN FILMS: SIMULATION OF EXTRACTION POWER

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In this work we present the results of evanescent wave optical field scattering simulation by a-Se nanoparticles obtained by Maxwell equation solver FullWAVE [1]. We relate it to the Differential Evanescent Light Intensity (DELI) imaging morphology experimental method developed by us [2,3] as a fast, low cost method for surface morphologys diagnostics of large areas (i.e., hundreds of mm^2) of nano layers of a-Se films. The morphology diagnostic DELI method is an optical microscopy technique based on the capture of the optical field extracted by the nano layer from the evanescent fields extracted from a waveguide by nanolayer on top of it [2,3]. This technique has the advantage over reflective or transmission microscopy that the propagating electromagnetic field in the waveguide does not interfere with the field extracted perpendicular to the substrate surface thus giving an excellent dark background. The method is also easier to use than Atomic Force Microscopy (AFM) and Scanning Electron Microscopy (SEM) and suitable for evaluating large areas of nanometer profiles.

Relating the results obtained by the DELI technique to the simulations of the evanescent wave scattering with the Maxwell equation solver FullWAVE enhances our understanding of the nature of the evanescent wave interaction with nanolayer.

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A-0045

APPLICATION OF THIN FILMS OF CHALCOGENIDE VITREOUS SEMICONDUCTORS IN THE OPTICAL RECORDING SYSTEMS

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For many years thin glasses of chalcogenide vitreous semiconductors were and remain now as one of basic materials of recording media in information carriers for optical information recording systems. To create the first specimens of WORM optical disks the processes of photothermal recording on thin chalcogenide films with a high content of tellurium were widely used. In disk carriers we used 35-nm thick eutectic $Te_{14}Se_{61}Ge_{15}Sb_{10}$ alloy films. Information recording was made by (80-20)-ns duration pulses. Under the action of focused radiation at the wavelength 530 nm the removal of material of an absorbing film from the area of irradiation occurred. Information pits were written down on both sides of tracks. Researches of recorded disks performed in 25 years showed that the shape and sizes of pits were not practically changed, content of oxygen increased insignificantly in the subsurface layer (the general amount of oxygen in material of the recording layer does not exceed 6%). The specimens under investigation retained mirror lustre and high reflection (>35%). So, thin films of chalcogenide vitreous semiconductors can be considered as promising material for optical carriers suitable for long-term information storage.

Nowdays the use of phase transitions to create recordable reversible optical carriers as well as phase transitions and photostructural transformations for making master disks are of the greatest interest. Both when synthesizing the films for carriers with phototermal removal of material from the area of record and preparing the films for reversible recording based on reversible glass-crystal transitions, they try to choose compositions of films made of chalcogenide vitreous semiconductors where minimum photostructural transformations are observed. The effect of photostructural transformations is linear enough, and at multiple addressing to recorded information causes the gradual change in optical characteristics, which ultimately causes diminishing the number of cycles for information reproduction because of gradual destruction of the photosensitive layer.

The photostructural transformations resulting in a sharp change of solubility of thin chalcogenide films can be effectively used in master disks to create relief microimages.As shown by the performed researches, positive inorganic photoresists allow to create relief images with the minimal sizes of 0.15-0.20 μm when recording the radiation with the wavelength of 405 nm, which enables to make stampers for DVD replication from them. The positive inorganic photoresist films possess a sufficiently wide dynamic range. More promising is the use of negative inorganic photoresists that allow to create relief images on nickel substrates, i.e., technology of direct mastering is being realized.

The idea to use high-temperature chalcogenide glasses for making relief microimages on nickel substrates, i.e., creation of nickel stampers without any process of electroforming is offered and experimentally checked up by us. The performed experiments showed high mechanical and thermal strength of relief images obtained on high-temperature chalcogenide glass. In the process of stamping the molten polycarbonate, changes of geometrical sizes of bumps on the surface of nickel substrate were not observed.

A-0046

SPECTRAL-LUMINESCENT PROPERTIES OF NOVEL SALICYLIDENEIMINOSPIR OPYRANS

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The spectral-luminescent properties of novel spiropyrans, modified by substitutes -hydroxyazomethine fragment- in 5' position were investigated. The novel compounds - 6-R-5' (5-R-salicylideneimino)-spirobenzopyranindoles (BF1- R=Br, BF2 - R=NO_2) and 5-(2-hydroxynaphthylmethyleneimino)spiroindolenaphtopyran (BF3) - were synthesized by one- step reaction /1/. According to the synthesis the same R are included in spiropyran part of BF and in the hydroxyazomethine fragment. The comparative study of absorption and stationary photoluminescence(PL) spectra of BF, corresponding R- substituted spiropyran and R -substituted azomethines as model structures was performed. The influence of substituent R and solvent polarity on absorption spectra and PL properties was investigate. It was shown that the long wave absorption band of the new compounds was determined by asomethine fragment conjugated with indole ring of spiropiran part of BF molecular. Substituent R in hydroxyazomethine fragment influences the long- wave band position of BF, but the presence of the same R in pyran part determines this band position in the photoinitiated merocyanine form absorption spectrum. All compounds fluoresced because of hydroxyazomethine fragment presence, not only in solid phase, but in liquid solvent at 293K also. Excitation within the absorption spectrum of enol form of azomethine fragment produced the Anomalous Stokes-shifted fluorescence, that is the evidence of emission from product of the ESIPT reaction proceeded in this fragment. The fluorescence quantum yield of BF1 presented in all solvents exceptionally in enol form was estimated at 293K in toluene and PMMA film.

Fractions of BF2 and BF3 with keto form of hydroxyazomethine fragment increased in the solvent with proton donating ability and particularly in the case of BF3. Excitation of the ground state of enol and keto tautomers at 293K lead to the same main band in PL spectrum. The PL of BF3 was sensitive to the solvent polarity and showed temperature dependent position of emission maxima in glass solvent.

Besides the main long - wavelenght PL (maximum spectral position 510-550 nm) caused by exited state of êeto form obtained directly from its S0 state and via the ESIPT reaction under excitation of the enol form short - wavelength emission (420-460 nm) was also observed. We believe that this short - wavelength emission , most intensive in the case when R- nitro groupe comes from the exited enol form of hydroxyazomethine fragment.

The PL spectra of BF3 showd two maxima in the main band of PL at 293 K, more pronounced at 77 K , that permitted to suggest the presence the BF3 with two structural forms of exited state of keto tautomer . The comparison of spectral -luminescent properties of the new compounds with early received one /2 / on the basis of spironaphthoxazines and the same hydroxyazomethines was performed.

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A-0047

HIGH DENSITY „LIPPMANN" DATA STORAGE IN THICK HOLOGRAPHIC MATERIALS

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Lippmann interference photography is a, more than one century old, colour photographic process [1]. In spite of this oldness, we decided to revisit this photographic process and to evaluate its ability to use it for mass data storage. Lippmann photography indeed shares many features with Denisyuk volume holography used for high density data storage [2]. In this photographic process, a lens images the scene onto a mirror set in contact with a thick photographic plate. The incident beam thus interferes with its reflection and records a small Bragg grating inside the thickness of the sensitive layer. The mirror is then removed and the photographic plate is processed. Illuminating this processed plate with white light reproduces the coloured scene thanks to the Bragg wavelength selectivity. Thus, similarly to holography, the colours are recorded by interferences. Nevertheless, contrary to holography, an additional reference beam is not required.

We are not the first to propose the Lippmann architectures for data storage [3,4]. Nevertheless, all the previous proposals were implemented in a bit oriented approach in which a focused beam records a series of wavelength multiplexed Bragg gratings, the coherence length for each wavelength being larger than twice the material thickness. Stacks of Bragg gratings are juxtaposed by moving the recording beam at other locations. We previously demonstrated that, with such an approach, increasing the material thickness does not improve the storage capacity.

In order to increase the capacity we now propose to implement Lippmann data storage by wavelength multiplexing pages of data at each location [5]. We demonstrate that if the depth of focus of the images is smaller than the material thickness, then noise appears during image readout. It originates from the fact that the reference beam used for reading out is a plane wave, while, during the recording process, the image beam itself acts as the reference. Nevertheless, we show that this noise can be kept at a reasonable level for data pages correctly formatted; typically binary amplitude images with a uniform phase. Data can then be retrieved without ambiguity whatever the material thickness. The wavelength selectivity of these recorded images is then similar to the Bragg selectivity of uniform reflection gratings. We thus anticipate that the capacity of Lippmann storage in thick holographic material should be the same as for conventional wavelength multiplexed holographic materials. First experimental tests will be presented.

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A-0048

GENERALIZED ONSAGER-FRENKEL RECOMBINATION OF OPTICALLY GENERATED ELECTRON-HOLE PAIRS

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Mechanisms of charge carrier generation and recombination are of decisive importance for optoelectronic phenomena in organic and inorganic amorphous semiconductors with an incoherent transport mode. The current state of the theoretical research on the dissociation/recombination processes in disordered semiconductors will be given in the talk.

The problem of the dissociation of geminate electron-hole pairs is closely related to the problem of carrier injection into semiconductor out of a metallic contact. The central question in both cases is how electrons escape from the Coulomb potential via a series of incoherent hopping transitions between spatially localized states. In the case of pair dissociation, the Coulomb potential is created by the geminate hole, while in the case of electron injection the potential is created by the image charge within the metallic contact. A solution of the dissociation/recombination problem is of vital importance for the physics of molecular solar cells, organic light emitting diodes, polymer field effect transistors, and other optoelectronic molecular devices.

It has become almost a routine procedure to describe the dissociation/recombination and injection phenomena in disordered materials using either Onsager, or Frenkel models. However the results of Frenkel and Onsager are based on the assumption that the system can be treated as a homogeneous media and they do not include disorder effects. It will be shown in the talk how to take into account the disorder effects for the dissociation/recombination problem in amorphous materials. In particular, a rigorous universal theoretical description of the dissociation problem for electron-hole pair on a one-dimensional chain in the hopping regime will be considered [1].

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A-0049

OPTICAL FUNCTIONALISM OF AZOPOLYMERS OF DIFFERENT GENERATIONS: PHOTOINDUCED ORIENTATION AND HARMONIC GENERATION

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We report on second and third order optical non-linearities investigated in E-O active polymer materials, which show potential for optical storage. Chromophores containing azo junction, i.e. four generations of polyester type dendrimers, (phenylazo)carbazoles, were used for all optical poling. Samples investigated were prepared as guest-host type system based on polycarbonate matrix spin-coated on a glass substrate. Molecular orientation and subsequent relaxation kinetics in both „dark“ and „light“ mode for different energies of the optical poling beams (fundamental and second harmonic of YAG laser) were measured [1]. The effect of saturation of optical poling at elevated excitation intensity was shown and analyzed. Therefore, shortening of the relaxation time with the energy of reading beam in the “light” mode was experimentally confirmed. On the basis of experimental

results a phenomenological model of photoinduced poling dynamics was developed. Given the intensities of fundamental and second harmonic field used for poling and the fundamental one for reading, generation and relaxation of second and third order non-linear optical susceptibilities have been studied. Parameters up to the fourth order for cis and trans orientation obtained from modeling were analyzed and identified with consequent molecular feature. Experimentally third harmonic generation was used to obtain third order optical nonlinearity of the material. Using Maker-Fringes technique oscillations in the third harmonic generation intensity produced from a structure "substrate-film" as a consequence of variation in the incidence angle for the excitation beam were measured. Exciting samples with the fundamental wavelength (1064 nm) cubic non-linear susceptibility values in the range of 1×10^{-21}-1×10^{-20} m^2/V^2 for different generations of dendrimers and other guest materials in polycarbonate were obtained and compared (calculations performed using method proposed by Wang [2]). In summary, the most important result was to place the new optical materials investigated and characterized among the well known non-linear optical materials.

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A-0050

ON THE URBACH RULE AND DISORDERING PROCESSES IN $A_{S2}S_3$ THIN FILMS

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As_2S_3 glassy semiconductors, due to interesting photostimulated structural changes being revealed in their optical properties, have found wide practical applications as efficient materials for optical data recording, holography, integrated optics.

As_2S_3 films were sputtered onto a non-heated glass substrate by vacuum thermal evaporation, the film thickness being 1-2 micrometres. The transmission spectra of the As_2S_3 thin films were studied in the temperature interval 77-300 K by a MDR-3 grating monochromator; a UTREX cryostat was used for low-temperature studies.

Based on the interference transmission spectra, the spectral dependences of optical absorption coefficient as well as refraction index dispersion dependences were studied in the temperature interval 77-300 K. The Urbach behaviour of exponential parts of the optical absorption edge is observed. The Urbach rule parameters are found, temperature dependences of optical pseudogap (the exponential absorption edge energy position at the fixed absorption level 1000 cm^{-1}) and Urbach energy (the energy width of the exponential absorption edge) are obtained; at T=300 K the values are 2.318 eV and 109.4 meV, respectively. The optical pseudogap nonlinearly decreases with temperature, while the Urbach energy nonlinearly increases. It is shown that the absorption edge temperature changes are determined by electron-phonon interaction, which is strong in the materials under investigation. The temperature dependences of the optical pseudogap and the Urbach energy are well described within the framework of Einstein model, the corresponding parameters are determined.

The Urbach behaviour of optical absorption edge in amorphous materials is determined by temperature-related and structural disordering. The structural disordering is related to the absence of long-range order, the presence of defects, inhomogeneities and pores. The absolute value of the structural disordering contribution to the Urbach energy at T=300 K is 57.3 meV, whereas its relative contribution is 52.4%. The comparison of absorption edge in three-dimensional and two-dimensional As_2S_3 shows that, unlike glassy As_2S_3, in which

the Urbach behaviour of the absorption edge is observed at T>250 K, in thin As_2S_3 films the Urbach bundle is observed already from low temperatures. It is shown that the optical pseudogap value in the thin films is slightly smaller than in the glass, while the Urbach energy is more than twice greater. At the transition from the three-dimensional to the two-dimensional As_2S_3 electron-phonon interaction substantially increases.
From the analysis of the interference transmittance spectra, the dispersion dependences of the refractive index are obtained. The dispersion dependences are well described by the optical-refractometric relation, relating the refractive index, the optical pseudogap, and the energy of the valence electron plasma vibrations. The refractive index increases with temperature at a rate $dn/dT= 2.4\times10^{-4}$ at the wavelength 750 nm.

A-0051

STRUCTURAL AND TEMPERATURE DISORDERING STUDIES OF CU_6PS_5I SUPERIONIC THIN FILMS

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Cu_6PS_5I compound belongs to argyrodite family and is known as a superionic conductor. They are promising materials for creation of solid-state batteries, electrochemical and optical sensors on their base. Cu_6PS_5I single crystals were grown using chemical vapour transport. The films were deposited onto glass substrates by non-reactive radio frequency magnetron sputtering. The film growth rate was 3 nm/min, the film thickness 0.5-0.6 micrometres. The deposition was carried out at room temperature in Ar atmosphere. The structure of the deposited films was analyzed by X-ray diffraction; the diffraction spectra show the films to be amorphous.
Optical transmission spectra of Cu_6PS_5I thin films were studied in the interval of temperatures 77-300 K by an MDR-3 grating monochromator, a UTREX cryostat was used for low-temperature studies. From the temperature studies of interference transmission spectra, the spectral dependences of absorption coefficient as well as dispersion dependences of refractive index were derived. It is shown that the optical absorption edge spectra in the range of their exponential behaviour in amorphous Cu_6PS_5I thin films, similarly to the single crystals, are described by Urbach rule. At T=300 K, the optical pseudogap value in Cu_6PS_5I thin film equals 2.008 eV while in the single crystal it is 2.079 eV; the Urbach energy in Cu_6PS_5I thin film is 217.5 meV while in the single crystal it equals 19.3 meV.
The temperature behaviour of the Urbach absorption edge in $Cu6PS_5I$ thin films is explained by electron-phonon interaction which is strong in amorphous films. It should be noted that in Cu_6PS_5I single crystals the Urbach absorption edge is formed by exciton-phonon interaction. The enhancement of the exciton-phonon interaction in two-dimensional film structures leads to the exciton vanishing and, as a consequence, the Urbach absorption edge is formed by electron-phonon interaction.
.It is shown that in amorphous films the Urbach behaviour of the absorption edge is observed in the temperature interval 77-300 K while in single crystals it is observed only in the superionic phase at T>180 K. An essential characteristic of the absorption edge spectra of the thin films under investigation is a lengthy Urbach tail which results in the Urbach energy being more than by an order of magnitude higher than that in the crystal.
It should be noted that the absolute value of the contribution of static structural disordering into the film Urbach energy increases by factor over than 19 in comparison with the single crystal while its relative value grows from 49.7% in the single crystal to 85.5% in the film. Static structural disordering in Cu_6PS_5I thin film increases due to (1) the absence of long-range order in the atomic arrangement and chemical bond breakdown; (2) lower density of the atomic structure packing due to the presence of pores; (3) the transition from the three-dimensional bulk structure to the two-dimensional planar structure.

A-0052

LUMINESCENCE AND OPTICAL ABSORPTION STUDIES OF SULPHUR-IMPLANTED CU_6PS_5X (X=I, BR) SUPERIONIC CONDUCTORS

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Cu_6PS_5X (X=I, Br) compounds with argyrodite structure are characterized by high ionic conductivity due to the structural disordering of the crystal lattice. They are well known as ferroelastic and nonlinear optical materials. Cu_6PS_5X (X=I, Br) single crystals were grown using chemical vapour transport. Implantation of Cu_6PS_5X (X=I, Br) crystals with 149 keV 32S+ sulphur isotope ions was performed using an experimental set-up with magnetic separation and variable accelerating voltage. The pressure in the chamber was 9.6x10-6 Torr, the incidence angle 10°.

Using scanning electron microscopy, we observed the ion implantation with the $32S^+$ ion fluence of 1x1015 ions/cm^2 to result in the formation of 5- to 15-micrometre microcrystals on the Cu_6PS_5I single crystal sample surface. The implantation-induced structural defects can be distinguished from the proper growth defects, the characteristic size of the latter being from 50 to 250 mm. Spectral dependences of luminescence and optical absorption edge were studied in the temperature interval 77-300 K using an MDR-3 grating monochromator; a “UTREX” cryostat was used for low-temperature measurements. The studies of optical absorption edge show it to have exponential shape in the temperature interval under investigation, while in the superionic phase the temperature behaviour of the exponential parts of the absorption edge is described by the Urbach rule. The parameters of exciton-phonon interaction, resulting in the Urbach behaviour of the optical absorption edge, are determined. The temperature dependences of the optical pseudogap and the Urbach energy are analysed in the framework of the Einstein model. The implantation effect on the absorption edge parameters as well as on the parameters of exciton-phonon interaction in Cu_6PS_5X (X=I, Br) superionic conductors is studied. In the photoluminescence spectrum of unimplanted Cu_6PS_5I crystal, measured at the excitation by a semiconductor laser operating at 532 nm at T=80 K in the energy range 1.5-2.1 eV, a wide impurity-related band is observed, which corresponds to a “band-to-local centre” transition (the recombination of a free charge carrier with the other one bound to a local centre). With temperature there is a noticeable temperature luminescence quenching, the impurity luminescence band shifts towards the higher energy, broadens, decreases in intensity and completely smears out at 120 K. In the implanted crystals (at the fluence of 1x1013 ions/cm2), the high-energy shift of impurity band, its broadening, and a more rapid temperature quenching of the luminescence are observed.

In the photoluminescence spectrum of the unimplanted Cu_6PS_5Br crystal at T=80 K a wide impurity-related band is revealed at 2.0971 eV. Implantation of this crystal by sulphur ions (with the fluence of 1x1013 ions/cm^2) results in an appearance of a broader lower-frequency defect-related band at 1.8343 eV. With the fluence increase, a complicated redistribution of intensities between the bands is observed as well as the variation of their spectral positions and halfwidths.

A-0053

CONTACT METAL AND PHOTOCONDUCTOR THICKNESS DEPENDENCE OF DARK CURRENT IN MULTILAYER STABILIZED AMORPHOUS SELENIUM PHOTOCONDUCTORS USED IN X-RAY IMAGE DETECTORS

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Commercially available, direct conversion, flat panel, x-ray image detectors use a layer of stabilized amorphous selenium (a-Se) sandwiched between electrodes to convert absorbed incident x-ray radiation into an amount of electrical charge proportional to the intensity of the incident radiation. This charge is collected on a storage

capacitor and read off, pixel by pixel, by scanning electronics to form an image on a computer screen. To increase the x-ray photogeneration efficiency and to drift the photogenerated charge carriers, a large electric field is applied across the a-Se layer, resulting in a significant dark current which has several adverse effects on device operation. n-type and p-type blocking layers are used to block the injection of holes and electrons respectively from the contacts, thus reducing the dark current to less than 0.1 - 0.5 nA/cm^2 which is required for acceptable device operation. The resulting dark current measured in this n-i-p structure has been shown to decay non-exponentially with time from the application of bias, to have a sub-linear dependence on the applied field and a dependence on contact metal which is not clearly correlated to the work function of the metal [1].
A set of three samples with varying thicknesses approximating the n-i-p a-Se structure used in mammographic x-ray detectors has been created. These samples have total thicknesses of 70, 120 and 320 μm, each with a 10 μm thick n-type blocking layer made from alkaline doped a-Se and a 2 μm thick p-type blocking layer made from a-As2Se3. The p-type layer is between the intrinsic layer of a-Se and the ITO substrate while the n-type layer is between the intrinsic layer and the top contacts. Contacts of Cr, Al, Au and Pt have been deposited on each sample. In this way, the dark current transients can be studied as a function of different combinations of nominal electric field, sample thickness and contact metal. The results of this study are analyzed to determine the contributions to the dark current from Schottky emission at the contacts and thermal generation in the bulk. These results provide new insight into the dominant factor contributing to dark current in multilayer stabilized a-Se x-ray photoconductors.

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A-0054

APPLICATION OF SCINTILLATOR IN ABSOLUTE MEASUREMENT OF PULSED GAMMA-RAY

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Absolute measurement of pulsed fission gamma-ray with a spectrum during the pulse time is challenging, it can be used to diagnose the time behavior of the nuclear reaction. In the absolute measurement of the fluence-time curve, the sensitivity of the detector should be energy independent. Based on the scattering electrons and scintillator thin film, a new scattering method suitable for measuring high intensity pulsed gamma-ray sources is proposed. Tungsten target and a scintillation thin film are used in this method. The target with thickness of 0.1mm is hung perpendicularly to the beam and a fast organic scintillator (ST401) film is placed parallelly to the axis of the beam. When a collimated gamma-ray beam passes through the collimator and impings on the tungsten target, secondary electrons, including photoelectrons, Compton electrons, and Auger electrons, are ejected from the target. Their directions are diversitified by multiple Coulomb scattering. Part of the scattered electrons can reach the scintillator and deposit energy when they penetrate the thin film scintillator, and the resulting scintillation is transformed into electric signal by a photoelectric device. The performances of the detector under several conditions were studied by Monte Carlo simulation using the MCNP code, the detector has a relatively flat energy response in the range 0.4 to 5 MeV. Using Co-60 1.25MeV gamma ray, the sensitivity for the detector with organic scitillation ST401 and photodiode is measured to be 5.46E-21C•cm2.
Key words pulsed gamma; scintillator; scattering electron; energy response; MCNP

A-0055

TWO-PHOTON MATERIALS FOR MULTILAYER OPTICAL DATA STORAGE

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Multilayer recording of information is one of the ways of development of high capacity optical data storage. But, this method demands special characteristics of registration materials, such as predominantly phase character of modulation, and the usage of threshold or nonlinear mechanisms of recording. In the present work we expose our results of experimental studies of two-photon recording of microholograms in photopolymer material and undoped lithium tantalate crystals. The application of two-photon absorption makes it possible to carry out recording spatially homogeneous on depth and to use a dynamic range of material effectively. Two-photon recording of microholograms in thick (100-200 μm) samples of photopolymer, containing new and effective photoinitiators on a basis of cationic thioxanthone derivatives was demonstrated. The two-photon absorption cross-sections of these chromophores were measured and the value as large as 252•10-50 cm4•s at 532 nm was obtained. The sequences of microholograms were recorded in the area of photopolymer material, arbitrary on depth, with pulse laser radiation at 532 nm. The size of the transmission microhologram was 1.0•1.4•6.4 μm. The microholograms are detected with the collinear optical heterodyne technique [1]. Two-photon holograms were recorded with large refractive index change 4.8•10-3, and high holographic sensitivity S = 1.2 cm/J. The recording has threshold character. The value of the threshold for one of the chromophore was estimated as 1.2 GW/cm2. The study of the evolution of the refractive index change during recording, and its dependence on intensity permits to testify the two-photon character of recording. We have demonstrated the two-photon holographic recording and nonvolatile reading in undoped lithium tantalate crystals with different composition. The microhologram size is 1.0•1.4•10 μm. The maximum light intensity in the region of recording is I = 5.8 GW/cm2. Holographic characteristics strongly depends on the Li/(Li + Ta) ratio. Even though the underlying photorefraction mechanisms in undoped lithium tantalate remain unclear, the experimental results show that two-photon recording provides high values of refractive index change 2.1•10-3, holographic recording sensitivity S = 1.3 cm/J, and recording time constant 24 ns. The last value shows that two-photon interband photoexcitation of electrons leads to much faster photorefractive response time in contrast to the case where charges get photoexcited from midgap impurity centers. The two-photon recording in all materials under investigation is carried out spatially homogeneous on the depth and unlike the case of linear absorption, in this case the saturation values of refractive index change can be reached in every layer.

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A-0056

OPTICAL PROPERTIES AND PHOTO- AND X-RAY LUMINESCENCE OF SM3+-DOPED CHALCOGENIDES

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Indirect conversion x-ray detectors using a scintillating phosphor are of interest in a wide number of applications, from medical imaging to nondestructive testing. In this paper, we report a new X-ray scintillator material whose composition is based on Sm-doped chalcogenides. These are partly crystallized glass ceramics prepared

by melt quenching techniques. Optical characterization of the samples was carried out at room temperature by measuring the transmission spectra. The photoluminescence emission spectra of S-Ga-Ge glasses ,S-Ga-Ba (SGB) and S-Ga-Ge-CsI glasses ceramics exited at 405 nm (20mW laser power) have been obtained. Photoluminescence emissions at 565, 600, and 650nm bands were identified and attributed to transitions from 4G5/2 to 6H5/2, 6H7/2, and 6H9/2 respectively in Sm3+. The PL intensity from SGB material is about 10 times stronger than that from S-Ga-Ge glasses doped Sm3+. The X-ray luminescence could be detected from the SGB glass ceramic samples under an excitation from Cu target X-ray tube (40kV, 200mA power). The red light XL was clearly visible in the dark.

A-0057

SPACE POLARIZATION AND NONLINEAR ABSORBABILITY OF HYROTROPIC CADMIUM DIPHOSPHIDE CRYSTALS

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The wideband gyrotropic cadmium diphosphide crystals posses much higher linear and nonlinear polarizability and also the gyrotropy in comparison with other known nonlinear crystals, due to what find wide application for development the devices of quantum electronics and nonlinear optics. Having the practical inertionless of light transmission, allow to realize an instant feedback on a working field of radiation, that forms the basis for functioning a number type of devices of laser engineering, such as stabilizers of temporary and spatial distribution of intensity of light beams, nonlinear elements for control of the duration of lasers pulses generation, correctors of cross distribution intensity of a flow of radiation etc. The properties of these devices depend both on a direction of the light beams propagation and from orientation of an electrical vector of a light wave on an optical axis of crystals (azimuth of polarization). For definition perspective of the crystals use at correlators manufacturing, optical allwaves of transpositions and keys the knowledge both spatial and azimutal dependences of absorption ability is necessary. In the report the results of complex researches as technologies of fabrication and control of the cadmium diphosphide crystals optical quality and their application for development of such elements of quantum electronics and nonlinear optics, as stabilizators of temporary and spatial distributors of light beam intensity, nonlinear elements for management and control of duration of pulses of generation of lasers are given. Both of such devices function on mutual display of two nonlinear optical phenomena, namely: twophoton absorption of light and selfinduced rotation of a plane of polarization of high intensity laser beam radiation (nonlinear gyrotropy). The first phenomenon is effective in materials with forbidden gap higher than quanta energy but lower it's double value. As the band gap of CdP2 is equal to 2,02 eV, this condition is valid for light beams emitted by ruby (h□ =1,79 eV) and neodymium (h□ =1,17 eV) lasers. The technique of measurement the azimutal dependence of efficiency the linear and twophoton absorption, and also their intensitive dependences near to a threshold of crystals destruction is briefly described. The materials with high efficiency of two-photon light absorption and natural optical activity (natural gyrotropy) are necessary for observing the nonlinear gyrotropy. Firstly this phenomenon was discovered by using of high optical quality CdP2 crystals for the light beam propagation along the it optical axes ([001] crystallography direction). The nonlinear optical phenomena were investigated only in crystals CdP2 of tetragonal modification (class of symmetry 422 or D4). The measurements were carried out on cleavages or natural mirror-like cadmium diphosphide platelets with an area 10x15 mm2 and the thickness varying from 0.1 up to 3 mm. In some cases it's frontal surfaces were polished up to a high class of optical quality.

A-0058

ELECTRON INJECTION INTO HOLE-TRANSPORTING LAYER FROM EMISSION LAYER IN ORGANIC LIGHT EMITTING DIODES

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Green electroluminescence (EL) from tris(8-hydroxyquinoline) aluminum (Alq3) has been observed in organic light emitting diodes (OLEDs) with device structure of ITO/NPB/Alq3/Li/Al. In this OLEDs, N, N'-bis(1-naphtyl)-N, N'-diphenyl-1,1'-biphenyl-4,4'-diamine (NPB) is used as hole-transporting layer and Alq3 is used as not only electron-transporting layer but also emission layer. No EL is observed from NPB. It has been suggested that the EL of NPB is due to block of electrons from electron-transporting layer by NPB because of wide LUMO gap between NPB and Alq3.

To confirm this suggestion and to investigate how to inject the electrons into the hole-transporting layer, we fabricated OLED with an emission layer of NPB lightly doped with red-phosphorescence emissive tris(1-phenylisoquinolinato-C2,N) iridium [Ir(piq)3], and compared its EL and photoluminescence (PL) characteristics with the case of OLED without Ir(piq)3 emission layer. The fabricated OLEDs are ITO/NPB (50nm)/NPB: x % Ir(piq)3 (20nm)/Alq3 (30nm)/Li (5nm)/Al (called Device A) and ITO/NPB (50nm)/Alq3 (30nm)/Li (5nm)/Al (Device B), where x = 1, 0.5 and 0.2. Such very low concentrations were chosen to avoid stronger emission from Ir(piq)3 by energy transfer from NPB host than host emission and to enhance emission from the host to obtain dual emission from the emitting layer.

EL emission due to Ir(piq)3 is observed at 611 nm in device A, but no emission from the host. Additionally, like the case of Device B, 540 nm green emission from the Alq3 electron-transporting layer was observed. The red emission intensity increases with increasing the concentration, which was obtained at luminance of 1000 cd/m2, while the green emission decreases. A greenish white emission light was obtained at x=0.5.

These results are interpreted as follows. The lowest unoccupied molecular orbital (LUMO) energy gap between Ir(piq)3 and Alq3 is much smaller than the gap between NPB and Alq3, giving rise to easy injection of electrons from Alq3 to Ir(piq)3. The highest occupied molecular orbital (HOMO) energy of Ir(piq)3 is higher than that of NPB, leading to enhance trapping of holes from 50 nm thick NPB hole transport layer and reduce the hole injection into Alq3 layer. Electron confinement in the electron-transporting layer induces the emission from Alq3.

Therefore, it is confirmed that no emission of NB in Device B is caused by wide LUMO energy gap between NPB and Alq3. The PL spectra of Device A indicate that Ir(piq)3 molecules are uniformly dispersed in NPB layer.

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A-0059

LIGHT - SENSITIVE ORGANIC RECORDING MEDIA FOR 3D OPTICAL MEMORY

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Progress of the information technique requires increasing its possibility to storage the large data massive and fast processing. It may be achieved by the change of present two-dimensional (2D) optical memory by three-dimensional (3D) one providing bit density more 1 □bit/□m3. It is achieved with the use of two-photon writing down of optical information in volume recording media instead of one-photon recording. This paper presents the current state of the development in the field of organic recording media for bitwise working (WERM) and archival (WORM) optical memory including owned advances. The main direction of this development is connected with preparation of light-sensitive organic polymer materials. For the development of recording media for bitwise WERM optical memory thermally irreversible photochromic compounds from diarylethene, fulgide and fulgimide classes manifesting reversible photoinduced valence are used For making WORM optical memory leucodyes, chromons and etc. which form fluorescent products from nonluminescent compounds during irreversible photochemical reaction under laser UV irradiation are suggested. Owned investigations allowed to develop two types of photochromic recording materials based on diarylethehes with nondestructive refractive and fluorescent readout of optical information, accordingly. Polycarbonate, polyurethane and poly(methyl methacrylate) were used as polymer binders. The materials of the second type beside photochromic compounds contain organic phosphor from phenolenone dyes. Its absorption band is situated in the spectral region outside absorption bands of initial and photoinduced forms of diarylethene. But the fluorescence spectrum collides with the absorption band of the diarylethene photoinduced form. Recording media for bitwise archival optical memory were prepared with the use of organic chromons transforming from nonluminescent state into the fluorescing photoproduct. The samples of multilayer photochromic recording media based on developed photochromic materials have been prepared with the use of the spin-coating method for preparation light-sensitive layers and the photopolymerization method for making wave-guide layers. These samples were tested with positive results using the developed device of optical memory. This device includes Nd - laser and provides generation of two- and three-harmonics of laser irradiation. The analysis received results is evidence of the real perspectives for making multilayer optical discs for bitwise working (based on photochromic materials) and archival (based on irreversible photofluorescent materials) two-photon optical memory with information capacity of more 1 TB per the standard optical disk.

A-0060

ULTRAHIGH-SENSITIVITY HARP PICKUP TUBES USING AVALANCHE MULTIPLICATION IN AMORPHOUS SELENIUM PHOTOCONDUCTIVE TARGETS AND THEIR APPLICATIONS

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For image sensors, the higher the sensitivity of the device, the brighter the image obtainable, even for dark subjects. Because of this, increasing sensitivity has always been the most important theme throughout the more than 80-year history of research on image sensor devices. NHK Science and Technology Research Laboratories set out at the start of the 1980s to research new image sensor devices that could achieve both ultrahigh sensitivity and high image quality. As a result, in 1985, the author discovered that if an amorphous selenium photoconductive target in a pickup tube is operated in a strong electrical field of about 10^8 V/m, a continuous and stable avalanche-multiplication effect occurs, yielding extremely high sensitivity while maintaining good image quality. Based on this, we developed and implemented a ultrahigh-sensitivity, high-image-quality sensor called the HARP (High-gain Avalanche Rushing amorphous Photoconductor) pickup tube. HARP pickup tubes are used in broadcasting for subjects such as reporting breaking news at night, shooting aurora and nocturnal animals, and also for advanced research in various fields, such as deep-sea exploration and research, medical x-rays for early cancer detection, and biology research to develop new medicines.

In this presentation the author will discuss the circumstances surrounding the discovery of the HARP technology and the characteristics of today's ultrahigh-sensitivity HARP pickup tubes, with performance improved over the many years of subsequent research. The author also introduces applications in various fields using this very sensitive imaging technology.

A-0061

PHOTOCHROMIC ORGANIC SYSTEMS BASED ON NEW NAPHTHOPYRANS FOR OPTICAL METAL SENSING AND LIGHT MODULATION

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Photochromic naphthopyrans are an important class of photosensitive organic compounds and the particular interest of them due to their efficient colorability, rapid reversibility, good fatigue resistance, photostability with relation to irreversible photochemical reaction and light-sensitivity. Usually application of such compounds is rather wide and is connected with the development of ophthalmologic plastic glasses and optical information technologies. This paper is devoted to the development of photochromic systems base on derivatives of naphthopyrans synthesized by us for making reversible optical chemosensor on metal ions. Photochromic transformations of these compounds include reversible the photoinduced formation of merocyanine colored form B from the colorless spiropyran form A under UV irradiation. This application is based on a complexation of only photoinduced form B with metal ion. The sensing effect is manifested in a change of absorption band position and, consequently, a solution color depending on the metal nature. In the frame of this science 5 new functionalized 5-cycloalkilaminocarbonyl- substituted 3,3-diaryl-3H-naphtho[2,1-b]pyranes were synthesized and studied of their functional properties in toluene, acetonitrile and poly(vinylbutyral). The long-wavelength absorption of the spiropyran form is found to be in the range of 360-365 nm and is not significantly affected by the compound structure. The photoinduced merocyanine form is characterized by absorption band maximum at the spectral range 460- 510 nm. It was found that over metal ions this absorption band is moved to the long-wave spectral diapason (595-730 nm). The values of the bathochromic shift depend on an ion type and may be used for selective optical sensing each cation in solution. It was found that the complexation process is realized in the polymer matrix namely poly(vinylbutyral). It is very important that unlike photochrochromic solutions, photochromic polymer systems, containing metal ions are characterized drastically enhances of photostability to irreversible photochemical transformations of photochromic naphthopyrans. The received results allow to suggest synthesized the naphtopyrans for the development of optical chemosensors on metal ions in solutions and for making photochromic polymeric light modulators with low fatigue.

A-0062

PHOTOFLUORESCENT ORCANIC MATERIAL FOR OPTICAL DISKS

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Spectral-kinetic, photochemical, technological studies of 35 light-sensitive chromone derivatives and polymeric systems based on the best compounds of this type were carried out. The initial state of chromones do not exhibit fluorescence, but these compounds undergo irreversible photochemical transformations under UV irradiation to give fluorescent photoproduct , that provide multiple fluorescent readout of optical information. The influence of the structure of the compounds on the spectral and luminescence properties was established. It was showed a possibility to shift absorption bands of the chromones and its photoproduct in the spectral range 300-390 nm and 400-450 nm by changing their structures that gives an opportunity to use the most appropriate laser sources for optical data recording. As a result of technological studies the photofluorescence light-sensitive polymeric material was developed.. It was established that the fluorescent efficiency depends on the polymer nature. Using chromones with the best spectral-kinetic characteristics and poly(methyl methacrylate) the experimental

samples of photofluorescent polymeric materials were prepared. The prepared samples were tasted with the positive result using a prototype of the archival optical memory device. The developed photofluorescent materials are used for the development multilayer photofluorescence recording media which contain alternate light-sensitive and wave-guiding polymer layers providing layered writing and fluorescence readout of optical information. These media are suitable for the design of advanced multilayer optical disks of the WORM type with high information capacity more than 1TB.

A-0063

RAMAN SCATTERING CHARACTERIZATION OF ZNSE/ZN$_{0.6}$CD$_{0.4}$SE MULTILAYERS PREPARED BY THERMAL VACUUM EVAPORATION

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Ternary alloys from II-VI semiconductors (e.g. ZnCdSe, ZnSSe) are an important class of materials which are applicable in fabrication of optoelectronic devices, as well as in fabrication of solar cells, thin film transistors, etc. Ternary ZnCdSe can be put into zinc-selenide based quantum structures, which have demonstrated considerable promise as short-wavelength light sources, fast switching devices, etc. The interest in inclusion of these alloys in low-dimensional structures is high since they have some advantages over binary compounds (e.g. ZnSe, CdSe) because their lattice constant and optical properties can be varied by changing the composition. Research work on developing synthesis routes for preparation of ternary ZnCdSe alloys is based mainly on application of molecular beam epitaxy and electrodeposition techniques.

In this study, ZnSe/Zn$_{0.6}$Cd$_{0.4}$Se multilayers (MLs) with three different layer thicknesses (3.5, 5.0, 10.0 nm) and, for comparison, 400 nm thick Zn$_{0.6}$Cd$_{0.4}$Se layers have been prepared. The ternary layers were deposited by independent simultaneous thermal evaporation of ZnSe and CdSe in vacuum, and rotation of the substrates which passed many times over both material sources during deposition of each layer. The layer composition was set by choosing proper ratio of the deposition rates of the binary compounds and determined by Energy Dispersive Spectroscopy. The ZnSe layers in MLs were deposited following a well established step-by-step deposition procedure [1]. Raman scattering spectra have been measured in the range 100-1000 cm-1 under excitation with the 488 nm and 514.5 nm lines of an Ar+ laser. Series of four bands have been seen in the spectra of all samples which has been related to LO-phonon replicas in the ZnxCd1-xSe layers. The replicas are well known in polar crystalline semiconductors and indicate that in both kinds of samples Zn$_{0.6}$Cd$_{0.4}$Se layers are crystalline. A blue shift of the 1LO maximum has been observed with decreasing layer thickness, which has been connected with increasing compressive stress in Zn$_{0.6}$Cd$_{0.4}$Se layers. It has also been obtained that the ratio of the integrated intensity of the 1LO band in the spectra excited with the 514.5 nm and 488 nm lines increases with decreasing Zn$_{0.6}$Cd$_{0.4}$Se layer thickness. This result has been related to size-induced increase of the optical band gap of the layers. This conclusion has been confirmed by spectral photocurrent measurements.

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A-0064

PHOTOLUMINESCENCE FROM SIO$_X$ LAYERS CONTAINING AMORPHOUS SILICON NANOPARTICLES

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Crystalline silicon is a key material in electronics and the technology of its growth and processing is well established. However, because of its indirect optical gap, low-intense light emission can be observed from c-Si only at low temperatures. The observation of intense visible photoluminescence at room temperature from porous Si has attracted much attention in the preparation and characterization of light-emitting porous silicon, nanocrystalline silicon films, and nanocrystals (NCs) embedded in an oxide matrix. Because of the compatibility with silicon technology and the possibility of manufacturing devices, in which absorber and emitter are on one chip and everything is made from silicon, the interest in Si NCs is rather high. The number of already available data on Si NCs is very large but amorphous Si nanoparticles are still relatively unexplored. On the other hand, amorphous clusters may represent an alternative to NCs because of the lower energy consumption which is necessary for their fabrication.

Amorphous SiO$_x$ thin films with various contents $1.1 \leq x \leq 1.7$ have been prepared by thermal evaporation of SiO in vacuum and then furnace annealed at 770 or 970K for various times (5-200 min). Optical and infrared transmission measurements have proven phase separation upon annealing and Raman scattering data have indicated growth of amorphous Si. Both kinds of transmission data were used to estimate the nanoparticle volume fraction and values of 0.05-0.2 are determined. The influence of annealing conditions and the initial film composition on photoluminescence from as-prepared and annealed films has been explored under excitation with the 488 nm line of an Ar+ laser and the 442 nm line of a He+-Cd+ 1.5,≥laser. Intense room temperature PL has been observed from films with x visible with a naked eye. Two distinct PL bands have been revealed in the spectra excited by the 442 nm line, peaked at around 2.3 and 2.5 eV, which do not shift appreciably with increasing annealing time. These bands have been related to radiative recombination via defect states in the SiOx matrix (the 2.5 eV band) or at the a-Si-SiOx interface (the 2.3 eV band). Besides, an 'orange-red' band has been observed whose maximum moves from 2.1 to 1.7 eV with increasing annealing time and temperature and decreasing initial oxygen content. The intensity of this band shows different dependences on the annealing time and temperature in the films with different initial composition. These observations have been explained assuming recombination in amorphous Si nanoparticles. The measurements on thermal quenching of the photoluminescence have confirmed the last assumption.

A-0065

THE HISTORICAL AND CONCEPTUAL ROOTS OF ACTIVE MATRIX TECHNOLOGYP3E

Peter Brody
Advantech US

This talk will cover the state of the display and semiconductor industries in the late 1960's and will analyze the factors, both external and internal to the inventor, that led - almost inevitably - to the correct formulation of the "display problem" and its successful solution. A brief summary will also be given of a new approach to active matrix circuit fabrication which could significantly reduce the cost of AM-OLED displays.

A-0066

INFLUENCE OF ELECTRON IRRADIATION ON OPTICAL PROPERTIES OF LANTHANUM-GALLIUM TANTALATE CRYSTALS

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Lanthanum - gallium tantalate ($La_3Ga_{5,5}Ta_{0,5}O_{14}$, LGT) has a unique combination of physical properties. It posses high piezoelectric coefficient, absence: of phase transitions up to the melting point (~1500 ^oC), pyroelectric effect and twinning. It makes them possible to widely use in design of devices operating on surface and bulk acoustic waves and in sensors based on the direct piezoelectric effect.

Optical transmission spectra and their transformations at electron irradiation have been inspected for single crystals of LGT nominally pure and grown in the different atmospheres (argon or argon - oxygen atmosphere with two concentrations of oxygen (2% and less 2%) and air). The polar cuts LGT samples were oriented at irradiation perpendicular to the electron beam and the irradiation doses were 10^{12} -$3•10^{15}$ cm^{-2}. The spectra were recorded with Cary-5000 UV-VIS-NIR spectrophotometer in spectral ranges 200-3200 nm. Quite different transient transmission spectra have been registered for the crystals after electron irradiation. The electron influence was surprisingly different for crystals obtained in various atmospheres.

The crystals were grown by Czochralski method from the melt. For the crystals grown in the argon atmosphere, the transmission spectra exhibit a weak absorption band in the range 290 nm. On the same wavelength range a wide absorption band for the crystals grown in air was observed too, but it is much stronger. The optical transmission spectra of the crystals grown in the argon with oxygen atmosphere significantly differ from the spectra of the crystals grown in argon and air. A spread of the intrinsic absorption edge is observed. Strong absorption bands in the range 290 nm, 360 nm and 480 nm was also observed.

After electron irradiation ($1•10^{13}$ cm^{-2}) the crystals grown in the argon atmosphere exhibit the strong absorption bands at 290 nm and 350 nm. The doses increase various influences on the intensity of those bands for all investigated samples. The suggested reason for this effect absorption band appearance is charge exchange of cations.

As for crystals grown in the argon with 2% of oxygen the electron irradiation leads to the strong changes of the absorption band at 360 nm and 480 nm. It may be explained by charge exchange of oxygen vacancies.

A-0067

CU2ZNSN(S,SE)4: NOVEL ABSORBER LAYERS FOR IN-FREE HIGH EFFICIENCY THIN FILM SOLAR CELLS

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In the past two decades solar cells based on $CuIn_{(1-x)}Ga_xSe_2$ (CIGS) thin films have been developed up to record laboratory scale cell efficiencies of 19.9%. This technology is now finding its way to the market, being currently possible to purchase panels based on CIGS from a couple of companies. However, despite the excellent results achieved there are concerns regarding the consumption of In given its scarcity. It is quite noticeable that in recent years a renewed interest in addressing the In issue is being undertaken by an ever increasing number of research groups. One promising approach is the replacement of $CuIn_{(1-x)}Ga_xSe_2$ with $Cu_2ZnSn(S,Se)_4$ (CZTS) keeping the cell structure. Record cell efficiency of 9.6% has just recently been reported demonstrating the potential of the new material.

Here we report the results of our work on the development of CZTS through the selenization/sulfurization of stacked elemental metallic layers deposited by magnetron sputtering. The CZTS layer's morphology, composition, structure and optical properties have been fully characterized through SEM/EDX, XRD, and transmission/reflectivity measurements. Preliminary solar cell performance results are also presented.

A-0068

LOCAL- AND INTERMEDIATE-RANGE STRUCTURE OF AS-SE GLASSES BY ANOMALOUS X-RAY SCATTERING

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As_2Se_3 is well known as a prototype material showing a strong glass-forming tendency, and several photo-induced effects, such as photo-darkening, photo-dissolution, etc. The physical properties of glassy As_2Se_3 have been intensively investigated. X-ray and neutron scattering and x-ray absorption spectroscopy experiments, as well as Raman scattering results, showed that glassy As_2Se_3 has a short-range order similar to the crystal, i.e., threefold coordinated As and twofold coordinated Se atoms are covalently bound to each other. The occurrence of a prepeak in the total structure factor S(Q) in glassy As_2Se_3 presented evidence of intermediate-range order (IRO). However the origin of the prepeak or IRO is still open to discussions. Anomalous x-ray scattering (AXS) allows to clarify the role of partial structures in the IRO. The AXS experiments were carried out at BM02/ESRF at two energies (-20 and -200 eV) below the K edge of each element using a normal omega-2theta diffractometer. To discriminate the elastic signal from the K_beta fluorescence and Compton scattering contributions, we chose a graphite analyzer crystal [1], providing an energy resolution of about 55 eV. The samples were prepared by quenching the melts after rocking a quartz ampoule containing the mixed compound. The measurements were performed at room temperature with reflectance geometry. The statistical quality of the obtained differential structure factors Delta_iS(Q) is excellent and allows an easy interpretation of the underlying structural situation. Delta_AsS(Q) has a larger prepeak at 12 nm-1 than S(Q) at the same Q position, whereas the first peak becomes smaller and shifts towards the higher Q values. On the other hand, Delta_SeS(Q) has a small shoulder around Q = 14.5 nm-1, which would produce an asymmetric shape of the prepeak in S(Q). Since Delta_AsS(Q) originates from partial structure factors Sij(Q) of about 33 % SAsAs(Q), 60 % SAsSe(Q), and 7 % SSeSe(Q), while Delta_SeS(Q) results from about -3 % SAsAs(Q), 40 % SAsSe(Q), and 63 % SSeSe(Q), it is obvious that the prepeak at 12 nm-1 is a result of the As-As correlation and the signal around 14.5 nm-1 is composed of the Se-Se contribution. We will also present AXS spectra over a wide concentration range ($0.15 \leq x \leq 0.40$), and discuss the relation between the atomic structure and the stiffness transition. From the obtained results, a RMC modeling will be applied to obtain the three-dimensional atomic configurations in As-Se glasses.

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A-0069

LOCAL- AND INTERMEDIATE-RANGE STRUCTURE OF AMORPHOUS GE2SB2TE5 BY ANOMALOUS X-RAY SCATTERING

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Rewritable optical storage devices like DVD-RAM are nowadays common media for data storage and are widely used in all areas of daily life. The writing/erasing process in these materials is thereby attained by a reversible laser induced crystalline-amorphous transition in e.g., $Ge_2Sb_2Te_5$ (GST), and occurs on a timescale of a few nanoseconds. However, the underlying microscopic processes enabling the fast change from crystalline to amorphous and vice versa are not yet understood.

Some structural models exist in the literature, which are currently controversially discussed. Kolobov et al. [1] investigated the local structure around each element in the crystalline and amorphous phases of GST by XAFS. They proposed a so-called umbrella flip mechanism for the fast transition where the Ge atoms switch from an octahedral arrangement in the crystal to a tetrahedral environment in the amorphous phase. On the other hand, Kohara et al. [2] measured the total structure factor, S(Q), of the amorphous phase, and analyzed the data by a reverse Monte-Carlo (RMC) calculation. They proposed that the amorphous phase can be regarded as an even-member ring structure, and suggested that the resemblance of this ring structure to the crystalline atomic arrangement is responsible for the fast phase change process. However, the key information on the structure the amorphous phase in the intermediate range is still lacking at present.

In order to investigate the local- and intermediate-range order in the amorphous phase of GST, an anomalous x-ray scattering (AXS) experiment was carried out at energies close to the Ge, Sb, and Te K edges. The amorphous sample was contained between two extremely thin walled (~0.05 mm) sapphire plates, or in a quartz glass capillary. The AXS experiments were carried out using a standard omega-2theta diffractometer installed at BM02/ESRF at two incident x-ray energies below each K edge (-20 eV for Ge, -30 eV for Sb and Te, and -200 eV for all).

A prepeak is observed in S(Q) at about Q = 10 nm-1, indicating the existence of an intermediate-range atomic correlation. At the prepeak position, Delta_GeS(Q) has a prominent peak, while Delta_SbS(Q) and Delta_TeS(Q) show only small peaks. Thus, the intermediate-range correlations originate from the atomic correlations related to the Ge atoms. This clear assignment could unambiguously be drawn from the present AXS measurements for the first time. In addition, there is almost no contribution from Delta_GeS(Q) to the first peak in S(Q), while the other two Delta_iS(Q)s have large peaks there. From the obtained results, a RMC modeling will be applied to obtain the three-dimensional atomic configurations in the amorphous phase of GST.

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A-0070

INFLUENCE OF DEFECTS ON RADIATIVE DISTANT-PAIR RECOMBINATION IN AMORPHOUS SILICON (A-SI:H)

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Besides the well-known double-component of lifetime distribution observed in the photoluminescence (PL) of a-Si:H at low temperature under the geminate recombination condition with the generation rate $G < 10^{19}$ $cm^{-3}s^{-1}$, a third lifetime component was discovered using quadrature frequency resolved spectroscopy (QFRS) ranging from 2 ns to 160 s, and was identified as a non-geminate electron-hole pair, or distant-pair (DP) recombination component.1)
In this report the effects of defects on the DP recombination process of the third component are studied by the QFRS for samples having defect density ND =1.7 $x10^{16}$ ~ 4.6 $x10^{17}$ cm^{-3} at 3.7 K and G =10^{15} ~10^{18} $cm^{-3}s^{-1}$. The direct-competitive recombination model between radiative and non-radiative tunneling processes, which was originally introduced to analyze the influence of defects on the double peak-lifetime component, 2) is modified by adding one more gaussian function with a variable of peak-lifetime for the DP recombination process. The modified direct-competitive recombination model gives the estimated defect density in fairly good agreement with that obtained by constant photocurrent method (CPM). It also predicts effective non-radiative recombination lifetime as well as observed PL-lifetime constant for various ND and G by adopting the G-dependent lifetime of the radiative DP recombination. 3)

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A-0071

FORMATION OF ALPHA AND BETA PHASES IN POLYFLUORENE AND IRIDIUM-COMPLEX CONTAINING POLYFLUORENES

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Poly(9,9-di-n-octylfluorene), which is named PFO, has attracted attention because of its highly efficient blue emission and excellent performances in optoelectronic applications such as white organic light emitting diodes (white OLEDs), e.g., as a blue emitter and as a material to covert to green and red emissions. In OLEDs based on PFO, they are fabricated by solution processing like spin-coating, allowing large-area and flexible display and lighting devices.
PFO has at least two phases of alpha and beta. The alpha-phase is disordered and twisted structure, while the beta-phase is ordered and more flat conformation in single molecular scale. The alpha-phase is formed when PFO is diluted in solvents such as chloroform and tetrahydrofuran (THF). The beta-phase is formed in non-solvents or poor-solvents such as methanol and dichloroethane. Many studies have been done for the films and solutions. However, the formation of the two phases has not been investigated for crystalline and polycrystalline states, and not fully investigated even for solutions and spin-coated films.
It is important to find which kinds of factors determine the formation conditions of two phases and the fraction ratio between the two phases predominantly, because the phases are changed during operation of optoelectronic

devices based on PFO.

We study the formation in not only PFO without any moiety in side chain and main chain but also fluorene copolymer containing iridium Ir(III)-complex, Ir(thq)2(dbm), in its main chain. We investigate these two kinds of polymers in (1) solvents and poor solvents at various concentrations, (2) spin-coated neat and doped films, and (3) polycrystalline state, by spectroscopy of absorption, photoluminescence (PL) and PL excitation spectra at various temperatures between room temperature and 12 K.

It was found that the alpha-phase is majority for PFO diluted in THF at low concentrations, while beta-phase becomes majority at high concentrations. In polycrystalline states (i.e., powders) of PFO and polyfluorene containing Ir(III)-complex, beta-phase is majority. The alpha-phase content is about 1% in PFO polycrystalline at 12 K, while 13 % in PFO neat film. The PL intensity of the beta-phase increases (about 1.45 times) with decreasing temperature from room temperature to 12 K. These results indicate that aggregation of PFO molecules leads to formation of beta-phase by interchain interaction. Energy transfer from fluorene moiety to Ir-complex was confirmed by the intensity of red emission due to Ir-complex relative to blue emission due to fluorene. When content of Ir-complex in single polymer increases, the energy transfer becomes more efficient and no blue emission is observed at higher contents. It is suggested, from comparison with copolymers in solutions, that the presence of beta-phase in copolymer enhances the energy transfer. Triplet emission of fluorene is expected by sensitization of Ir(thq)2(dbm) phosphor at high contents, but it was not observed clearly.

A-0072

HIGHLY CONDUCTIVE TITANIUM OXIDE FILMS BY RF MAGNETRON SPUTTERING

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Transparent conducting oxides have extensively been investigated for applications to optoelectronic devices. Indium Tin Oxide (ITO) is the most commonly used for these applications. For ITO, however, high cost of In and weakness for erosion make people search the other transparent conductive oxide (TCO) films. Recently, another type of TCO using titanium oxides and niobium oxides have been reported. TiOx films deposited by rf magnetron sputtering showed highly conductive characteristics when the deposition conditions were adjusted; sputtering power of 250w, target of sintering TiO_2 disk, substrate temperature of 120 ^{o}C, sputtering atmosphere of argon and water vapor. Pressure as a parameter in the sputtering chamber were changed from few Pascal (Pa) to 250 Pa. Characteristics of the film conductivity showed an interesting feature that the films deposited at the pressure of 250 Pa show high conductivities around 101 S cm-1, while those at the pressure below 100 Pa show low conductivities around 10^{-4} S cm^{-1}. Optical absorption edges of the high conductivity films are shifted for 0.05 eV to the high energy side. In the infrared region, transparences for the high conductivity film are drastically decreased in all spectrum region. These characteristics suggest the Moss-Burnstein effect and sub-metal transition for high conductivity films. XRD spectrum show mixed crystalline of rutile, anatase, with unknown crystal structures of titanium oxides, especially, spectral peak at the diffraction angles 34.5º of 2□ arises for the high conductivity films. In the observation of AFM, crystalline morphologies in the size of about 200 nm have been found for the both films.

A-0073

THE INFLUENCE OF CD2+ AND MG2+ ON THE ELECTRICAL AND THERMAL PROPERTIES OF MANGANESE MERCURY THIOCYANATE CRYSTALS AND ITS LEWIS BASE ADDUCTS -FUTURE MATERIALS FOR PHOTONICS DEVICE FABRICATION

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Recently material scientists are fascinated by organobimetallic crystals and their Lewis base adducts, for it has the advantages of high optical nonlinearity of the organic materials with the device handling properties of the inorganics. Metal organic complexes offer higher environmental stability combined with greater diversity of tunable electronic properties by virtue of the coordinated metal center. Interestingly, recent studies indicate that the Lewis-base adducts of the organometallic crystals possess superior NLO property than the parent metal thiocyanate crystals. This encouraging switch over is mainly attributed to the improvement of NLO property by the addition of DMSO ligand. The introduction of DMSO aids better electronic oscillations in SCN ligand, leading to an enhancement in NLO efficiency. The present study deals with the influence of Cd^{2+} and Mg^{2+} on the electrical and thermal properties of Manganese Mercury thiocyanate (MMTC) and manganese mercury thiocyanate bis (dimethyl sulfoxide) (MMTD), a Lewis base adduct of MMTC. A comparative study shows that MMTD is the best material in terms of second harmonic efficiency among the other organo-metallic crystals reported so far.

As a sequence to our on going research work on novel organometallic crystals, this paper deals with the synthesis, growth and characterization of metal substituted organometallic crystals- promising materials for blue violet lasers. In the present work relatively large and good optical grade crystals of Cd^{2+} and Mg^{2+} doped MMTC and MMTD crystals were grown by slow evaporation technique and their optical properties were studied by FTIR and UV-Vis-NIR absorption spectra. The SHG efficiency of these crystals was evaluated by the Kurtz and perry technique and microcrystalline powder of urea was taken as the reference material. The second harmonic generation efficiency of doped crystals is found to be higher than that of parent crystals and very much higher than that of urea. The dielectric studies were carried out using a HIOKI MODEL 8532-50 LCR Hitester and a conventional two terminal sample holder. It is found that the dielectric constant of Cd^{2+} and Mg^{2+} doped MMTC and MMTD crystals is constant at lower frequencies and it decreases with increase in frequency. The TG/DTG thermograms reveals the slight increment in the decomposition temperature of doped crystals, suggesting that the substitution of Cd^{2+} and Mg^{2+} can enhance the thermal stability of MMTC and MMTD. Hence it can be conclude that the metallic dopants play a key role in improving the optical quality of the MMTC and MMTD crystals.

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A-0074

ACTIVE FIBER DEVICES WITH NANO-WATT OPERATIONS IN ELECTRO-OPTIC CRYSTALLIZED GLASS

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Fabrication of newly developed fiber-type devices with hybrid structure of crystallized glass and demonstration of light controlling with the electro-optic (EO) effect based on second-order optical nonlinearity for the future optical communication will be described. Research collaboration with the Asahi Glass Co. has been performed to achieve “active” fiber devices such as variable optical attenuator and polarization controller involved in the glass fiber networks with huge number of access lines. We have succeeded in developments of novel glass ceramics with large second-order optical nonlinearity, new processing for space-selective laser-crystallization, and advanced fiber-type devices with the glass-crystal hybrid structure. The active fiber-type devices have exhibited the electro-optically modulations of intensity and phase in light propagation. In addition, the most impressive property from this device is the ultra-low electrical power dissipation, nano-wattage (nW), for EO operations. This is an important requirement for the future optical communication system in the world, since the “nano-watt devices” will save the energy crisis caused by the millions of usage in optical components.

A-0075

SYNTHESIS OF POLY (3, 4 ETHYLENEDIOXYTHIOPHENE) NANO POWDER USING REVERSE MICREMULSION POLYMERISATION

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Recently nano structured conducting polymers represent an attractive class of electrochromic (EC) materials due to its broad surface area, low band gap and metal like conductivity. Here we have attempted to synthesis and characterization of poly (3,4 ethylenedioxythiophene) (PEDOT) nanostructures for electrochromic applications1,2. To synthesis PEDOT nanostructures, reverse microemulsion was first prepared by dissolving sodium bis(2-ethylhexyl) sulfosuccinate, AOT (19.12 mmol) in 70 mL of n-hexane and adding a solution of $FeCl_3$ (10.0 mmol) in 1.0 mL of distilled water to it. The resulting orange-colored mixture was gently stirred for 5 min followed by addition of EDOT monomer (3.52 mmol). After 3 h under gentle magnetic stirring, the blue/black precipitate of PEDOT nanotubes was filtered and washed with equal amounts of methanol and acetonitrile. Drying under vacuum for 18 h at 70 °C yielded a navy blue powder of PEDOT3. Characterization of synthesized PEDOT by FT-IR spectroscopy, Scanning electron microscopy (SEM) and standard four-probe method. Typical FTIR spectra are in good agreement with the previously reported result4. SEM images shows that the polymer particles in the range of ~100nm. The conductivity of PEDOT nano particles was 14.78 Scm^{-1}.

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A-0076

NEGATIVE REFRACTION PROPERTIES IN MAGNETIC FILM UNDER FERROMAGNETIC RESONANCE CONDITIONS

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It is generally believed that nature does not provide materials with negative refraction. Hence, most researches focus on the artificial materials to, such as metamaterials, photonic crystals, and multilayers. Recently, Pimenov et al. have proved that the manganese-based perovskite oxides film alone is able to realize negative refraction at GHz frequencies. In fact, this kind of materials has been widely studied because of the colossal magnetoresistance (CMR) effect. The magnetoresistance of conventional materials enables changes in resistance of up to 5%, but materials featuring CMR may demonstrate resistance changes by orders of magnitude. In the presence of a magnetic field, the CMR materials show metal property, which can provide a negative permittivity. Near the ferromagnetic resonance (FMR), the permeability is negative. The negative index materials made by the perovskite oxides have many advantages, such as convenient fabrication, magnetically tunable working frequency. However, both permittivity and permeability of these materials become tensor quantities under magnetic field. To date, there is no theoretical report on negative refraction properties in such anisotropic magnetic materials under ferromagnetic resonance conditions in detail. In this paper, an analytic calculation of the initial complex permeability frequency spectra of thin film with in-plane anisotropy, using Landau-Lifshitz-Gilbert theory, is presented. The problem of how to differentiate between left-handed materials (LHM) and right-handed material (RHM) under ferromagnetic resonance conditions has been analyzed in detail. We hope the results, which presented in this work, can give a guideline for further experimental work.

A-0077

NONRELATIVISTIC REVERSED DOPPLER SHIFTS IN NEGATIVE-INDEX MATERIALS

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In 1968, Veselago theoretically predicted the existence of the left-handed material (LHM), in which the electric field, the magnetic field and the wave vector are not composed of a set of right-handed coordinates but a set of left-handed coordinates. Within LHM, the phase velocity of light wave propagates in the opposite direction of the energy flow and it is also called negative-index material (NIM). Thus, some intriguing or even counterintuitive phenomena in NIM have attracted much attention, for example, the inverse Doppler effect. However, because of difficulties of frequency shift measurements inside of the NIM, most researchers used numerical simulations to study anomalous Doppler shifts. To our best knowledge, the only indirect experimental result which has been reported by Seddon and Bearpark in nonlinear transmission lines is at 1~2 GHz and nonrelativistic reversed Doppler shifts have never been observed at optical frequencies. Here, we report an observation of inverse Doppler shift in a photonic crystal (PC) prism, which has NIM property at 10.6 wavelength. The proposed structure of the PC prism consists of a triangular array of Si rods in air. Its shape is a rhombus with side of 5 mm and vertex angle of . The radius of the Si rods is , where is the lattice constant. The height of the Si rods is . According to our experimental work, the sample can exhibit negative refraction property at 10.6 wavelength. At optical region, the frequency is too high to be measured directly, so that the Doppler shift was detected using the heterodyne interferometry. Our results indicate that the observed Doppler effect is anomalous. The experiment was repeated more than 20 times using 8 different PC prisms with same crystal structure to verify experimental repeatability. All results are similar.

A-0078

MODELING OF OPTICAL PROPERTIES OF CDI2 CRYSTALS DOPED WITH NI2+ IONS

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Cadmium iodide crystals CdI_2 have a layered structure [1] formed by close hexagonal arrangement of iodine atoms, a half of whose octahedral cavities is occupied by cadmium atoms, and the second half remains unoccupied. Strong ionic-covalent bonds existing between cadmium and iodine atoms result in the formation of two-dimensional triple I-Cd-I layers (or sandwiches), whose superposition forms a three-dimensional crystal. The interest to this compound is driven by its properties, which can be used in scintillator applications [2] and non-linear optical devices [3]; CdI_2 is also suitable for doping with various rare earth and transition metal ions [4].

In the present work we give the results of detailed experimental and theoretical studies of CdI_2:Ni^{2+} crystals, which were grown by Bridgman method from the stoichiometric ratio of NiO_2 and CdI_2 mixtures.

The room-temperature absorption spectra of the title compound were analyzed using two different approaches: i) exchange charge model of crystal field [5] and ii) DFT based ab initio calculations [6]. The former method allows for calculating crystal field splitting of all 5 LS terms of Ni^{2+} ion in a trigonal crystal field, analysis of low-symmetry effects and their influence on the energy level scheme and comparison with experimental absorption spectrum of CdI2:Ni^{2+}. The latter method gives an opportunity to calculate the optimized crystal structure, band structure, total and partial density of states, elastic properties, absorption spectrum of pure and Ni^{2+}-doped CdI2. It was shown that the conduction band consists mainly of cadmium 5s, 5p states, which are slightly hybridized with iodine 5s, 5p states. The valence band is about 5 eV wide and is determined by the iodine 5p states mainly. The band gap is an indirect one. Calculations of the optimized crystal structures at different hydrostatic pressures allowed for estimations of the bulk modulus B for CdI2 as 29.930+/-0.913 GPa, and its pressure derivative B`=3.586+/-0.113.

By comparison of the calculated properties for the pure and doped host, it is possible to reveal the changes and modifications of the structural, electronic and optical properties, induced by Ni2+ impurity ions. In particular, the most striking difference from a pure crystal is that the Ni^{2+} 3d states appear in the band gap and contribute to the absorption at energies lower than the experimental band gap of 3.75 eV [7].

Comparison of the calculated results with experimental data and other materials is discussed.

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A-0079

OPTICAL CHARACTERISTICS OF GE-SB-TE PULSED LASER DEPOSITED THIN FILMS

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Phase-change memory materials based on chalcogenides are widely used commercially as active layers for data storage media. Ge-Sb-Te family is of large interest from the point of view of currently used optical discs technology and future electrical based memories as well.

One of prospective deposition methods for thin films preparation is pulsed laser deposition (PLD) being favourable due to its simplicity, easy control of the process, often stoichiometric transfer of target material to the films and possibility to fabricate films of unusual composition [1].

In this work, we connect PLD as advanced deposition technique with important inorganic materials (being represented by Ge-Sb-Te thin films) fabrication. We characterize fabricated layers (GeTe, $Ge_2Sb_2Te_5$, $Ge1Sb_2Te_4$, $Ge_1Sb_4Te_7$, and Sb_2Te_3) in terms of their optical characteristics (refractive index, extinction coefficient, optical band gap, optical contrast) in as-deposited state (amorphous phase) as well as in crystalline state induced by thermal annealing (fcc phase). Optical functions/parameters of interest were derived from the analysis of variable angle spectroscopic ellipsometry data using Cody-Lorentz model in broad spectral region (4.13-0.54 eV) including near- and above-band gap energies. The parameters of used Cody-Lorentz model are discussed in detail in relation with the chemical composition and state of the layers. The amorphous-to-fcc phase transition was complementary studied also by in-situ reflectivity measurements.

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A-0080

ALL-OPTICAL RECONFIGURABLE ADD-DROP MULTIPLEXER WITH PHOTOREFRACTIVE $SN_2P_2S_6$:SB CRYSTAL

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For consisting of Reconfigurable Optical Add-Drop Multiplexer (ROADM) systems, high performance tunable optical wavelength filters are required. Fiber Bragg Gratings (FBGs) are key components as the tunable wavelength filters in Dense Wavelength Division Multiplexing (DWDM) systems because of high resolution multiplexing and demultiplexing. However, FBGs are not adapted to Coarse Wavelength Division Multiplexing (CWDM) systems because of narrow tuning range. The CWDM systems are also necessary for the ring network interconnection as well as DWDM systems and require tunable wavelength filters having wide tuning range over 100nm.

We focus on a transmission-type holographic wavelength filter with a photorefractive (PR) medium for the CWDM systems. This device has a great advantage of unnecessary for circulators because its operation is based on Bragg diffraction through the transmission-type grating which is induced in the PR medium as a real-time hologram by two mutually coherent beams. When a WDM signals are incident on the PR medium, only the particular wavelength matched the Bragg condition is diffracted by the grating, and the others pass through the medium. The filtering wavelength can be shifted by controlling the Bragg condition, and tuned into another wavelength of the multiplexed signals by changing the grating pitch all-optically in a wide tuning range. By controlling the incident angles of writing beams, the grating pitch can be dynamically erased and reconfigured without external electric field and heater elements. However, this type of tunable wavelength filter reported so far has a problem of slow response time.

In order to improve the response time, we try to use $Sn_2P_2S_6$:Sb crystals as the PR medium. Widely used $BaTiO_3$ has very slow response time and requires temperature regulation because the tetragonal-orthorhombic phase transition is at ~ 9°C, in spite of the highest nonlinear susceptibility. The $Sn_2P_2S_6$ crystals are ferroelectrics with monoclinic symmetry m, and have a faster response time of several-hundred-fold compared with $BaTiO_3$. In particular, the Sb-doped $Sn_2P_2S_6$ crystals have the fastest response time in those crystals. For an example, $BaTiO_3$ shows the response time of 1300ms at 1.0W/cm2, but $Sn_2P_2S_6$:Sb shows that of 1.5ms at 0.3W/cm2. In addition to having the fast response time, the $Sn_2P_2S_6$ crystals do not require the temperature regulation. The crystals undergo a second-order phase transition to the centrosymmetric paraelectric phase, point group symmetry 2/m, at 64°C, and show the PR effect at room temperature.

In our development of tunable wavelength filters which are core devices in the ROADM systems, we improve not only the response time, but also the diffraction efficiency. To increase the diffraction efficiency, we propose an apodization method by controlling the grating distribution spatially. Conventionally, the diffraction efficiency is improved by increasing the grating area. However, the problem of increasing the area not contributing to diffraction efficiency occurs even if the large size crystal is used. Our apodization method overcomes this problem and further improves the diffraction efficiency by optimizing the intensity ratio of the writing beams to activate four corners of the medium.

A-0081

TRANSPORT AND RECOMBINATION OF PHOTO-CARRIERS UNDER POTENTIAL FLUCTUATION IN TIOX FILMS PREPARED BY RF MAGNETRON SPUTTERING METHOD

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The ac- and dc- transports and photo-transport measurements have been performed in titanium oxide films prepared by rf magnetron sputtering method. We have found some inhomogeneous properties in electronic properties, which may originate from long-range potential fluctuations leading band-edge modulation. The extent of potential fluctuation is deduced to be 0.26eV in typical TiOx films.

If such an inhomogeneity exists as proposed in ac and transport studies, recombination kinetics of photo-excited carries under a UV light may strongly depend on the extent of potential fluctuations. The long-term photocurrent decay (persistent photocurrent), after stopping illumination, was observed in theses films. The rise curve and decay curve of the photocurrent can be expressed empirically by a stretched exponential function. By fitting the stretched exponential function to the experimental data we extracted the extent of long-range potential fluctuations (0.26 eV), which is consistent with that estimated from the ac transport study.

The observed long-term photocurrent decay in the form of stretched exponential was attributed to a dispersive-diffusion controlled recombination of well separated localized electrons and holes which lie under potential fluctuations. The studies of ac-, dc-, and photo-transports are useful for understanding electronic natures in random media such as the present TiOx films.

A-0082

PHOTOREFRACTIVE COLLINEAR HOLOGRAPHIC DATA STORAGE BY PHASE SHIFT RECORDING

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As a new application of photorefractive (PR) media, small and rewritable optical memory system is investigated. To control phase of the diffraction beam from PR media, a method of enabling the combination of PR media and collinear holographic memory system by phase shift recording is proposed. Finally, shift selectivity is calculated to clarify the multiplexing performance in this system aiming at realizing small and high density holographic memory.
The PR media are well-known as one of nonlinear optical media and widely investigated for optical data storage, optical amplifier, and dynamically-reconfigurable optical devices and so on. Especially, the dynamicity of PR media is focused as rewritable media in holographic data storage systems, which are known as one of the post Blu-ray optical memories with Tbyte/inch2 data density and Gbps data transfer rate. In general, hologram is generated by interference of two beams, signal and reference beam. However, we can modulate both signal and reference beams in one beam path and the typical system with such recording scheme is widely-known as collinear holographic data storage. Since there is only one beam path in collinear holographic data storage system, it is adapted for downsizing of holographic data storage. The collinear holographic data storage has been mainly developed as write-once type, however, it can be applied to rewritable type of memory by using PR recording media. The reason why the collinear recording system has not been combined with PR media is derived from the special property in PR media. Generally in PR media, the spatial phase of induced refractive index grating is different from that of illuminated interference pattern. This spatial phase difference leads the energy translation of the illuminated beams because the phase changes of pi/2 ± f are occurred in each diffracted beam, where f is the spatial phase shift value in PR media. However since reference region is troidally-distributed around signal region in collinear system, the quality of reconstructed signal is decreased by destructive interference from the diffracted readout beams from mutually opposite side.
We propose a novel recording method to solve the problem in collinear holographic data storage with PR media of f=pi/2 such as BaTiO3 and KNbO3. In this method, pi/2 phase shift is added to half region of recording beam. As a result, the spatial phase shift in PR media is destructed and the reduction of reconstructed signal quality can be prevented. We simulate the operation of PR collinear holographic data storage with pi/2 phase shift recording by numerical simulation based on fast-Fourier transform beam-propagation method (FFT-BPM). In this simulation, in order to consider the spatial phase shift in PR media the Hilbert transformation is applied to FFT-BPM. As a result, by using phase shift recording, the signal-to-noise ratio of reconstructed signal about 1.5 times increased compared with the case without any solutions. Furthermore, we measured shift selectivity in PR collinear holographic data storage with phase shift recording for the purpose of clarifying the multiplexing property.

A-0083

ELECTRONIC AND OPTO-ELECTRONIC DEVICES BASED ON THIN ORGANIC FILMS

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Most microelectronic devices are based on inorganic semiconductors, in particular silicon and gallium arsenide. In contrast, molecular electronics is concerned with the exploitation of organic compounds in electronic and optoelectronic devices. The subject can be divided into two main themes (although there is substantial overlap). The first concerns the development of devices exploiting the unique macroscopic properties of organic

compounds. Examples here are ‘plastic’ transistors, organic electroluminescent displays, solid state lighting and photovoltaic structures. For device applications, the organic materials are normally required to be in the form of thin films (e.g. for ease of processing). Many electro-active organic materials can be deposited using methods that are in widespread use for inorganic compounds, such as thermal evaporation, spin-coating and inkjet printing. The second strand to molecular electronics recognises the dramatic size reduction in the individual processing elements in integrated circuits. Molecular-scale electronics therefore deals with the manipulation of organic materials at the nanometre level. There are relatively few techniques currently available to organise organic molecules on this scale. Examples are Langmuir-Blodgett deposition, self-assembly and layer-by-layer electrostatic adsorption. This presentation will provide an overview of such methods and discuss applications of these organic superlattice architectures to the field of molecular electronics.

A-0084

LOCALIZED-STATE DISTRIBUTIONS AND CHARGE CARRIER MOBILITIES OF ORGANIC BULK HETEROJUNCTION SOLAR CELLS

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Solution-processed organic bulk-heterojunction (BHJ) solar cells have gained much attention during the last few years and are one of the future photovoltaic technologies for low-cost power production. A power conversion efficiency of BHJ solar cells is approaching 8 % [1]. This presentation reviews a method for measuring localized-state distributions and charge carrier mobilities in the BHJ because the transport of electrons/holes in the BHJ is a crucial parameter and must be controlled to further improve solar-cell performance. Energy distributions of localized states and drift mobilities in the BHJ are determined by means of impedance spectroscopy [2, 3]. The analysis of impedance spectra is based on a theory for single-injection space-charge-limited current [4]. Advantages of the impedance spectroscopy over conventional methods such as time-of-flight transient photocurrent measurements are (i) extremely low drift mobility and density of states can be detected, (ii) drift mobility of thin samples whose thickness is about 100 nm and is comparable to the active layer thickness of organic BHJ solar cells and organic light-emitting diodes can be measured, (iii) hole drift mobility and valence-band tail state, and electron drift mobility and conduction-band tail state can be determined separately using a hole-only device and an electron-only device, respectively, and (iv) drift mobility and localized-state distribution can be observed simultaneously. The applicability of the impedance spectroscopy is demonstrated in thin films of poly(3-hexylthiophene) (P3HT) and [6,6]-phenyl C61-butyric acid methyl ester (PCBM) BHJs, where a blend of P3HT and PCBM is a prototypical BHJ for high efficiency organic solar cells. In this presentation, we discuss the impedance spectroscopy in BHJ organic solar cells but the impedance spectroscopy can be straightforwardly applied to the characterization of other organic diodes such as organic light-emitting diodes. The impedance spectroscopy reveals how the power conversion efficiency of organic BHJ solar cells is improved. For instance, a balanced transport of electrons and holes will be shown in BHJ solar cells with high power conversion efficiency because the build-up of the space-charge is suppressed in the BHJ.

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A-0085

PREPARATION, SPECTROSCOPIC AND CRYSTAL FIELD STUDIES OF ZN2SIO4 POWDERS DOPED WITH NI2+ AND CO2+ IONS

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Willemite Zn_2SiO_4 is known as a very suitable host for both rare earths and transition metals, providing an excellent luminescence in the blue (Ce^{3+}), green (Tb^{3+}, Mn^{2+}) and red (Eu^{3+}, Sm^{3+}) domains of visible spectral region. These compounds have been extensively used as phosphor for cathode ray tubes and electroluminescence devices, and as crystalline phase in glass ceramics, glazes and pigments. In particular Co^{2+} and Ni^{2+} doped Zn_2SiO_4 have intense blue-coloration, and due to high-temperature and chemical stability of zink-silicate they have found main use as blue ceramic pigments. High purity and homogeneity of activators in doped Zn_2SiO_4 is essential for all abovementioned applications. This is difficult to achieve by traditional synthesis methods based on the solid-state reaction and sputtering technique. Mainly for this reason sol-gel process is increasingly used for the synthesis of luminophors as being able to ensure complete and controlled mixing of the starting components in the preliminary stage, providing desired structure under relatively mild conditions. For our study Co^{2+} and Ni^{2+} doped Zn_2SiO_4 powders were prepared with slightly modified sol-gel synthesis, where an organic polymer (polyethylene glycol) has been employed as a fuel. On these samples we performed detailed structural, spectroscopic and crystal field (CF) studies. To establish reliable structure of the doped willemite samples X-ray diffraction studies were performed and the interionic distances and chemical bond angles were calculated. The reflection spectra of the prepared samples were measured in a wide spectral region (4000 - 40000 cm^{-1}) and exchange charge model of crystal field has been applied to their analysis. The only input information for the model calculation was the experimentally obtained structural data, which were used for the calculations of the crystal field parameters with subsequent diagonalization of the crystal field Hamiltonian for both ions. Agreement between the calculated and experimentally detected energy levels of impurity ions was good. It was also shown that there exists a systematic trend of preferential occupation of one out of two possible crystallographic sites for both impurity ions.

A-0086

SEMICONDUCTOR SCINTILLATOR BASED ON PHOTON RECYCLING

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Traditionally, an ideal scintillator requires material that is highly transparent to its own luminescence. However, in high-quality direct-gap semiconductors like InP, most of the scintillation photons reaching the detectors surface are not photons directly generated by the electrons and holes at the site of the gamma particle interaction, but photons that have been re-absorbed and re-emitted a multiple number of times. This phenomenon is called the photon recycling. Photon recycling circumvents the problem of making the semiconductor slab essentially transparent to its own infrared light.

The number of photon recycling events (recycling factor) depends on the radiative efficiency of the material (the probability that a minority carrier generates a photon rather than recombines nonradiatively) and the material transparency relative to free-carrier absorption (which defines the probability that a photon survives to generate another minority carrier). Both of these characteristics are nearly optimum in lightly doped InP. The radiative efficiency is about 98%, the free-carrier absorption length is several centimeters, and the estimated recycling factor exceeds 50. This enables a new kind of ideal (lossless) scintillator capable of very high photon collection

efficiency (PCE), even though the material is not transparent in the usual sense to its own luminescence. In order to take full advantage of photon recycling, double-sided integrated photodiodes are desirable. We are working on the implementation of such integrated photodiodes by epitaxy of quaternary InGaAsP pin diodes on both sides of an InP wafer. The estimated PCE in this case exceeds 90%.

Scintillator wafers, supplied with its own epitaxially integrated two-dimensional photo-diode array (in x,y plane), can be stacked up in the z-direction, thus enabling the possibility of three-dimensional (3D) pixellation of Compton scatterings of the incident gamma photon. The 3D pixellation in turn enables rapid simultaneous determination of both the incident gamma-photon energy and the direction to its source.

An important advantage of semiconductor scintillators is their high intrinsic energy resolution. It is well known that the energy resolution even in the best modern scintillators does not compare well with that in semiconductors diodes. One of the fundamental reasons for the relatively poor resolution is that the luminescent yield in dielectric scintillators is controlled by reactions that are nonlinear in the density of generated electron-hole pairs, such as the formation of excitons at low densities and the Auger recombination at high densities. Such nonlinear processes do not exist in direct-gap doped semiconductors, where interaction with gamma radiation induces minority carriers while the concentration of majority carriers does not measurably change. Every reaction on the way to luminescence, including Auger recombination, is linear with respect to the concentration of minority carriers. One can therefore expect, as a matter of principle, that doped semiconductor scintillators will not exhibit effects of non-proportionality and their ultimate energy resolution could be on par with that of diode detectors implemented in the same material.

A-0087

ELECTROLUMINESCENT DEVICES FABRICATED FROM CARBON-IMPLANTED SILICON

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Silicon-based light emitting diodes (LED) produced by carbon ion implantation (using methane feedstock gas) have potential applications in low-cost photonic devices. We discuss the processing of silicon by plasma ion implantation and the fabrication of electroluminescent (EL) diodes. The electroluminescence of our devices is broad-spectrum (orange-white) visible light, but two bands at 555 nm and 630 nm can be clearly identified. We assigned these bands to buried porous silicon (p-Si) and (hydrogenated) carbon-rich silicon (Si-C:H). The data suggest that the orange-white background is caused by disordered silicon. The optimal injection current density for maximum visible light output was found to be approximately 3 A/cm^2. We argue that emission from disordered Si is dominant for higher injection currents and this causes the observed decrease of the luminescence intensity at higher currents.

A-0088

HOLE-BLOCKING MECHANISM IN HIGH-GAIN AVALANCHE RUSHING AMORPHOUS PHOTOCONDUCTOR (HARP) FILM

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The effects of changes in the substrate deposition temperature and the thickness of a cerium dioxide (CeO_2) layer were studied to examine and improve the hole-blocking mechanism in an ultrahigh-sensitivity high-gain avalanche rushing amorphous photoconductor (HARP) photoconductive film. It was found that the hole-blocking ability of the film could be improved by reducing the number of defect levels generated from oxygen vacancies in the CeO_2 hole-blocking layer. HARP photoconductive film made of amorphous selenium (a-Se), which makes use of the avalanche multiplication phenomenon, has been developed for ultrahigh-sensitivity television cameras for reporting breaking news at night or producing nature and science programs. Now it is also used in various applications, including medical diagnosis and bio-imaging. In the HARP film, the avalanche multiplication factor can be improved by strengthening an applied electric field to the film. However, the maximum avalanche multiplication factor is limited from the point of view of the picture quality, because the dark current also increases as the applied electric field becomes higher. Therefore, reducing the dark current in the HARP film is important for improving its sensitivity. The HARP film has two blocking layers at each end that prevent charge injections from outside the film and suppress the dark current. One is a hole-blocking layer, which interrupts the injection of holes, and the other is an electron-blocking layer, which interrupts the injection of electrons. The hole-blocking layer consists of CeO_2, which is an n-type wide-gap material that forms a potential barrier to holes in HARP films. To examine the hole-blocking mechanism in the HARP film, we measured the dark current of HARP films with CeO_2 layers of three kinds of thicknesses (10, 20, 30 nm) deposited at two different substrate temperatures (with or without substrate heating). And then, we calculated the band gap of each CeO_2 layer from the transmittance value. The dark current increased and the band gap decreased in the thicker CeO_2 layer. The effect was especially remarkable in the unheated substrate. Furthermore, x-ray photoelectron spectroscopy (XPS) of each CeO_2 layer indicated that there were more oxygen vacancies in the CeO_2 layer that showed the higher dark current. This also agreed with the density measurement results of CeO_2 layers by x-ray reflectivity (XRR). From these results, we concluded that defect levels generated from oxygen vacancies in the CeO_2 layer lessened the potential barrier to holes and deteriorated the dark current characteristic of HARP films. Therefore, reducing the number of defect levels of the CeO_2 layer by such as substrate heating in the deposition process effectively improved the hole-blocking ability in HARP films.

A-0089

SIMULATION STUDY OF THE CUBIC PHASE STRUCTURE OF GE.2SB.2TE.5 BY RMC MODELING ON EXAFS AND DIFFRACTION DATASETS

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The $Ge_{.2}Sb_{.2}Te_{.5}$ is that phase change material, whose properties on its amorphous and crystalline cubic phase are exploited on rewritable DVD [1]. Its (rock-salt) cubic phase is possible to be built up using two Wyckoff positions: one is occupied by Te atoms exclusively, the another one is occupied by Sb, Ge atoms and vacancy too (the occupancies are 40%, 40% and 20%, respectively) [2]. Although, analysation of the Bragg-peaks in the powder pattern provides the average structure, it does not give any information about the local differences from the average structure. This is able to achieve by total powder diffraction pattern analysis and EXAFS for nearest neighbours. The Reverse Monte Carlo for POWder [3] simulation procedure provides that kind of 3 dimensional structural models, which are consistent with the measured diffraction and (recently) the EXAFS datasets. The resulting configuration has been analysed and partial pair distribution functions, bond angle distributions will be shown.

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A-0090

LIGHT-INDUCED EFFECTS ON THE RADIATIVE RECOMBINATION RATE OF ELECTRON-HOLE PAIRS IN A-SI:H

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Study of photoluminescence (PL) in a-Si:H is important to clarify the mechanism of light-induced creation of defects because it provides detailed information of defects. The PL spectra in a-Si:H films consist of a principal band at 1.4 eV and defect PL of the energy lower than 0.9 eV. We have reported light-induced effects on temperature variation of radiative recombination rate of electron-hole pairs responsible for defect PL in a-Si:H films [1]. In the previous studies, defective a-Si:H films were used since strong defect PL was desired. When the radiative recombination of electron-hole pairs competes with non-radiative recombination, the radiative recombination rate is proportional to I/tau, where I and tau denote the intensity and lifetime, respectively. The analysis of radiative recombination rates has been successfully done by obtaining characteristic values of tau in our previous studies for the defective a-Si:H films. However, we recently found that the analysis becomes more complicated in the case of high quality a-Si:H films. The results of the principal PL in the high quality a-Si:H films have been reported and understood by considering contributions from high quality regions and defective regions [2]. In this paper we report our recent results of defect PL in a-Si:H films, including those for high quality a-Si:H films. The a-Si:H films were prepared in a capacitively coupled glow discharge reactor. In order to investigate the light-induced effects, the samples were illuminated by a pulsed light from a YAG-OPO laser system. The PL measurements were performed by means of frequency resolved spectroscopy for the samples before and after illumination. The intensities and characteristic lifetimes of the defect PL were obtained at various temperatures in the range of 10 - 200 K for the high quality a-Si:H film after illumination, although the defect PL in high quality a-Si:H films before illumination was too weak to obtain the results. The value of I/tau increases with increasing temperature as has been observed in the case of defective films. The temperature dependence of I/tau is stronger than that in the case of the defective film. Further experiments are in progress. We will discuss relation between the temperature variation of the radiative recombination rates and the quality of the films and light-induced effects on the radiative recombination rates.

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Keywords: amorphous silicon, light-induced effects, luminescence

A-0091

BROADBAND SENSITIZATION OF NEAR INFRARED EMISSION THROUGH ENERGY TRANSFER FROM TRANSITION METAL TO RARE-EARTH IONS IN LIYBMO2O8 PHOSPHORS

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Si-based solar cells can effectively convert the photon with energy close to the band gap of Si (~1.1 eV), which leads to mismatch between the incident solar spectrum and the spectral responses of the solar cells, and consequently limits the efficiency of the solar cells. Acquisition knowledge of the ways to modify the solar spectrum is significantly important towards high conversion efficiency Si-based solar cell and optoelectronic devices with a desired performance. This article aims to provide the ways to modify the solar spectrum by using rare-earth and transition metal ions. Ultra-broadband sensitization of near infrared emission through energy transfer from Pb and/or Bi to Yb ions in $LiYbMo_2O_8$ phosphors has been achieved upon excitation of ultraviolet lights varying from 300 to 450 nm. Application of these phosphors in silicon-based solar cells might be greatly enhance its ultraviolet response via spectrum modification.

Keywords: Photoluminescence; Rare earth; Energy transfer; Charge transfer state; Solar cell.

A-0092

PERSISTENT LUMINESCENCE IN RARE EARTH DOPED OXYNITRIDES

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In 1996, $SrAl_2O_4$:Eu2+ codoped with Dy^{3+} ions was developed as an efficient persistent luminescent material with a very long afterglow [1]. This fact, combined with global efforts to reduce energy consumption of light sources, has led to a renewed interest in the class of long persistent luminescent materials. However, large scale application in safety illumination, emergency and road signage, … is hampered by the limited number of different colors available, especially in the long wavelength part of the visible spectrum. Therefore, the quest for phosphors with better specifications and different emission spectra is still open. In the present work, the oxynitrides of the family $MSi_2O_2N_2$:Eu (M = Ca, Sr, Ba) were synthesized using high temperature solid state reaction (3 h at 1400 °C). Without codoping, only $BaSi_2O_2N_2$:Eu shows persistent luminescence, with a broad blue-green emission peak around 495 nm. This is similar to the steady state photoluminescence spectrum, showing that Eu^{2+} is indeed acting as the recombination center. Thermoluminescence emission and excitation spectroscopy was performed, which showed the presence of two different recombination centers (with slightly different emission spectrum), in spite of the reported single crystallographic site for Eu^{2+}.

Until now, most of the materials that show persistent luminescence fall into two main categories, the aluminates and the silicates. Investigating persistent luminescence in oxynitrides can thus be very interesting to help us understand the exact mechanism of the phenomena [2]. In order to gain a better understanding of the why and how of persistent luminescence in this class of materials, the structure of the host compound was investigated in detail, as a function of the synthesis conditions, and related to the luminescent properties. This information is particularly useful to find out whether there are different possible sites for the Eu-ions in the oxynitride lattice. In addition, the effect of Eu dopant concentration and codopants was studied.

While there is still room for improvement and further research on these oxynitrides, they are serious candidates for practical applications in persistent luminescence.

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A-0093

SEEING THE LIGHT: NEW STANDARDS FOR QUANTIFYING SPECIFICATIONS OF LOW LEVEL LIGHT SOURCES

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Since many years, standards for measuring the brightness and color of artificial light sources such as lamps and displays have been well established. The units involved are photometric: they take into account the average human eye sensitivity and color perception. The same photometric quantities are used for specifying low level light sources such as persistent luminescent materials (long afterglow phosphors), while it is realized these are not valid at low light levels. Using the usual photometric standard, a luminance of 0.32 mcd/m^2 is taken as the visibility threshold for applications and - by definition - any source with this luminance should look equally bright, irrespective of its emission spectrum. However, this is not the case, as the human eye sensitivity shifts from photopic vision at high light levels (corresponding to cone vision) to scotopic vision at low levels (rod vision). During this transition, the spectral sensitivity gradually shifts to shorter wavelengths - the so-called Purkinje effect - and it is a real challenge to describe the eye sensitivity in the intermediate (mesopic) region. Efforts are currently undertaken to describe the actually perceived brightness by means of a unified luminance concept [1]. The same effect is also responsible for the fact that it is notoriously difficult to produce a red-emitting persistent luminescent material, as the human eye is not red-sensitive at low light levels.
The present work aims at a better understanding of human eye behavior in the mesopic region, and focuses on persistent luminescent materials as model systems with a high application value. Specifically, it is the aim to find the optimum emission spectrum of persistent luminescent materials, combining a reddish color, needed for emergency signage, and sufficient visibility at low light levels.

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A-0094

INVESTIGATIONS OF THE COMPLEX IMPEDANCE OF PHOTOVOLTAIC CELLS UNDER ILLUMINATION

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Although a photovoltaic power generator in principle is a d.c. current source the quality control during solar cell and module production requires tools for a fast access to electrical parameters. The time of data registration preferably is well below 1 ms where both the real as well as the imaginary part of the impedance have to be considered during data evaluation.

The equivalent circuit model of a photovoltaic device can be described by a current source in parallel with several loss current paths which form current dividers. The loss components can be modelled by voltage dependent resistors and capacitors. The external connection to a test equipment add an additional impedance in parallel to the measurement circuitry. The frequency response of a photovoltaic cell will basically have a low pass characteristic which limits the sampling rate during data acquisition.

In order to predict the frequency response of a solar cell, the transfer function or the equivalent circuit must be determined. In this work we have derived the impedance for different solar cells from low frequency small signal measurements. Based on these results simulations were performed with a circuit simulator. The simulated transfer function then was compared with experimental findings for two situations: (1) The device was exposed to a sinusoidally modulated light source up to a frequency of 1 MHz and (2) The current transient caused by a 50 ns light pulse was analysed. After minor adjustments in our simulation experimental results agree very good with the simulation. The applied corrections in the simulation were presumably necessary because of the external wiring which adds an inductor and a resistor in series to the circuit.

The results we have made so far will be discussed with respect to the bandwidth limit for fast diagnostic measurements.

A-0095

COMPARISON OF STRUCTURAL TRANSFORMATION IN BULK AND AS EVAPORATED OPTICAL MEDIA DURING POLYCHORMATIC AND ENERGY DEPENDENT MONOCHROMATIC ILLUMINATION

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Photostructural changes in chalcogenide glasses are intensively studied nowadays. They affect the performance of optoelectronic devices made of these materials so the understanding and control of these processes has great practical importance. In this work structural changes caused by monochromatic and polychromatic light illumination were investigated in bulk and thin film As2S3 and As45S55 chalcogenide glasses using Raman spectroscopy. Raman spectra of the samples were recorded using 1.17 , 1.58 , 1.96 and 2.41 eV excitation energies.

It was found that intensive structural transformation of realgar (r-As_4S_4) to pararealgar (p-As_4S_4) takes place when the photon energies close to or above the threshold energy of the sample. In addition the higher photon energies caused the widening of the main complex band in g-$As_{45}S_{55}$ and g-$As_{40}S_{60}$, mainly because of the increase of the contribution of bands around 300, 320, 355, and 380 cm^{-1}, related to vibrations of rings in orpiment (crystalline compound c-As2S3, mineral). On the other hand polychromatic illumination and heat treatment of $As_{40}S_{60}$ film resulted in disappearance all of bands typical for r- and p-As_4S_4 and appearance only of orpiment ring vibrations.

The influence of changes of refractive index and thickness of films on their optical spectra was also calculated.

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A-0096

FABRICATION OF WIDEBAND NEAR-INFRARED PHOSPHOR COMBINING SM3+-DOPED GLASS AND YB3+, ND3+ CO-DOPED GLASS PHOSPHORS

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Wideband light sources are used in an absorption spectrometry for agricultural application [1], and optical coherence tomography (OCT) that is a recently developed cross-sectional imaging technique for biological tissues [2]. In general, wideband light source is desirable for the absorption spectrometry in order to measure a broad region of the absorption spectrum. Since the OCT is based on the Michelson interferometer, a low-coherence wideband light source has several advantages for a high depth-resolution. Moreover, the central wavelength in near-infrared region is suitable for these applications, leading to high penetration depths in the samples.

Light emitting diodes (LEDs) in the near-infrared region and a halogen lamp are usually used as the near-infrared wideband light sources. The LED is small and has a long lifetime. However, the spectral width of the LEDs is 50 nm at maximum, which is insufficient for most spectroscopic applications. On the other hand, the halogen lamp has a very wide spectral width. However, the size of the halogen lamp is much bigger than that of the LEDs. Moreover, the lifetime is much shorter than that of the LEDs. Therefore, we propose a novel wideband near-infrared light source by combining a wideband near-infrared phosphor and the LED as an excitation source in one package. To realize this light source, we synthesized a phosphor that emits at around 1000 nm using Bi_2O_3-B_2O_3 based glasses doped with Yb^{3+} and Nd^{3+} [3]. The wideband luminescence from 950 nm to 1100 nm was achieved. It is reported that Sm3+ shows luminescence around 580 nm□with near-infrared region (from 900 to 1000 nm and from 1100 nm to 1200 nm) [4]. Luminescence at around 580 nm coincides with one of the excitation band of Yb^{3+}, Nd^{3+} co-doped glass phosphor. Therefore, in this study, we tried to increase spectral width of Yb^{3+}, Nd^{3+} co-doped glass phosphor by using Sm3+.

Photoluminescence of combining Sm3+-doped glass phosphor ($1Sm_2O_3$-$10Bi_2O_3$-$44B_2O_3$-$44Sb_2O_3$ in nominal molar composition, 1mm of thickness) and Yb3+, Nd3+ co-doped glass phosphor ($1Yb_2O_3$-$1Nd_2O_3$-$10Bi_2O_3$-$44B_2O_3$-$44Sb_2O_3$, 1mm of thickness) shows a wideband luminescence from 860 nm to 1200 nm. Luminescence of Sm^{3+}-doped glass phosphor overlaps with that of Yb^{3+}, Nd^{3+} co-doped glass phosphor. Although there are many peaks, we successfully increased the spectral width. On the other hand, luminescence of Sm^{3+}, Yb^{3+}, and Nd^{3+} co-doped glass phosphor ($0.4Sm_2O_3$-$0.6Yb_2O_3$-$0.5Nd_2O_3$-$10Bi_2O_3$-$44B_2O_3$-$44.5Sb_2O_3$, 2mm of thickness) is almost the same as that of Yb^{3+}, Nd^{3+} co-doped glass phosphor. These results indicate that the combining Sm3+-doped glass phosphor and Yb^{3+}, Nd^{3+} co-doped glass phosphor is a good approach to realize the wideband near-infrared phosphor.

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A-0097

INFLUENCE OF DOPING UPON THE STRUCTURE AND OPTICAL CHARACTERISTICS OF GE2SB2TE5

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$Ge_2Sb_2Te_5$ (GST) is one of the materials that are commonly used as a data storage media for phase change random access memory (PCRAM) and rewritable optical storage technology [1]. In this study, the influence of doping with Bi, Sn or In upon the structure and the optical characteristics of GST has been determined using a variety of techniques including Raman micro-probe spectrometry, X-ray diffraction (XRD), Rutherford backscattering (RBS) (backscattering of deuterons with energy □d = 1 MeV) and a variable incident angle spectroscopic ellipsometer (VASE). The selection of given elements as dopants was caused by isoelectronic structures of Ge and Sn, Sb and Bi conformably. Furthermore, these dopants speed up the crystallization of GST and the rate which data transfers, accordingly.

The films were thermally evaporated in the vacuum chamber onto unheated substrates using previously synthesized compositions. The RBS data have shown that distributions of all dopants on a thickness of the films are uniform. Doping maintains the NaCl-type crystalline structure of GST but expands the lattice due to the larger atomic radii of dopants. The Raman spectra of all amorphous films performed two broad peaks B=130 cm^{-1} and C=150 cm^{-1} which could be interpreted as different vibration modes of heteropolar bonds in $GeTe_4$-nGen tetrahedron. The doping causes the changing of Raman shift and it testifies to the changing of chemical bond lengths and bonding angles. The most considerable changing causes the doping by tin (approximately wt. 3 %). The optical properties of the films were determined under two incident angles of 60 and 70 by a spectroscopic ellipsometer operating from 0.12 to 3.27 eV. It was shown that the optical contrast in the doped samples increases steadily with increasing wavelength and shows a high optical contrast of more than 20% in the wavelength range of 400 to 1000 nm.

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A-0098

NEW HYBRID PHOTOCHROMIC MATERIALS FOR OPTICAL SWITCHING

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Recent years have seen an extensive development of research in the area of the design of photocontrollable hybrid photochromic systems and study of their properties. Photochromic probes, the markers that allow the properties of a modified object to be controlled with the use of light, attract particular interest. Among investigated types of photochromic compounds we have chosen spiropyrans due to their well-studied photochromic properties. Herein, we developed a new type of photochromic systems capable for effective interaction with quantum dots due to the presence of a spacer with different nature possessing the reactive terminal thiol-group. Our

approach consists in introducing spacer with reactive thiol group at the C5-position of the molecule. The new spiropyran derivatives bearing linker of different length introduced in the 5-position of indolenine moiety have been synthesized. We used covalent binding of a spiropyran residue via a thiol-metal linkage on the surface of semiconductive CdSe nanocrystal. The spectral-kinetic study of the new class of photochromic probes bearing these reactive groups and their conjugates with 3.5 nm CdSe quantum dots was performed. The spiropyran modified quantum dots exhibited light-induced photochromism that was very similar to photochromic characteristics of unbound ligands. Fluorescence from the hybrid photochromic materials was observed when the dye was in its spiro form and was drastically quenched by the dye in its merocyanine form.
These results demonstrate that optical modulation of nanoparticle fluorescence is possible, suggesting potential application to optically addressable devices.

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A-0099

PHOTONIC AND RELATED APPLICATIONS OF QUANTUM-SIZED NANOSILICON

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Current topics of the application studies on quantum-sized nanosilicon [1] are presented in terms of photonics, electronics, and acoustics.
Under the appropriate oxidation condition, the PL emission band can be tuned from red to blue. In heavily oxidized and annealed samples, efficient blue phosphorescence was observed with a few-seconds decay time [2]. The implication is that the optical property as a molecular structure appears in oxidized nanosilicon network. The blue phosphorescence is applicable to a host matrix for the optical energy transfer [3]. The nanosilicon layer, on the other hand, exhibits a high-sensitivity photoconduction effect involving avalanche multiplication of photo-carriers [4]. The band gap controllability in the visible range is attractive for application to advanced photovoltaic conversion.
Regarding the previously reported ballistic emission from nanosilicon diode, our tunnelling cascade model has been confirmed by a theoretical analysis [5]. The usefulness of energetic and directional electron emission has been demonstrated in vacuum (parallel EB lithography [6]; image sensing [7]), in atmospheric-pressure gases (VUV emission [8]), and even in solutions (H2 generation [9]).
The characteristics of the nanosilicon sound emitter have been clarified in relation to the frequency response. In addition to the use as a ultrasound generator for studies on bio-acoustic communication, the capability as a broad-band speaker has been verified under a digital drive [10].

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A-0100

ELECTRONIC AND OPTICAL PROPERTIES OF CUXS$_2$ (X = AL, GA, IN) AND AGGAS$_2$ SEMICONDUCTORS FROM FIRST-PRINCIPLES CALCULATIONS

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Ternary semiconductors CuXS$_2$ (X=Al, Ga, In) and AgGaS$_2$ are widely studied due to their applications in nonlinear optics, solar cells, optoelectronic devices etc [1,2]. Many research groups have reported detailed experimental information on their optical properties; some works on ab initio calculations for these systems can be also found [Ref. 3 and references therein]. However, it should be mentioned that there exists considerable difference between the results reported by different authors.

In the present work we report on consistent calculations of the optimized crystal structures, band structures, partial and total densities of states, absorption spectra, dielectric functions, refractive indices at ambient and varying hydrostatic pressure for the above mentioned compounds. All calculations were performed in the DFT framework, using the CASTEP module [4] of Materials Studio [5]. From the pressure dependence of the unit cell volume the elastic constants (bulk modulus and its pressure derivative) were estimated. Dependence of the electronic properties (distribution of the electron density, band gaps, effective Mulliken charges) on applied pressure was analyzed. Discussion of the calculated results and their comparison with available experimental data is also presented.

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A-0101

WATER-BASED SONOCHEMICAL CLEANING OF SILICON WAFERS IN THE MANUFACTURING OF PHOTOVOLTAIC CELLS

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In recent years, the usage of renewable energy sources like solar cells and panels has increased rapidely. Among installed photovoltaic systems, more than 90% are mono- and polycrystalline silicon cells, which provide the advantages of low cost and large area with relatively high efficiency. In the photovoltaic industry, cleaning of surfaces in silicon wafers is one of the most important unit operations in the device processing. An economic way to completely remove contaminations and passivate rechargeable states on the surfaces are very important issues for the further improvement of the energy conversion efficiency of commercial silicon solar cells. A critical point is that more energy is required to remove small particles, because it is physically harder to deliver the necessary force to tiny dimensions. Among other techniques, ultrasonic agitation is widely used

to provide energy into the wet cleaning bath. The physics behind the ultrasonic-induced cleaning process is not yet completely understood. A combination of an induced streaming flow in the cleaning solution, acoustic cavitation, the level of dissolved gases and oscillatory effects are all thought to contribute to removing particles and complex organic materials from the wafer surface. We study the photovoltaic behavior of mono- and polycrystalline Si wafers subjected to a surface cleaning process in ultrasonically agitated distilled water. The kHz-frequency acoustic power delivered at the Si-water interface is about 10 W/cm^2 at a water bath temperature of 60-70 ^{o}C. The photovoltaic response is checked using the photovoltage (PV) decay transients, PV lifetime mapping and current-voltage (I-V) curves. The FTIR transmission and optical reflectance spectra are used to trace the removal of organic contaminants and to check for Si-O and Si-H absorption modes. We found that metal and organic particle contaminants are effectively removed during ultrasonic cleaning over the first 40-60 min, as evidenced by the disappearance of organic-related absorption peaks and remarkable shortening of the photovoltage decay transients. This is accompanied by activating the air/oxide and oxide/wafer interface dangling bonds, which affects free carrier migration barriers developed at the interfaces, as deduced from the I-V curves, and acts as recombination centers thus accelerating PV decays. Carrier lifetime mappings obtained by the PV decay technique with a 50-micron spatial resolution show that, in polycrystalline Si wafers, the decay shortening is accompanied by a remarkable smoothening of the lifetime distribution over the wafer surface. This is not reproduced in monocrystalline Si wafers. The data are tentatively interpreted in terms of the wafer hydrogenization, which most probably occur along the grain boundaries. The effect is likely due to hydrogen production by sonochemical decomposition of the water.

Our results can be used in promoting environmentally friendly and non-toxic cleaning steps in manufacturing photovoltaic Si wafers thus paving the ways to make cleaning products that work, don't pollute and save money.

A-0102

ELECTRONIC AND OPTICAL PROPERTIES OF ZNCR$_2$SE$_4$ AS EXPLORED BY FIRST PRINCIPLES AND CRYSTAL FIELD CALCULATIONS

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$ZnCr_2Se_4$ spinel has attracted recently considerable interest due to interesting optical, electrical, magnetic properties [1-3].

The present study is devoted to combined ab initio (with the use of the CASTEP module [4] of Materials Studio [5]) and crystal field (in the framework of the exchange charge model [6]) calculations of the structural, electronic, and optical properties of the title compound. Ab initio calculations of the density of states allowed evaluating contribution of each ion into the calculated bands. In addition, the spin-polarized calculations allowed for finding difference between densities of the spin-up and spin-down states of 6-fold coordinated Cr^{3+} ion.

Crystal field calculations resulted in getting a set of crystal field parameters, which were used to calculate the energy levels of octahedrally coordinated Cr3+ ion in the title compound.

Results of calculations are compared with available experimental data and discussed.

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A-0103

STUDY OF FUNCTIONAL PROPERTIES OF THERMALLY IRREVERSIBLE PHOTOCHROMIC DIARYLETHENES IN VARIOUS AGGREGATE STATES

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One of problems for a development of multilayer recording media for 3D bitwise working optical memory is making thin photochromic layers containing maximal concentration of photochromic compounds in the layer and developing a high efficiency of photochromic transformations. In this connection, the comparative spectral-kinetic study of photochromism for certain thermally irreversible diarylethenes in solution, a polymer matrix and a solid film without the polymer binder was carried out for the first time. As a photochromic compounds 1,2 - bis(3-benzothienyl-2-methyl-6-phormyl)cyclopentene and 1,2-bis(3-benzothienyl-6-benzoyl-2-methyl) cyclopentene synthesized by the reaction of 1,2-bis(3-benzothienyl-2-methyl) cyclo-pentene with corresponding acylation agents were used. Poly(methyl methacrylate) and polycarbonate (both in granulated form and thin film) were selected as polymer binders.

Differences in the structure of diarylethene not lead to any fundamental changes in the photochromic properties, in the applicable state of matter, as it was detected. The dependences of the efficiency for processes such as photocoloration, photobleaching and photodegradation from the aggregate state, the nature of the polymer binder and the structure of photochromic compounds have been revealed. The obtained results indicate that photochromic films both polymeric and thin solid are characterized by comparable photosensitivity and can be used for making a multilayer recording media for 3D bitwise working optical memory.

A-0104

INFLUENCE OF THE OXIDATION TEMPERATURE ON PHOTOLUMINESCENCE AND ELECTRICAL PROPERTIES OF AMORPHOUS THIN FILMS SIC:H:O + TB

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Amorphous SiC:H+Tb films were deposited on p-type Si substrate by reactive RF magnetron sputtering of the polycrystalline SiC and Tb targets, in Ar(96 vol %)+CH_4(4 vol %) as working gas. After deposition, the silicon substrate was cut into smaller pieces and annealed in dry oxygen for 15 min. in the temperature range of 450-700°C. Gold contact on the surface of the a-SiC:H:O+Tb film was deposited for electrical properties measurement. Properties of the films were investigated by PL spectroscopy, FTIR spectroscopy, HF capacity-voltage characteristic (C-V) and current-voltage characteristics (I-V). Film composition was measured by Auger spectroscopy (AS) and by Raman spectroscopy (RS).

The results of AS showed that with increasing RF sputtering power the carbon concentration decreases and silicon concentration increases, tending toward stoichiometric SiC. Study of FTIR transmission spectra demonstrated complete oxidation at 450ºC of the films deposited at the lowest RF sputtering power (90 a.u.) and lack of oxidation even at a temperature 700ºC for those deposited at high RF sputtering power (110 a.u.). Carbon inclusions have been observed by RS in films deposited at low RF power at oxidation temperatures higher than 600 °C, while no such inclusions are seen at higher RF power subject to same high-temperature oxidation.

The PL spectrum and electrical conductivity of films obtained with the low RF power sputtering show strong dependence on the temperature of oxidation. For the unoxidized structure the PL has a broad spectrum covering the range of wavelength 490 nm – 700 nm and high level of electrical conductivity. Oxidation at 450 ºC led to a doubling of the PL intensity without changing the shape of the spectrum, and considerable decrease of electrical conductivity for both bias polarities. Further increase of oxidation temperature (Tox) beyond 600 ºC resulted in decrease of PL intensity of the broad spectrum by more than an order of magnitude, while a narrow band with peak at 545 nm - corresponding to the luminescence of Terbium - appeared. At the same time the electrical conductivity increased significantly, with possible association with carbon inclusions in the film.

The intensity of PL of the films obtained with high power of RF sputtering is significantly lower than for the films obtained with low power. Increasing oxidation temperature leads to increase of PL intensity in the whole temperature range compared to the unoxidized structure, and to monotonic decrease of current in the direct I-V characteristics. Moreover, all spectra have similar shape: a broad band in the wavelength range 490 to 650 nm, and a clear narrow band corresponding to Terbium luminescence. C-V measurements showed strong increase of capacitance when Tox is higher then 600 ºC. The observed phenomena are explained on the basis of the strong influence of material graphitization on PL quenching, electrical conductivity and capacitance.

A-0105

PROCESS CONTROL IN PULSED-DC REACTIVE SPUTTERING OF VANADIUM OXIDE THINS FILMS FOR UNCOOLED INFRARED IMAGING

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Low resistivity thin films of vanadium oxide with high temperature coefficient of resistance (TCR) are currently used as the imaging layer in uncooled infrared imaging. However, process control remains an issue because the films are formed under oxygen-starved conditions. In this work, the influence of cathode current (target current) hysteresis on the properties of pulsed-dc reactive sputtered vanadium oxide thin films is investigated. VO_x thin films were sputter-deposited from a vanadium metal target under different Ar/O ratios. The gas flow rates and oxygen partial pressures were varied systematically, and the corresponding changes in the cathode current were monitored. Increasing the gas flow rate from 10 sccm to 100 sccm caused the cathode current to decrease by ~25%, but on reversing the flow rate, the cathode current did not go back up along the same curve, instead exhibiting a hysteretic behavior. A similar trend was observed for the change in oxygen partial pressure between 0 and 20% as well. The width and position of the hysteresis curve depends on the relative values of the gas flow rates and the oxygen partial pressures. VOx thin films deposited at various points along the hysteresis curve were evaluated using four-probe resistivity measurements over a wide temperature range. The resistivity of vanadium oxide thin films increases with increase in total gas flow rate as well as increase in oxygen percentage, and was also found to have a direct dependence on the cathode current. Further characterization has been done by X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM) and transmission electron microscopy (TEM) to correlate the film properties with the processing conditions.

A-0106

RELATIONSHIPS BETWEEN STRUCTURE AND PROPERTIES OF SILICATE GLASSES IMPLANTED WITH AU+ IONS

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The metal nanocluster composite glasses (MNCGs), which are prepared by ion implantation, have been shown to be promising non-linear photonic materials. Here, we report on the influence of glass composition on the properties of gold nanoparticles embedded in different types of silicate glasses. The used glasses varying in concentration and the types of the network modifiers and/or formers elements were implanted with Au+ ions with the energy 1.7 MeV and the fluency 1×10^16 cm^{-2}. The formation of nanoparticles was induced by the post-implantation annealing of the samples around transformation temperature of the used glasses for 5 hours. The samples were characterised by various methods: Rutherford Backscattering Spectroscopy, Raman spectroscopy, UV-VIS absorption spectroscopy, Transmission Electron Microscope Analysis and Z-scan technique.

Our results clearly showed that it was the structure of the glass network that had the significant influence of the glass structure on the migration of the implanted ion through the glass matrix during the ion implantation and during post-implantation annealing of the as-implanted samples. That migration finally results in the different size, shape and distribution of the nanoparticles and their optical properties. On the bases of the obtained data the relations between the structural changes and optical properties, important for photonics applications, were formulated.

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A-0107

LUMINESCENCE PROPERTIES OF ER:LINBO3 THIN LAYERS FABRICATED BY ION IMPLANTATION

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Single crystals like lithium niobate are frequently doped with optically active rare earth or transition metal ions for a variety of applications in optical devices such as solid state lasers, amplifiers or sensors. From a practical point of view it would be very attractive to create a material system where the energy of the emitted photons is close to the pumping energy, therefore the intention in integrated optics was to explore the IR region and more specifically the three telecommunication windows laying between 0.9 and 1.6 µm. To exploit the potential of the Er: $LiNbO_3$ one must ensure hight intensity of the 1.5 µm luminiscence as an inevitable prerequisity. For that generally crystaline materials are particullary suitable, due to that well known fact that crystal field formed

by the atoms surrounding the lasing ions can strongly affect the resulting luminiscence properties. The ion implantation technique is one of the ways to prepare a laser active ions doped optical layers.

Optically active Er: $LiNbO_3$ layers were fabricated by medium energy implantation under various experimental conditions. Er+ ions were implanted at energies of 330 and 500 keV with fluences of $1.0x10^{15}$, $2.5x10^{15}$, and $1.0x10^{16}$ cm^{-2} into $LiNbO^3$ single crystal cuts of both common and special orientations. The as-implanted samples were annealed in air or in oxygen at the three different temperatures (350, 600 and 1000°C) for 5 hours. The depth concentration profiles of the implanted erbium were measured by Rutherford backscattering Spectroscopy (RBS) using 2 MeV He^+ ions. The photoluminescence spectra of the samples were measured to determine the emission of 1.5 µm .

Projected range Rp of implanted erbium depends on the different energies of implantation. Concentration of implanted erbium corresponded well with fluences and it was similar in all the cuts of lithium niobate. But what was different were intensities of the 1.5 µm luminiscence bands not only before and after the anneling but also in various types of the crystal cuts. The cut perpendicular to the cleavage plane (10-14) exhibited the best luminescence properties for all the experimental conditions used. Using a combination of RBS/channeling and Neutron Depth Profiling (NDP) methods we tried to clarify the behavior of implanted ions to explain so different emission in various lithium niobate cuts.

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A-0108

THIN FILMS OF LINBO3 CREATED USING LASER DEPOSITION

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$LiNbO_3$ is a material which can be used in many applications, especially if various dopants change its properties as a material for photoferractive recording (Fe, Mn), harmonics generation (Er), holographic storage (Fe:Cu, Fe, Ce:Cu, Fe:Mn, Ru, Tm, Tb, Ce:Mn, Er), higher resistence to powerfull light radiation (MgO), ferroelectric materials (Co), upconversion (triply doped Tm, Yb, Nd), icreasing photoconductivity (Sc), increase of upconversion (Ho), laser 1.5 µm (MgO + Er), increase of photoconductivity (Zn + Nd), photorefractive properties (Mn), second harmonic generation (Zn, Er, Eu), two color holograms (Tb), optical parametric oscilator (Mg), holography (Zn:Fe, Cr:Cu, Tb,Fe, Mn, Ce), nonvolatile holograms (Ru), holographic gratings (Fe:Mn, Ce: Mn, Ce:Cu, Fe:Cu), emission at 1.5 µm (Er), cw generation at 929 nm (Zn), cw generation at 1.3 µm (Nd), lasers for blue-green spectral domain (Nd+Zn), surface acoustic wave - SAW (MgO), cw laser (Zn + Nd).

There are several methods for preparation $LiNbO_3$ thin films. In this study we focused on $LiNbO_3$ fabrication by pulsed laser deposition (PLD) with main emphases given to the target material. (Overview of up to now laser created $LiNbO_3$ film is given with emphasize on target composition and target preparation.)

The films were created from crystalline and sintered targets using KrF excimer laser. As substrates the SiO_2/Si (1000) and (0001) sapphire were used. Thickness of the SiO_2 layers (several hundred nanometers) were measured using m- line technique. The films were created at substrate temperatures around 600 °C. Influence of deposition conditions and parameters on the films crystallinity, morphology, waveguiding properties and transparency will be compared with literature data and discussed. Laser deposition arrangement for deposition of doped $LiNbO_3$ layers using two lasers and two targets will be also presented.

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A-0109

NOVEL PHOTOCHROMIC HYDRAZONES BASED ON 3,3-DIMETHYLSPIRO-[2 -1-BENZOPYRAN-2,1-[2]-OXAINDAN]

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Synthesis of the novel polydentate ligand systems capable to form polynuclear coordination compounds with metal ions combined with photochromic properties is of great interest as promising optic materials for different purposes.

We have synthesized series of hydrazones based on dimethylspiro-[2□-1-benzopyran-2,1-[2]-oxaindan] and hydrazides of aromatic acids and 4-N-benzylthiosemicarbazone. It was shown that in the solution obtained compounds possess photochromic properties only in case of derivatives, containing electron donor substituents in benzopyran moiety of the molecule. With Cu (II), Ni (II), Co (II) ions hydrazones form binuclear coordination compounds with interesting magnetic properties. Structure and composition of the obtained complexes was studied with several physical chemical methods, including low-temperature magnetochemical study of binuclear complexes. (Work was supported by FAP “Scientific and scientific-educational cadres of innovational Russia”, contract □1266, NK-190P-3)

A-0110

COMPARISON OF SPECTROSCOPIC PROPERTIES OF SILICATE AND PHOSPHATE GLASSES DOPED WITH RARE EARTH IONS

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In this work we closely concur to the current research done in our previous work, which up to now resulted in designing and forming a new family of zinc-silicate glasses containing laser active rare earth ions. We have proved that silicate glasses doped with rare earth ions can be used in photonics application similarly as phosphate glasses without having their drawbacks.

Here, we are going to report spectroscopic properties of newly designed zinc-silicate bulk glasses having different concentrations of erbium and ytterbium ions and compare them with the properties of commercially available phosphate glasses. The Er^{3+}:Yb^{3+} ratio in both types of the used glasses varied around 1:20. Optical absorption and emission, radiation lifetimes and gain properties of the used glasses will be presented.

Because of potential use of the silicate glasses in the waveguide-based devices, feasibility of ion-exchange fabrication of optical waveguides in the glasses were also studied, as well as the relations between luminescence properties of the resultant waveguides and experimental conditions of their fabrications.

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A-0111

EFFECTS OF THE CLADDING ON THE EMISSION OF DOPED PLASTIC OPTICAL FIBERS

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Doped plastic optical fibers have attractive applications as optical devices due to the fiber waveguide geometry, the low production cost of the fibers and the wide range materials that can be embedded into the fiber core. The aim of this work is to analyze the effect of the cladding on the emission properties of the doped plastic optical fibers. For that propose, we have compared the photoluminescence spectra of cladded and uncladed plastic fibers, both with same doped core material. We have measured the near field of cladded fibers to distinguish the light in the core from the light in the cladding. We have also measured the variations in the emission spectra as a function of the position of the incident spot, the incident angle and the propagation distance through the fibers. When the fiber core is surrounded by a cladding, a lower propagation loss of the emitted intensity is detected. We have developed a theoretical model in order to describe the observed experimental behavior. The study has been performed in plastic optical fibers doped with polyfluorenes.

A-0112

COLLECTIVE MODES OF A BILAYER DOUBLE PARABOLIC QUANTUM WELL SPIN POLARIZED ELECTRON GAS

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We investigate the possible electromagnetically induced collective excitation modes in a bilayer quasi-two-dimensional structure build from two adjacent parabolic quantum wells. We consider both charge and spin excitation modes within and beyond the random phase approximation. To account for higher order effects we used both exchange and correlation spin-dependent local field correction factors. We analyzed intra- and inter-subband excitations and provide analytic results for their excitation frequencies in the long wavelength limit.

A-0113

DESIGN AND CONSTRUCTION OF A WDM TRANSCEIVER WITH VHGT USING HYBRID INTEGRATION TECHNOLOGY

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Planar lightwave circuit (PLC) hybrid integration technology enables us to construct component by combining PLC with passive function (fiber and planar optical waveguides, optical greatings) and active optoelectronics devices (laser diodes, optical amplifiers and photodiodes) hybridized on a PLC.

We report about design and construction of WDM bidirectional transceiver module for the passive optical network (PON) of a fiber to the home FTTH topology. An optical WDM transceiver (TRx) transmits a 1310 nm radiation upload and receives a 1490 nm download data as well as a 1550 nm download digital video signals for wavelength division multiplexing WDM cable TV application [1]. The optical bidirectional WDM transceiver TRx is the key component for subscriber part of the PON - FTTH topology. The TRx uses a microoptics hybrid integration technology with volume holographic Bragg grating triplex filter (VHGT) for wavelength multiplexing/ demultiplexing.

Our optical WDM transceiver TRx has been constructed using system of a three micromodules in the new circle topology. The triplex optical multiplexing/ demultiplexing micromodule is composed of VHGT filter with collimating cylindrical microlens and optical multimode fiber. The diffraction angles, efficiencies and insert losses of the triplex VHGT filter were verified by the beam analyzing system Beam Profiler BP 104-IR from Thor Labs. The diffraction angle was 18 and 19 degrees for wavelength 1490 and 1550 nm, diffraction efficiency from 0.8 to 0.9 and insert losses 0.1 dB. The next two optoelectronic receiver micromodules include collimation lenses and hybrid microwave optoelectronic receivers with optimalized microwave connection between input of the amplifiers and surface-illuminated InGaAs PIN photodiodes. The optoelectronics receivers were made by thin layer hybrid integration technology [2].

The optoelectronic transmitter micromodule uses Fabry-Perot InGaAsP single mode laser diode on metallic submount with a microwave modulator and optical average power feed back control electronics on a alumina substrate. Alternatively we design a optical WDM transceiver TRx in circle topology by the polymer PLC (planar lightwave circuit) hybrid integration technology. The demultiplexing micromodule designed by beam propagation method by BeamProp and GreatingMOD simulation module by RSoft software and construct by a epoxy novolak polymer NANOTM SU-8 2000 (SU-8) monomode ridge waveguides with planar optical interference filters. The SU-8 waveguides were deposited by using spin coating method on silica on silicon or GaAs substrate. The attenuation of fabricated polymer optical waveguides was .measured by the method end-fire coupling with waveguide of different length. The attenuation was around 1 dB.

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A-0114

USE OF NOVEL FUNCTIONALIZED NANOPARTICLES IN DYE SENSITIZED SOLAR CELLS

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We report on our preliminary investigations of novel dye doped organosilicate nanoparticles (DNPS) and ultra small Platinum nanoparticle decorated counter electrodes to achieve high efficiency Dye sensitized solar cells (DSSCs). DNPs have been investigated as potential low-cost and high efficiency replacements for quantum dots and conventional ruthenium based dyes in the fabrication of dye sensitized solar cells. DNPs are synthesized from poly-methyl silsesquioxane (PMSSQ) encapsulating commonly used organic fluorescent dye molecules. In this study, Rhodamine 6G has been used as a model dye for encapsulation because of it's relatively broad absorption spectrum. Encapsulation of the dye molecules within the stable and inert organosilicate matrix has been found to dramatically improve its photostability while increasing the overall absorption efficiency of the nanoparticles on account of encapsulation of multiple number of dye molecules within each single nanoparticle. In addition, our novel synthesis technique facilitates fabrication of the nanoparticles with sizes as small as 3nm with appropriate surface functionalization to enable covalent bonding of the nanoparticles with the TiO_2 surface. Small size of nanoparticles also allow the tunneling of electrons from DNPs to TiO_2 matrix.

Herein we also report on the electrochemical study of ultra small Pt nanoparticles for charge storage and catalyst applications. We have developed a highly controllable, room temperature process for the growth of spherical Pt nanoparticles with uniform size and high density in the sub-2 nm regime through physical vapor deposition techniques. Size tunable Pt nanoparticles ranging from 0.8 to 2.0 nm with densities in excess of 5E12 cm^{-2} have been successfully deposited on a variety of substrates using this optimized process. The particles with sizes less than 1.5 nm show slow electron transfer and increased charge storage capacity, whereas, larger particles (2 nm) show fast and efficient electron transfer characteristics. To demonstrate the applicability of these nanoparticles as highly efficient catalysts for DSSCs, we have studied the photovoltaic efficiencies of DSSCs employing 100 nm thick Pt film as counter electrode and that of Pt nanoparticles deposited on carbon coated Aluminum thin film counter electrode. The counter electrodes with 2 nm Pt nanoparticles show efficiency similar to that of 100 nm Pt counter electrode. Detailed analysis of electron transfer characteristics and photovoltaic efficiency for different size Pt nanoparticles will be presented.

A-0115

MN-RELATED RAMAN RESONANCES IN GAN:MN AND ALGAN:MN EPITAXIAL FILMS

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The considerable number of controversial reports on the magnetic properties of the GaN:Mn-based materials systems calls for a systematic study of the correlation of their magnetic and structural characteristics as a function of the fabrication methods and parameters, in order to shed light on the origin of the reported magnetic behavior [1].

In the perspective of the above mentioned comprehensive characterization and understanding, we have employed Raman scattering to investigate the Mn related features in wurtzite GaN:Mn and AlGaN:Mn films fabricated by metalorganic vapor phase epitaxy (MOVPE) with Mn concentrations ranging from 0% to 2%. High-resolution transmission electron microscopy, synchrotron diffraction and absorption experiments on the layers give evidence of

the substitutional position of the Mn ions in the Ga sublattice and no hint of the presence of secondary phases. [2]
The micro-Raman experiments are performed at room temperature, without polarization, and in backscattering geometry in a Horiba Jobin Yvon setup model LabRAM HTS equipped with 532 nm, 633 nm and 785 nm lasers. Both the TO and the LO GaN phonon related peaks are evident in the Raman spectra from GaN:Mn samples at the tree lasers lines. However, an intermediate peak centered at ~670 cm-1 only arises upon 633 nm and 532 nm excitations and its intensity shows a systematic dependence on the Mn content in GaN films.
In the Al(x)Ga(1-x)N:Mn (x ~ 0.15) samples, the same peak is detected with a 5 cm^{-1} shift to higher frequencies at the 532 nm excitation. Upon co-doping with Mg (AlGaN:Mn,Mg) we have the onset of an intense contribution at ~ 690 cm^{-1}. Interestingly the AlGaN:Mg sample (Mn free) shows no Raman peak in the 600-700 cm^{-1} range. Different works have attributed the 670 cm^{-1} features to defect induced vibration modes like Ga-vacancies in GaN [3]. Nevertheless, our Raman spectra from GaN, GaN:Fe, GaN:Mg, GaN:Si, AlGaN and AlGaN:Mg give no evidence of this contribution. Therefore, we discuss the origin of the 670 and 690 cm^{-1} peaks based on a resonant Raman interaction related to electronic transitions involving the semi filled Mn d-gap states and the valence and conduction bands of the host lattices.

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A-0116

MODELING OF CDS/CDTE THIN FILM SOLAR CELLS

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The second generation thin film solar cells are increasingly promising for their cheaper production and better efficiency [1]. Polycrystalline cadmium telluride (CdTe) is one of the most potential photoconductors for thin film solar cells because of its excellent efficiency [2]. In CdS/CdTe based solar cells, a very thin layer of CdS is used as a buffer layer, which acts as highly doped n-type material. The CdTe layer is slightly doped p-type material. The structure is equivalent to an n-i type structure where the slightly doped p-type CdTe layer is fully depleted and behaves almost like an intrinsic layer [3]. The thickness of the CdTe layer is few micrometers (compared with few hundred micrometers in the crystalline Si solar cells). The photons are absorbed in the CdTe layer and the photocarriers are collected by the built-in electric field in this layer. Some carriers can be lost due to trapping during their drift towards the electrodes. The rate of loss of the carriers increases with increasing load voltage because of the reduction of the built-in electric field in the CdTe layer.
There has been an active theoretical and experimental research to improve the performance of these devices. Hegedus et al. reviewed a few theoretical models to describe the J-V characteristics in CdS/CdTe solar cells [3]. The most successful model calculates the photocurrent considering a n-i-p structure and the carrier generation near the radiation-receiving electrode by utilizing Hecht collection efficiency formula. In this paper, we solve the continuity equation for both electrons and holes considering exponential photon absorption, exponential carrier generation, carrier trapping and carrier drifting in the nearly intrinsic CdTe layer.
We obtain an analytical expression for the external voltage dependent photocurrent. The overall load current is calculated considering the effect of voltage dependent forward dark current and the actual solar spectrum. We examine the effects of various dark current components on the J-V characteristics. It is found that the recombination current in the depletion region dominates over the ideal diode current. We analyze J-V characteristics, fill-factor, power, efficiency with varying the i-layer thickness and the material properties. The model is verified with the published experimental data on polycrystalline CdTe and CuInGaSe thin film solar cells. The model shows a very good agreement with the experiment.
The present results show that the efficiency of solar cell generally does not continue to improve with greater i-layer thickness because of carrier trapping effects. There exists an optimum solar cell thickness to maximize

the efficiency. The modeling work in this paper identifies the important factors that limit the thin film solar cell performance, which can ultimately lead to the better efficiency.

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A-0117

A STUDY OF DYE SENSITISED SOLAR CELLS' ELECTRICAL PERFORMANCE OVER TIME AND ITS LIMITING FACTORS

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In this work, a set of dye-sensitized solar cells, also known as Grätzel cells, with starting efficiencies between 4.3% and 6.8%, was produced and studied throughout 9 months. In order to characterise the time evolution of their performance, their electrical and physical behaviours were studied both qualitatively and quantitatively. A set of techniques comprising spectrophotometry, scanning electron microscopy, I-V measurements, open-circuit voltage decay (OCVD) and impedance spectroscopy was employed to provide optical, morphological, electrical and diffusive information related to each cell. From the collected data, it was possible to figure out a few factors responsible for the observed degradation of the cells' performance over time, such as an apparent relationship between the decrease of the diffusion length of the electrons in the TiO_2 and the increase of the cells' equivalent series resistance, leading to higher loss of charge due to recombination processes. Overall this study suggests that the electrolyte is a key element responsible for the degradation of the dye-sensitized solar cells that were produced, although further studies are required. The knowledge provided by this work is of relevant importance for the future improvement of these devices.

A-0118

LEAD OXIDE AS X-RAY CONVERSION MATERIAL: THE WAY TOWARDS APPLICATION IN MEDICAL IMAGING DETECTORS

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Lead Oxide (PbO) photoconductor has enormous potential for applications in x-ray imaging including both radiographic (static) and fluoroscopic (real-time) applications. It is a suitable high-Z (atomic number) material with distinct advantages over amorphous selenium (a-Se) - currently the only commercially viable x-ray photoconductor in direct conversion x-ray detectors, such as a higher x-ray detection quantum efficiency and higher x-ray to charge conversion gain. Indeed, the evaluation of the imaging performance of a prototype detector consisting of a PbO layer deposited on a large area (18 cm x 20 cm) TFT plate has been encouraging: the modulation transfer function (MTF) of the PbO conversion layer itself was close to unity indicating a very high spatial resolution.
However, PbO layers are still experimental: they have not yet achieved as high as expected conversion efficiency and have not yet shown adequate temporal behavior for fluoroscopic applications. A broad material science research is needed to overcome these problems. This in turn requires a comprehensive analysis of PbO photoconductive and structural properties. Our new experimental results presented here allow us to discover problems which limit PbO's ability to be used in imaging and, at the same time, indicate ways to solve these problems.

A-0119

ANDERSON LOCALIZATION OF COUNTERPROPAGATING BEAMS IN OPTICALY INDUCED PHOTONIC LATTICES

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Anderson localization of mutually incoherent counterpropagating beams in an optically induced two-dimensional photonic lattice is observed. The effect is displayed in a system of two broad probe beams propagating head-on through a fixed disordered photonic lattice recorded in a photorefractive crystal. Changing the disorder added to the lattice we observe steady-state localization as well as dynamical localization; that is, the localization of time-changing beams. As compared to the localization of single beams, in which there exist no dynamical effects, the localization of counterpropagating beams is more pronounced and prone to instabilities.

A-0120

ULTRAVIOLET HOLOGRAPHIC RECORDING IN PHOTOPOLYMERS

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Norland Optical Adhesive (NOA) acrilate based photopolymers were studied as a medium for Bragg grating fabrication. NOA photopolymers have absorption maximum in near UV region, but they are transparent in visible light region. Photopolymers were irradiated by He-Cd laser 325 nm line interference pattern during holographic recording. In light irradiated regions photopolymerization takes place and volume grating can be recorded. Diffraction efficiency in dependence on sample thickness, recording beams polarization state and intensity was investigated on transmission and reflection modes. Enlargement of sample thickness allows to achieve better angular selectivity of diffracted beam, therefore thickness of prepared samples were up to 2,4 mm. In this work diffraction efficiency over 80% was achieved. The best angular selectivity of diffracted beam was several minutes. Gratings with high diffraction efficiency and good angular selectivity successfully can be used in telecommunications and data storage devices. Advantages of this grating are long term mechanical stability, low dependence on temperature changes, simple and cheap preparation.

A-0121

OPTICAL SPECTRA AND DIELECTRIC SUSCEPTIBILITY OF INDIUM NITRIDE AND RELATED ALLOYS

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Optical studies of InN and related alloys [1, 2, 3] probe the details of their electronic structure. The central properties of interest are the responses of these semiconductors to electromagnetic fields of sufficiently high frequency and these responses are the subject of investigation for the following semiconductors: InN, $In_xGa_{(1-x)}N$, $In_xAl_{(1-x)}N$, InN containing oxygen, and non-stoichiometric InN (including the two cases of: In atoms on N sites and N atoms on In sites). The response of certain semiconductor is measured in terms of the real and imaginary parts of dielectric susceptibility. The imaginary part at each energy depends on the density of occupied and empty electron states differing by that energy and on the oscillator strength associated with the coupling of those states.

This part is investigated by the absorption spectrum of certain nitride semiconductor. The following parameters needed for theoretical investigation are found from this spectrum: the density of states, the absorption threshold, the absorption peak associated with the average splitting between the conduction s- and the valence p-bands, and the principal absorption peak associated with splitting between the p-bands. The corresponding real part of the dielectric susceptibility is investigated for electromagnetic field of zero frequency, and the imaginary part of the dielectric susceptibility is investigated as a function of the energy. These investigations are made for each semiconductor given above. Both parts of the dielectric susceptibility are determined by the perturbation method. The corresponding matrix elements having places in the perturbation formulas are calculated as matrix elements between local wave functions describing the highest electron state of the valence band and the lowest electron state of the conduction band for certain value of the electron wave vector. It is found that overlapping between these wave functions must occur in order for the corresponding matrix element to have a non-zero value. This overlapping occurs if tunnel optical absorption has place in the corresponding nitride semiconductor compound alloy. The theoretical results are compared with experimental data and agreement is found if the energy interval at point □ between the occupied states and the empty states occurs at the following values: 0.20 eV for non-stoichiometric InN:In, 1.19 eV for InN containing oxygen, 1.48 eV for $In_xGa_{(1-x)}N$, 1.60 eV for $In_xAl_{(1-x)}N$, 1.92 eV for InN, and 2.18 eV for non-stoichiometric InN:N. The real part of the dielectric susceptibility is used for determination of numerical values of both the dielectric constant and the refractive index for all of the semiconductors given above, and the results are presented as well.

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A-0122

PHOTOSENSITIVE CHROMONE DERIVATIVES FOR RECORDING MEDIA OF ARCHIVAL THREE-DIMENSIONAL OPTICAL MEMORY

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Compounds undergoing irreversible changes under ultraviolet irradiation with formation of photoluminescent products, which provide optical information read-out, are of considerable interest for the development of novel recording media for multilayer bitwise archival three-dimensional optical memory. The goal of our investigation is the synthesis of derivatives of 2-hetaryl-3-acetylchromones and their analogues which are not fluorophores themselves but under irradiation undergo irreversible transformations into the fluorescing products providing optical information reading. A wide range of 2-hetaryl-3-acetylchromone derivatives has been prepared by the improved method based on the oxidation with selenium dioxide of the product of crotonic condensation of 1-(2-hydroxyphenyl)-3-arylpropane-1,3-dione with aldehydes. Spectral and kinetic study of the synthesized chromones showed that the thiophene-containing chromones manifest efficient irreversible phototransformations in solutions forming the photoluminescent photoproducts with acceptable photosensitivity and efficiency of fluorescence. The introduction of chromones into the polymeric matrix provides a sharp increase in the intensity of photoinduced fluorescence.
On the basis of these compounds can be developed multilayer optical disks for the 3D archival optical memory with super high information capacity exceeding information capacity of the modern optical disks in dozens times.

A-0123

OXIDIZED GOLD ELECTRODES FOR FLEXIBLE ORGANIC OPTOELECTRONICS

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Oxidized gold is shown to function as a direct drop-in replacement for the de facto standard indium tin oxide (ITO) electrode in flexible organic light emitting diodes (OLEDs) fabricated on large-area plastic substrates. OLEDs fabricated with oxidized gold electrodes exhibit superior device performance and ITO-like Lambertian (i.e., angle independent) emission. Enhanced light out-coupling due to a weak microcavity effect, in conjunction with a much lower series resistance than ITO, contribute to the superior device performance of OLEDs fabricated using oxidized gold electrodes. Ultraviolet photoelectron spectroscopy (UPS) measurements and single carrier device data demonstrate the formation of quasi-Ohmic contacts between oxidized gold electrodes and most commonly used hole transporting molecules. The unique combination of optical properties, high electrical conductivity, good chemical stability, and ease of processing make oxidized gold electrodes a promising candidate for enabling the roll-to-roll processing of next generation flexible organic optoelectronics for applications such as solid state lighting.

A-0124

PHOTOLUMINESCENCE STUDY OF EUROPIUM DOPED ANATASE TIO2 NANOPARTICLES

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TiO$_2$ is characterized with high refractive index, low absorption and low dispersion in visible and near-infrared spectral regions, and possesses high chemical and thermal stabilities. This important metal-oxide semiconductor, with relatively wide band gap (3.25 eV) and low phonon energy (< 700 cm^{-1}), is a good host for various rare earth impurities providing their efficient emission in visible range. One of the mineral forms in which titanium (IV)-oxide occurs in nature - anatase, is considered very promising optical material and has been widely investigated for various applications in filters, waveguides, anti-reflective and highly reflective coatings. At the same time, being non-toxic and biocompatible, europium doped anatase has strong potential to replace standard types of fluorophores (quantum dots, organic dyes, etc.), traditionally used as fluorescent markers in medicine and biological applications. Herein we investigated anatase nanoparticles doped with trivalent europium ions in different concentrations (0.1, 0.5, 1, 3, 5, 7, 10 at.%). To produce it in the form of nanopowder the sol-gel route has been adopted, starting from europium nitrate and titanium (IV)-isopropoxide. We documented basic characteristics of synthesized materials from thermal analysis, X-ray diffraction, FTIR, scanning and transmission electron microscopy, nitrogen sorption measurements, UV-vis and photoluminescence spectroscopy and discussed obtained results. Samples containing less than 3at.% of Eu^{3+} are polycrystalline while with higher Eu concentration resembles glassy state. The band gap values for all samples are found to be around 3.25 eV. Luminescence properties were investigated measuring photoluminescence spectra and decay curves, both at room and low temperatures (10 K). At room temeperature all samples exhibited characteristic red emissions from Eu^{3+} ions, with the strongest line centered on 613 nm and average emission lifetime ranges from 0.3 to 0.9 ms.

A-0125

OPTICAL LINESHAPES FOR POLYMETHINE DYES AND THEIR AGGREGATES: NOVEL THEORY OF QUANTUM TRANSITIONS AND ITS CORRELATION WITH EXPERIMENT

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The problem of theoretical treatment of the optical lineshapes for polymethine dyes and their aggregates is a top problem in physics and chemistry for many tens of years, but it is not solved finally up to now [1, 2]. The author proposes a novel theory of quantum transitions on the basis of dozy chaos [1 - 4] that gives insight into the nature of the optical lineshapes for polymethine dyes, their dimers, H-, Hstar-, and J-aggregates. This theory formulates a proper definition of electron-nuclear coupling in dynamics of the transient state what is of paramount importance for quantum transitions in such organic makes, by reason of their largeness [1, 2]. By dozy chaos the light electron succeeds to control the motion of extremely heavy nuclei in the transient state, by making it chaotic [1, 2]. Formerly in terms of the novel theory the author cleared up the nature of the optical lineshapes for dye monomers and J-aggregates [3, 4]. Now this theory is developed to involve excitonic effects that are important for dimers and H-aggregates [1, 2]. Results are the theoretical absorption lineshapes fitted by the author to the basic experimental data [5] for dye monomers, dimers, H-, Hstar-, and J-aggregates. Also results are the theoretical curves fitted to the well-known data [5] for the monomer-dimer concentration equilibrium. Hereby the novel theory of quantum transitions exhausts all types of the optical absorption lineshapes for polymethine dyes and their aggregates that sent a challenge to it. Dozy chaos underlying the novel quantum theory was introduced into physics at the beginning of the 21st century as a novel physical substance to describe extended multiphonon transitions [4]. The necessity of introducing this substance stems from the presence of inherent singularity in the probability of extended transitions as a result of exit beyond the adiabatic approximation in quantum mechanics of electron-nuclear motion [1, 2, 4]. It is not improbable that trends in future development and applications of the quantum theory in terms of dozy chaos could be such immense as were in the case of the standard quantum mechanics not long ago. One application of the novel theory in the future could be a control of dynamics of quantum transitions in macromolecules. In future, such control could allow the control, say for a short while, of biological functions in living creatures. As regards the polymethine dyes, their dimers and Hstar-aggregates could be proposed as a design for two-qubit gates.

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A-0126

PHOTOSTABILITY STUDIES OF NONLINEAR OPTICAL CHROMOPHORES IN AMORPHOUS POLYCARBONATE

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Nonlinear optical chromophores have the potential to be used in applications ranging from optical communication to THz generation [1,2]. They offer numerous advantages over inorganic compounds (e.g. LiNbO3) such as much higher elecro-optic coefficients [3], lower drive voltages and are easy processable. One drawback of these materials is the tendency to photodegrade when exposed to UV or visible light for long periods of time. Thus, it is important to develop strategies to reduce the photodegradation quantum efficiency and to fully understand the different photodegradation mechanisms.

We report the results from optical and photostability measurements on host-guest films containing amorphous polycarbonate and an organic chromophore, which has a high 2nd order nonlinear optical figure of merit [4]. The photodegradation quantum efficiency depends strongly on the oxygen concentration and it is believed that the main degradation process is oxygen mediated. The decrease in the photodegradation quantum efficiency with increasing optical intensity can be modelled in terms of oxygen depletion in the film. [5] We will also present the results of the effect of various additives incorporated in the polymer matrix with the aim to further reduce the photodegradation quantum efficiency via single oxygen or chromophore triplet state quenching.

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A-0127

SENSITISED RARE EARTH DOPED LAF3 NANOPARTICLES

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During the past few years, lanthanide doped nanocrystals have attracted growing interest because they are promising materials for a wide variety of applications such as polymer optical amplifiers, upconversion and solar-energy converters [1,2]. Hexagonal LaF_3 is an ideal host matrix for rare earth ions due to the low phonon energies and high photochemical stability it exhibits. These nanocrystals can be prepared using low temperature chemical methods [3] and can be easily incorporated into polymers. Luminescence of the rare earth ions arises from parity forbidden transitions between the 4f orbitals of the lanthanide ions and thus have low molar absorption coefficients. The absorption cross section can be improved by surface functionalizing the nanoparticle with a sensitizing ligand.

In this talk we report the results from optical and Raman measurements on LaF_3 nanocrystals doped with different rare earths and capped with oleic acid (OA) and a sensitizing beta-diketonate ligand tenoyltrifluoroacetonate (TTA). We will demonstrate the sensitization of the nanoparticles through the TTA ligand, which results in a significant enhancement of the photoluminescence emission intensity. The change in optical properties of the nanoparticles after ligand exchange will be explained using a core-shell model. The results from Raman measurements on LaF_3 nanocrystals doped with a range of europium concentrations will also be discussed.

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A-0129

RADIO-LUMINESCENCE AND OPTICALLY STIMULATED LUMINESCENCE STUDY OF MN2+ AND EU2+ DOPED FLUOROPEROVSKITES

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We have been researching a range of fluoroperovskite compounds as potential dosimeters for tissue-equivalent or nontissue-equivalent applications [1-4]. In this talk we report the results from measurements on NaMgF3: Eu2+ (nearly tissue-equivalent), RbMgF3:Eu2+, and CsCdF3:Mn2+. We will discuss the radio-luminescence results and present a model to fully account for the dose-dependent increase in the radio-luminescence intensity. The optically stimulated luminescence after exposure to ionizing radiation is stimulable over a wide wavelength range. This can be accounted for by a distribution of carrier traps, which is supported by thermally stimulated luminescence measurements. We will also discuss the results from measurements on composites containing fluoroperovskite nano-particles.

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A-0130

OPTICALLY TUNABLE DIFFRACTION GRATINGS IN PHOTOCHROMIC POLYMER THIN FILMS

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Narrow band wavelength filters are key elements in optical communication as well as strain and chemical sensing [1-4]. Filters for these applications are predominantly made from photobleachable material and the resulting diffraction gratings can not be rewritten or modulated. However, there is a clear need for optically tunable or switchable narrow band wavelength filters for applications that include dense wavelength division multiplexing. We have recently demonstrated optically rewritable Bragg gratings in bulk fluoroperovskites [5]. However the rewriting process requires two-beam interference. It is clearly advantageous to be able to tune or switch wavelength filters using only one beam. For this reason we have been researching photochromic polymer thin films and report our results in this poster. Diffraction gratings were made by two beam interference. We show that one compound can be processed so the diffraction grating can be “turned on” by exposure to UV light and turned off by exposure to visible light. Another compound acts in the opposite fashion where the grating amplitude can be significantly reduced by exposure to visible light and the recovery of the grating amplitude occurs rapidly at room temperature.

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A-0131

MULTIPHASE SEMICONDUCTOR QUANTUM DOTS IN GLASSES

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Quantum dots (QDs) made of lead chalcogenide (IV-VI) semiconductors have been investigated for various applications since they can provide tunable absorption and photoluminescence in the wavelength range from visible to near-infrared due to the quantum confinement effect [1]. For the practical applications, it is important to incorporate these QDs into solid state matrices such as glasses. In fact, glasses containing lead chalcogenide QDs have been studied for saturable absorbers and optical amplfiers. Several techniques have been employed to control the size and spatial distribution of lead chalcogenide QDs in glasses in order to realize the desired characteristics. For example, controlled thermal treatment of precursor glasses containing lead chalcogenides can result in the homogeneous precipitation of QDs in the glass [2]. Ion-implantation and femtosecond laser irradaition can lead to the formation of QDs in the selected region with limited success [3,4].

Effects of the rare-earth ions and metal nanoparticles on the formation of lead sulfide quantum dots in the glasses were studied. It was found that addition of Er_2O_3 led to the blue shift of the absorption band, indicating that sizes of the quantum dots decreased with increasing Er_2O_3 content even when the glasses were subjected to the same thermal treatment. On the other hand, addition of the Ag_2O led to the enhancement of the absorption of PbS QDs formed in the glasses. This result indicated that number of PbS QDs formed in the glasses increased with increasing Ag_2O concentration even when the glasses were heat-treated under the same condition. These results showed that rare-earth ions and silver ions may form clusters in the glasses and PbS QDs were built on top of these clusters.

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Keywords: PbS quantum dots, Rare-earth ions, Silver nanoparticles, optical properties

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A-0132

MAGNETICALLY DRIVEN EFFECTIVE REFRACTIVE INDEX OF THREE DIMENSIONAL ARRAYS OF SEMICONDUCTOR QUANTUM DOT MOLECULES

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Progress in the semiconductor nano-technologies made it possible to design quantum dots and quantum dot molecules within a wide range of geometries and material parameters [1,2]. The quantum mechanical coherent coupling and forming of molecular states in quantum dot molecules can be considered in complete analogy to the real molecules. However in "purpose-designed" quantum dot molecules we have unique opportunity to dynamically manipulate and redistribute wave functions of electrons confined in the quantum dot molecules by application of external fields. Magneto-optical properties of layers of semiconductor double quantum dot molecules (DQDMs) have been studied in details in literature [3-5]. In this theoretical study we consider collective electromagnetic responses from three dimensional arrays of InAs/GaAs asymmetrical lens-shaped DQDMs. Each DQDM is presented by a single discrete dipole and it is characterized by the excess polarizability [4]. This polarizability consists of a static part determined electromagnetically and dynamic part determined quantum mechanically from the excitonic characteristics of the DQDMs when the external magnetic field B is applied to the system. Once the polarizability of an individual DQDM is found we use the Claussius-Mossotti equation [6] to simulate effective refractive index of metamaterials made from three dimensional arrays of DQDMs embedded in semiconductor host materials. Our simulation results show that the imaginary part of the effective refractive index of those metamaterials demonstrates peaks at frequencies relating to the excitonic transitions in the DQDMs. The asymmetry of the DQDMs generates non-uniform diamagnetic shifts of the transition's energies [4]. This leads to the crossing between transition energies at the certain magnetic field magnitude. At the crossing point the peaks of two transitions are combined into one peak and the overall value of the imaginary part of the effective refractive index increased by factor two. We emphasize that this magnetically driven change in the effective refractive index of the three dimensional arrays of semiconductor DQDMs reproduces important information on quantum mechanics of the individual DQDMs. In addition we've simulated the effective refractive index for arrays with different volume concentration of DQDMs. Our simulation results suggest an opportunity to design semiconductor nano-structured metamaterials with dynamically controllable optical characteristics.

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A-0133

PHOTOSTIMULATED LUMINESCENCE FROM POLYCRYSTALLINE, TRANSLUCENT, RARE EARTH DOPED CAESIUM BROMIDE

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Caesium bromide doped with divalent europium ions is a new and efficient storage phosphor used for x-ray imaging. It is commonly prepared by thermal evaporation techniques in the form of needle-like structures which allow for an improved spatial resolution compared to the widely used BaFBr:Eu storage phosphor. This latter material is in the form of a resin encapsulated powder on a substrate and the inferior resolution is caused by light scattering stimulating a large area during the photostimulated luminescence (PSL) readout which occurs optically by raster scanning a focussed laser beam. The caesium bromide storage phosphor has an improved spatial resolution as the readout laser light is to some degree light guided along the needle axis, which is perpendicular to the imaging sheet plane, minimising the scattering. In this presentation we describe the x-ray storage performance of thin CsBr:Eu sheets prepared in an alternative way as translucent polycrystalline sheets. The material has been characterised using optical absorption and fluorescent spectroscopy, scanning electron microscope and electron spin resonance. Representative x-ray images recorded using the sheets will be shown. Results are compared with a commercial imaging plate based on the needle structure on the basis of PSL efficiency, image stability and spatial resolution. The optical transparency of the polycrystalline sheet material is a key performance parameter which is limited by scattering from centres such as pores and impurity phases, the origins of which will be briefly discussed. The preparation method also permits stratification, so that a two-layer sheet with different rare earth dopings can be prepared. The motivation for this stratified structure is single shot dual energy imaging, where two images recorded at different x-ray energies allow for the determination of object composition. In this dual energy imaging plate the images at different energies are distinguished by their different penetrating powers and by the different emission colours from the two layers. Preliminary results from a two-layer imaging sheet are presented.

A-0134

SENSITIZATION MECHANISMS OF 1 UM LUMINESCENCE IN TB3+-YB3+ CO-DOPED BORATE GLASSES

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Tb3+-Yb3+ codoped materials have potential applications as solar spectrum converters in order to improve efficiency of silicon solar cells because of their possibility of quantum cutting mechanism converting one photon into two 1um-photons with quantum efficiency approaching 200 %. In this study, Tb3+-Yb3+ co-doped borate glasses were prepared and the energy transfers (ET) including the quantum cutting mechanism have been evaluated by photoluminescence (PL), photoluminescence excitation (PLE) and lifetime measurements. The compositions of borate glasses are $60B_2O_3$-$20Al_2O_3$- (19.8-x)La_2O_3-0.2Tb_2O3.5-xYb_2O_3 (x=0, 0, 0.5, 1, 3, 5, 10, 19.8) in mol %. The PL of all samples was measured by 378 nm and 488 nm laser excitation. Visible emission peaks between 480 nm and 700 nm due to the 5D4-7FJ transitions of Tb3+ ion and an emission peak at 1030 nm due to the 2F5/2-2F7/2 transition of Yb3+ ion were observed both by 378 nm and by 488 nm excitation. However, the Yb^{3+} concentration dependences of the emission intensity were different between those by 378 nm and 488 nm excitations. The 1030 nm emission intensity of Yb^{3+} by 378 nm excitation drastically increased in low Yb^{3+} concentration, while that by 488 nm excitation smoothly increased with increasing Yb^{3+} concentration. In the PLE monitoring the 540 nm emission of Tb^{3+}, sharp peaks due to the 4f-4f transition of Tb^{3+} at 300 nm, 320 nm, 340 nm, 350 nm, 370 nm, 380 nm and 480 nm were observed, while a broad excitation band with 300 nm peak that is due to the intervalence charge transfer (IVCT) of Tb^{3+}-Yb^{3+} and those due to the 4f-4f transition of Tb^{3+} were observed in the PLE monitoring the 1030 nm emission of Yb^{3+}. In addition, the relaxation time from the excited level to the 2F5/2 level of Yb^{3+} by 337 nm excitation was much shorter than that by 488 nm excitation from the lifetime measurement. These results indicate that the energy transfer mechanisms are different by excitation wavelengths. It is considered that the energy transfer are caused through the IVCT by UV excitation while the energy transfer by the cooperative downconversion is dominant upon the 5D4 level of Tb^{3+} by 488 nm excitation.

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A-0135

X-RAY IRRADIATION EFFECT ON THE OPTICAL ABSORPTION OF CDSE1-XTEX NANOCRYSTALS EMBEDDED IN BOROSILICATE GLASS

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Optical studies of external effects on the optical properties of II-VI semiconductor nanocrystals are of essential interest in view of both fundamental aspects of confinement-related effects and possible applications. Among this class of materials less investigated are $CdSe_{(1-x)}Te_x$ nanocrystals obtained, as a rule, by diffusion-limited growth in a glass matrix. Namely, the behaviour of optical characteristics of $CdSe_{(1-x)}Te_x$ nanocrystals under irradiation has not been studied yet. here we report on the X-ray irradiation-induced effects in the optical absorption spectra of the borosilicate glass-embedded $CdSe_{(1-x)}Te_x$ nanocrystals as well as their variation at subsequent long-term storage at room temperature. The samples were prepared from commercially available Schott optical filters based on borosilicate glass with embedded $CdSe_{(1-x)}Te_x$ nanocrystals. The chemical composition and average size of the latter were determined by spectroscopic techniques. The composition of the nanocrystals in the samples was determined from the difference in the frequencies of CdSe-like and CdTe-like LO phonons in Raman spectra (measured using a Dilor XY 800 spectrometer with a CCD camera and a Kr+ laser operating at 647.1 and 676.4 nm). The samples were additively irradiated using a molybdenum anticathode tube (40 kV, 20 mA), providing an irradiation dose rate of 0.15 Gy/s enabling us to achieve an irradiation dose D of up to 2000 Gy, its value being determined by LiF thermoluminescent gauges. Optical absorption measurements were performed using a LOMO MDR-23 monochromator with a FEU-100 and FEU-62 phototubes in the range from 360 to 1000 nm. The interval between the irradiation and the beginning of the measurement procedure was 1 h. In the optical absorption spectra of the glass-embedded $CdSe_{(1-x)}Te_x$ nanocrystals confinement-related maxima in the near-edge spectral range are observed, their spectral position being determined by the chemical composition and average size of the nanocrystals. X-ray irradiation of the samples results in the confinement-related maxima smearing out and an apparent blue shift of the absorption edge, the value of which increases with the irradiation dose. The observed irradiation-induced transformation of the the optical spectra are explained by the $CdSe_{(1-)}Te_x$ nanocrystal ionization. The radiation-induced colour centres formed in the glass matrix trap the holes from the irradiation-excited electron-hole pairs while electrons are captured by the nanocrystals and occupy the lowest energy states disabling the corresponding optical transitions. Contrary to photoionization, this is a long-lived process: long-term storage of the irradiated samples at room temperature results in a gradual recovery of their initial optical characteristics, the complete recovery being achieved in 2000 h after the irradiation.

A-0136

PHOTO- AND THERMALLY STIMULATED LUMINESCENCE OF BOROSILICATE GLASS-EMBEDDED CDS1-XSEX NANOCRYSTALS

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II-VI semiconductor nanocrystals are intensely studied due to their luminescent properties related to spatial confinement of charge carriers and a variety of possible applications. Additional possibilities for the variation of the emission maximum position arise in solid solution nanocrystals where the energy spectrum is determined by both nanocrystal size and composition. Luminescent properties of II-VI nanocrystals can also depend on the host matrix properties. Not only the spectral dependence of luminescence intensity is interesting, but also its behaviour under external factors - temperature, pressure, high-energy electromagnetic and particle beam irradiation. A special interest is attracted to thermally stimulated luminescence which can provide additional information about the recombination centres.

Here we report on the studies of photo- and thermally stimulated luminescence of $CdS_{(1-x)}Se_x$ nanocrystals grown in borosilicate glass by solid-state precipitation. Photoluminescence (PL) spectra were measured at room temperature using DFS-24 (excitation with a 488.0-nm Ar^+ laser) and Dilor XY 800 (excitation with a 441.6-nm He-Cd laser) spectrometers. For the thermally stimulated luminescence (TSL) studies, the samples, excited with X-ray irradiation (molybdenum anticathode, 40 keV, 2 Gy) and subsequently , 20 □□), were heated at a constant rate 1 K/s from room temperature to 300°C. The TSL spectra were measured using a MS7501i spectrometer.

In the PL spectra of the glass-embedded CdS1-xSex nanocrystals, as a rule, two emission bands are observed. The nature of the higher-energy "near-edge" band is described by the "dark exciton" model, or by exciton coupling to acoustic phonons. Meanwhile, its considerable halfwidth can be the evidence for the defect states being involved in the recombination. The dependence of the higher-energy PL band on the nanocrystal composition and size correlates with the optical absorption data. The observed intensity increase and narrowing of the "near-edge" PL band with the nanocrystal size increase is. in particular, related to the decrease of the contribution from competing surface-related channels of raditive and non-radiative recombination. A broad lower-energy PL band is related to the recombination at surface states and is less dependent of the $CdS_{(1-x)}Se_x$ nanocrystal composition and size.

The measured TSL dependences exhibit a rather sharp maximum at 330 K, its temperature position being independent of the nanocrystal size and composition. Comparison of the TSL data for different luminescence bands is carried out, enabling their assignment to different rcombination centres in the semiconductor nanocrystals as well as in the glass matrix.

A-0137

MASKING PHOTOCHROMIC FILMS FOR NANOLITHOGRAPHY TECHNOLOGY

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Continuation of IC area density scaling demanded by Moore's law with the use of the optical lithography requires research and development of novel materials with unique optical properties. One of the pathways to such optical lithography extension is the use of materials exhibiting a significant range of photoinduced transmission modulation at 193 nm under laser irradiation of the same wavelength.

For this goal the method of photochromic masking based on films exhibiting the reversible change of optical density at 193 nm as a result of photochemical or photophysical transformations of organic compounds between two A and B forms was used.

More than 150 photochromic compounds from 11 classes have been studied in solutions and several photochromic compounds exhibiting the best value of the photoindused change of optical density (OD) at 193 nm have been chosen for the following investigations in the polymer binder and solid films.

The method of testing the photochromic polymer and solid films in operating conditions has been developed. For the testing, a technology for preparation of thin photochromic polymer films using the spin-coating technique has been worked out. It was shown that polymer and photochrome should be at an optimal mass ratio in a thin film to reach the maximum of OD. The best result (OD = 0.87) was received for the polymer film based on one from photochromic diarylethenes and poly(methyl)methacrylate (at the concentration ratio as 90/10 mass.%) of thickness 450±50 nm under 193 nm laser irradiation at exposure doses about 525 mJ/cm2. An application of these photochromic layers may allow to increase a resolution on the photoresist layer up to 22 nm and more with 193 nm photolithography double-exposure method. This work was supported by INTEL

A-0138

HEAT TREATMENT TO PREVENT IMAGE DEFECT OCCURRENCE IN AMORPHOUS SELENIUM DOPED WITH TELLURIUM AVALANCHE MULTIPLICATION PHOTOCONDUCTIVE FILM

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Amorphous selenium (a-Se) has attracted great interest in the engineering and scientific community and has been widely investigated for many years. We have been developing an a-Se avalanche multiplication photoconductive film, or high-gain avalanche rushing amorphous photoconductor (HARP) film [1-3], to meet the demand for a high-sensitivity broadcasting video camera that has superior characteristics for night shoots. In 2001, we developed a 15-micron-thick HARP film with an avalanche multiplication factor of 200. In other fields, the applications of x-ray imaging sensors that use a-Se in medicine have also been studied [4-6].

A HARP film is made of mainly a-Se and has little sensitivity to red light. Then, the HARP film for the red channel in a color camera is doped with tellurium (Te) having the narrower band gap than that of a-Se to

improve its red-light sensitivity. We succeeded in making a 15-micron-thick HARP film with a red-light photoelectric conversion efficiency of double that of the previous one by increasing the amount of doped Te. However, the film has a problem that image defects, called highlight defects, easily occur when a camera using the film is shooting fixed intense spotlights. Highlight defects are caused by a built-in-field from electrons trapped in the Te-doped a-Se layer. We presumed that a heat treatment would give thermal energy to these trapped electrons and release them from trap levels. We found a heat treatment consisting of two steps from the start of operation was effective to prevent highlight defects. The first-step heat treatment lasts one minute with temperatures over 325 K, and the second-step heat treatment keeps over 305 K. During the first step, the dark current increased remarkably. After the first step, the sensitivity to blue and green light with wavelengths of 350-550 nm decreased. These results indicate that some initially trapped electrons in deep and shallow trap levels are released and that the electric field around the incident-light-side interface decreases by the first-step heat treatment. Furthermore, even if photo-generated electrons moving in the conduction band are trapped in shallow trap levels, they are excited to the conduction band due to the thermal energy during the second step and highlight defects occurrence is successfully prevented.

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A-0139

ORGANIC NEAR-INFRARED PHOTODIODES CONTAINING A WIDE-BANDGAP POLYMER AND AN N-TYPE DOPANT IN THE ACTIVE LAYER

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Optical devices operating in the near-infrared region were widely used in the optical communication systems. These devices were usually made from inorganic materials, e.g. GaAs and InGaAs. On the other hand, organic devices have advantages in low-cost and saving-energy, because they can be fabricated by using wet-process. In this research, organic photodiodes (NIR-OPDs) operating in the near-infrared region were fabricated. To improve the dark current property and external quantum efficiency (EQE), a wide-bandgap polymer and an n-type dopant material were mixed in the active layer.

Copper(II)5,9,14,18,23,27,32,36-octabutoxy-2,3-naphthalocyanine (Cu(II)) was used as a photovoltaic material in the active layer. All samples consist of a single organic layer, which was fabricated on an ultrasonically cleaned Indium-Tin-Oxide (ITO)-coated glass substrate. The thickness of the active layer was about 100 nm. Finally, the aluminum (Al) layer was evaporated as the cathode metal.

The samples consisting of Cu(II) only reveal a large dark current. To reduce the large dark current, a wide-bandgap polymer Poly(N-vinylcarbazole) (PVK) was mixed in the active layer. As a result, the dark current was drastically decreased by PVK mixing. This result suggests that the carrier injections from both electrodes were suppressed by the wide-bandgap of PVK, resulting in the suppression of the dark current. However, the photocurrent and the corresponding EQE were also decreased with an increase of PVK mixing. Therefore, the high-efficient separation of the photo-generated electrons and holes in the active layer is important to further improve the photocurrent properties and the corresponding EQE.

Then, an n-type dopant material, [6,6]-phenyl-C61-butyric acid methyl ester (PCBM) was mixed in the active layer to improve EQE. As a result, the photocurrent and the corresponding EQE were clearly increased by PCBM mixing. Moreover, the maximum EQE of 9 % was observed when the ratio of Cu(II):PVK:PCBM is 1:1:5. This result is most likely caused by photo-induced charge transfer by PCBM mixing. The photo-

generated electrons are trapped in C60 in the active region, while the holes contribute to photoconductivity, resulting from the high-efficient separation of electrons and holes.
Finally, ON/OFF ratio was evaluated to optimize device characteristics. As a result, the maximum ON/OFF ratio was observed when Cu(II):PVK:PCBM ratio is 1:1:1. Moreover, the dark current of this sample was suppressed. In addition, the samples consisting of Cu(II):PVK:PCBM mixture layer exhibit a large EQE, which is about ten times larger than that of the samples without PCBM. These results indicate that the optimum device characteristic of NIR-OPDs is accomplished when the ratio of Cu(II):PVK:PCBM is 1:1:1.

A-0140

WELL-WIDTH DEPENDENCE OF EXCITONIC PROPERTIES IN ORGANIC-INORGANIC HYBRID QUANTUM WELL MATERIALS

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Excitons confined in two-dimensional (2D) systems attract great interest from the perspective of fundamental optical physics and device applications. Several studies of the fine structure and the relaxation dynamics of 2D-excitons have been carried out. For inorganic semiconductors, however, it is difficult to investigate such excitonic properties with changing the well width in an atomic order level, because of the small band-gap energy difference and the interface roughness between the well layer and the barrier layer. Organic-inorganic hybrid quantum well material, $(C_4H_9NH_3)_2PbBr_4$, overcomes the problems above. This material forms a self-organized 2D system, in which inorganic semiconductor well layers are sandwiched by organic barrier layers without well-width fluctuation. The inorganic well layers are composed of a mono-layer (ML) sheet of corner-sharing $[PbBr_6]_4$- octahedrons. The thickness of the inorganic layer is about 8 angstrom. The interface between the well and the barrier is intrinsically flat, and has no lattice mismatch. Owing to a very large band-gap energy difference between inorganic wells and organic barriers, strong quantum confinement of excitons is obtained [1]. We can clearly observe the excitonic signals even at room temperature, and the exchange splitting fine structure of the exciton at low temperature. In our previous studies, we estimated that the binding energy and the exchanging energy of exciton are 480 meV [2] and 30 meV [3], respectively. These values are more than an order of magnitude larger than those in inorganic semiconductors. The biexciton binding energy is also estimated to be 60meV [4]. In this study, we synthesized an organic-inorganic hybrid material with bi-layer (BL) inorganic sheets, $(C_4H_9NH_3)_2(CH_3NH_3)Pb_2Br_7$, in addition to ML sample. We have measured photoluminescence (PL) spectra and time-resolved PL. For BL sample as well as ML sample, the splitting in exciton emission due to the exchange energy and the biexciton emission were clearly observed. By comparing the result of BL and ML samples, we can investigate the well width dependence of the confinement effect of excitons in angstrom scale. By analyzing the PL spectra, we estimated exchanging energy and biexciton binding energy in BL are about 9meV and 28meV, respectively. Both energies are decreased comparing with those in ML sample due to a weaker quantum confinement effect. Owing to the narrow splitting energy of the fine structure levels, the transition between the fine-structure levels is activated at higher temperatures. As a result, the temperature dependence of PL spectra and the relaxation dynamics of the excitons in BL sample are different from those in ML sample. The detail results and discussion focused on the difference between BL and ML samples will be presented.

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A-0141

OPTICAL PROPERTIES AND JUDD-OFELT PARAMETERS OF SM^{3+} DOPED $BIO_{1.5}$-WO_3-TEO_2 GLASSES

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Nonlinear optical (NLO) materials with large third-order nonlinearities have attracted much interest in novel applications in optoelectronics, such as optical switchers and limiters, as well as in optical computers, optical memory, and nonlinear spectroscopy. It is well known that a family of glasses comprised of tellurite (TeO_2) as a main entry has great optical nonlinearities due to the significant contribution of the virtual transition from the anionic valance p-orbitals to empty cationic 5d-orbitals of Te atom. In addition to having larger optical nonlinearities, TeO_2-based glasses are very often reinforced by addition of either a second lone air holder (Bi3+, Pb2+) or of cations with empty d-orbitals (W^{6+}, Ti^{4+}, Nb^{5+}). So far, we studied $BiO_{1.5}$ doping effect on third-order nonlinearities into WO_3-TeO_2 binary glasses. And we concluded that WO_3-TeO_2 binary glasses comprise two phases, tellurite molecular phase and WO_3 cluster phase, and that higher third-order optical nonlinear susceptibilities was obtained when a small quantity of $BiO_{1.5}$ content was added. In this paper, we report photoluminescence (PL) properties of Sm^{3+} ion doped- $BiO_{1.5}$-WO_3-TeO_2 glasses. TeO_2-based glasses have a possibility for higher luminescence efficiency due to their low phonon energy (~660 cm-1) and self-focusing effect. These glasses were examined by PL spectra, PL lifetime and UV-Vis optical absorption spectra. Judd-Ofelt (JO) theory was used to calculate phenomelogical JO parameters (Ω2, 4, 6), the spontaneous emission probabilities, the branching ratios, and the radiative lifetime of the state 4G5/2. From these parameters, we discuss the environment around Sm3+ ions and emission properties of Sm^{3+} ions in $BiO_{1.5}$-WO_3-TeO_2 glasses.

A-0142

SECONDARY OPTICAL PROCESSES AND APPLICATION OF X-RAY EXCITED OPTICAL LUMINESCENCE IN MEDICINE

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Radiotherapy and photodynamic therapy are established modes of cancer treatment. They are both effective modes of treatment but they have significant drawbacks. Photodynamic therapy, as it is practised, cannot be used for deep tumor treatment without being very invasive. Radiotherapy is an effective mode of treatment but it results in significant dose related side effects. Our research aims at combining elements of radiotherapy, photodynamic therapy and optical emission from nanoparticles to effectively treat deep tumors.

Excitation of specifically designed nanoparticles with hard x-ray results in optical photons emitted by a secondary process. The energy and lifetime of the emitted optical photons are tuned to be effective in the treatment of cancer cells and lower radiotherapy dosages. Deep photodynamic therapy, bystander effect in radiation therapy, synthesis and spectroscopy of metal oxide nanomaterials will be presented.

A-0143

LASER COOLING OF SOLIDS TO CRYOGENIC TEMPERATURES

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Laser radiation has been used to cool matter ranging from dilute gases to micromechanical oscillators. In laser cooling of solids, heat is removed through the annihilation of lattice vibrations in the process of anti-Stokes fluorescence. Since its initial observation in 1995, research has led to achieving a temperature of 208 K in ytterbium-doped glass. Here, we report laser cooling of ytterbium-doped $LiYF_4$ (YLF) crystal to a temperature of ~155 K starting from ambient, the lowest temperature achieved to date without the use of cryogens or mechanical refrigeration.

The experimental apparatus consists in a YLF crystal, doped with Yb-ions, irradiated with a laser tuned below the mean emission frequency, producing a non-equilibrium electron distribution in the manifolds of the initial and final states. The interaction of these excitations with the lattice leads to phonon absorption followed by blue-shifted fluorescence. Heat and entropy are carried away by the fluorescence photons, resulting in net cooling of the material.

At the maximum available absorbed power of 3.5 W at 1023 nm, the sample cools to 155 K absolute temperature, with a cooling power of 90 Mw.

We used a model to predict cooling performance attainable by pumping the Yb-ions in the best theoretical configuration: the predicted temperature is ~110 K, but lower temperatures and higher cooling efficiencies are expected upon enhancement of absorption efficiency by higher purity and/or ytterbium concentration.

This result demonstrates that laser cooling of solids has evolved from a laboratory curiosity to the only tenable approach for attaining cryogenic temperatures using all solid-state components.

A-0144

KINETICS OF PHOTODARKENING AT ROOM AND LIQUID HE TEMPERATURES IN A-AS45SE55 THIN FILM

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Chalcogenide glasses show a remarkable shift in their optical absorption edge when irradiated with bandgap light. This photodarkening (PD) phenomenon has both scientific and technological importance. Although photodarkening has been investigated extensively at room temperature, relatively little is known about its existence, especially its the kinetics at low temperatures. In this paper, we report the overall magnitude of PD and its kinetics at 4.2K in $As_{45}Se_{55}$ thin films and compare the results obtained at ambient temperature. Our experimental results clearly indicate PD is strongest at low temperature, however the rate of PD was very much slower than high temperature.

We prepared $As_{45}Se_{55}$ thin films by thermal evaporation. PD in these films was measured in situ by using a pump probe optical absorption method. The pump beam which produced PD was a 532 nm (intensity = 1 W/cm^2) diode pumped solid state laser and the probe beam was a very low intensity white light (wavelength ranges from 400 to 1200 nm). The pump beam was expanded considerably to encompass an area that was larger than the probe beam, so that an area of uniform light intensity was examined. The two beams were directed such that they passed through the same spot on the sample. The spectra were collected simultaneously with an interval of one minute from the time when the pump beam was switched on and continued till the PD was saturated.

For low temperature measurement, we kept the sample inside an optical cryostat, and the temperature was brought down to liquid helium temperature (4.2K). The transmission spectra were recorded after stabilizing the temperature at 4.2K (~30 minute).

To quantify bandgap shift, we set its value at the wavelength where the transmittance was 0.05. For low temperature illumination, the initial bandgap was at 559.4 nm and with light illumination it changed to 579.4 nm, i.e. there was a 20 nm red shift at liquid He temperature. However, the magnitude of PD at room temperature was 12 nm, significantly smaller than the low temperature value.

To determine the effect of temperature on the kinetics of PD, we irradiated the sample and simultaneously measured its optical absorption spectrum as a function of time. Interestingly, the rate of PD was very much slower at 4.2K when compared to room temperature.

In conclusion, we studied the PD and its kinetics at room and liquid He temperatures. The experimental results show that the PD is stronger at low temperatures but at the same time the kinetics are very much slower, when compared to room temperature.

A-0145

NON-LINEAR OPTICAL PROPERTIES AND STRUCTURE OF WIDE BAND GAP NON-CRYSTALLINE SEMICONDUCTORS

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Non-linear optical effects in amorphous semiconductors are interesting for both better understanding of their properties and the application possibilities. Here we report of non-linear optical properties of non-crystalline semiconducting (NCS) chalcogenides of the As-S-Ge system along the As_2S_3-GeS_2, As-GeS_2 and As-Ge_2S_3 sections. Coefficient of two-photon absorption (beta) of the samples was measured using a laser operating at the photon energy of 1.8 eV and 40 nanoseconds pulse duration. The structure of the glasses was investigated using Raman spectroscopy, XPS and ab initio DFT calculations. Relationship between (beta) and the pseudo band gap, coordination number as well as other features of the structure was evaluated.

With the monotonous increase of E^0 from 2.35 (As_2S_3) to 3.2 eV (GeS_2), refractive index of ternary glasses As_2S_3-GeS_2 measured at 690 nm decreases from 2.7 to 2.1, respectively. The smallest value of (beta)=0.01 cm/MW was found for As_2S_3-GeS_2 and As-GeS_2 glasses with small GeS_2 and As content respectively. Ternary glasses of the As2S3-Ge2S3 system with relatively high (beta)=0.2 cm/MW values were found to have high level of nanophase inclusions in their structure. The increase of (beta) was observed also in As-GeS_2 and As-Ge_2S_3 glasses after the appearance of SGe3/3-based nanoclusters with 3-fold coordinated Ge and S atoms in their structure, similarly to crystalline c-GeS. For compositions of this ternary system E^0 was found to have smaller values than for As_2S_3 or GeS_2. Based on these results the role of lone-pair electrons in the formation of valence band and changes of (beta) for g-As_2S_3, g-GeS_2, c-GeS will be discussed, together with correlations observed between (beta) and E^0 in wide band gap ternary glasses.

A-0146

OPTOELECTRONIC PROPERTIES OF METAL ORGANIC FRAMEWORKS WITH INCORPORATED DYES

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Because of their outstanding importance for many applications, e.g. catalysis, gas separation or gas storage, the synthesis of new Metal Organic Frameworks (MOFs) and the optimization of already existing MOF networks proceed very fast. However, not only the features relevant for the mentioned applications are worth to be investigated but also the optoelectronic or possible semiconducting properties of MOFs.

The investigated MOFs consist of inorganic zinc-oxo complexes as so called secondary building units (SBUs) that are connected via organic linkers (e.g. terephthalic acid) and are acting as junctions in a three dimensional network.

Small dye molecules like Eosin, Coumarin and Rhodamine were incorporated into the MOF pores either directly during the synthesis or in a subsequent step. A soxhlet extraction was carried out to remove the weakly adsorbed dyes.

In order to the use the MOF/dye hybrid thin films in dye sensitized solar cells the dye molecule should be sensitive to near uv and visible light, thus their optoelectronic properties are studied by uv/vis and fluorescence spectroscopy. Compared to dye-free MOF-5 in the system MOF-5/Eosin Y the absorption of Eosin Y is slightly blue shifted whereas the band edge of the zinc-oxo-system is red shifted.

By excitation with light a ligand to metal charge transfer (LMCT) transition proceeds from the dye molecule to the SBUs. The dye molecules and the linkers behave like light harvesting antennas. Furthermore the photoinduced redox potentials of the pure MOFs were obtained by using a thin film electrode of the concerning MOF as working electrode in a three electrode setup. Comparing different MOFs it is possible to estimate which MOF system is superior as semiconducting material for solar cells. For example the reduction and oxidation potentials for MOF-5 and IRMOF-3 are red= -0.13 V and ox= 0.2 V as well as red = -0.32 V and ox= 0.28 V, respectively.

Moreover the flatband potentials representing the positions of the conduction and valence band of the MOFs are important to find an optimal matching pair of MOF and dye. Mastering the synthesis of dense MOF thin films it is possible to investigate the flatband potential by applying a Mott-Schottky plot. So far the flatband potential was determined on copper containing MOF thin films that were deposited by the layer-by-layer method.

A-0147

OPTOELECTROACTIVE SPECIES IN CONDUCTING THIN FILMS WITH ORDERED MESOPOROSITY: FLUORESCENCE AND ELECTROCHROMIC PROPERTIES

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Titanium dioxide (TiO_2) and indium tin oxide (ITO) are two of the most important materials with application in solar cells and electrochromic devices due to their high transparency and concurrently good electric conductivity. The thin films of these both materials have consistent mesoporous architecture with good accessibility of the pores. This enables the insertion of optoelectroactive guest molecules to get fluorescence sensors and electrochrome materials.

In this work Rhodamine B and Prussian Blue (PB) were incorporated in thin films with ordered mesoporosity of the (semi)-conductors and characterized concerning the obtained optical and optoelectronic behavior.

Rhodamine B belongs to the class of Xanthene dye which shows a well known fluorescence. This can be used to determine the electron transfer between the excited electrons of the dye to TiO_2. Prussian Blue is one of the most extensivly studied material with electrochromic properties. It is a metal hexacyanometallate ($Fe_4III[FeII(CN)_6]_3$), a zeolite-like structure with a high spin Fe(III) coordinated by N-atoms and a low spin Fe(II) cooardinated in the center of the C-atoms. Applying a cyclic voltage in the range of 0.6 - (-0.2) V the blue color changes to colorless and back again caused by the redox behavior of the high spin Fe(III). This reaction is used to examine the electrochromic behavior and the influence of (semi-)conductors during this process.

UV-Vis and fluorescence spectra indicate the successful anchorage of Rhodamine B in the pores. Different types of bonding and concentration have been tested to find the best system for TiO_2 and ITO. It is demonstrate that after excitation a SiO2/Rhodamine B film shows a much higher fluorescence signal than the TiO_2/Rhodamine B film with the same dye concentration. The quenching effect in the latter is caused by transfer of the electrons from the dye to the TiO_2 matrix. In this process the excited electrons in the LUMO of the dye are transferred to the conduction band of the semiconductor. The successful incorporation of Prussian Blue in the pores of the thin films can be demonstrated by X-ray diffraction, UV/Vis and energy-dispersive X-ray spectroscopy.

Measurements to determine the electrochromism have been carried out with a 3-electrode setup and KCl as solution. During cyclic alteration of the voltage applied to the PB/metal oxide hybrid film from 0.6 V to -0.2 V the transmission at 700 nm for PB/TiO_2 and 727 nm for PB/ITO is continuously recorded. Analyzing the electrochemical and electrochromic behavior, both hybrid materials PB/TiO_2 and PB/ITO show a good long term stability. Whereas with progressive cycling Prussian Blue deposited on nonporous ITO or FTO (fluorine-doped tin oxide) exhibit a permanent loss of color intensity, the mesoporous hybrid materials show a little loss only in the first few cycles, but are than stable for all of the more than 100 tested cycles.

The calculated coloration efficiencies of the PB/TiO_2 and PB/ITO films have values with good prospects, which can yet be circumstantiate with more porous hybrid systems (e.g. antimony-doped tin oxide). Therefore these materials are promising candidates for application in electrochromic devices and smart windows.

A-0149

CONTROL OF MACROSCOPIC RESPONSE OF RABI OSCILLATIONS IN A QUANTUM DOT ENSEMBLE

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Optical Rabi oscillation (RO) plays crucial roles in coherent control in a two-level system. The lowest excitonic state in a quantum dot (QD) is a good candidate for the demonstration of RO in a solid-state system, since it exhibits discrete energy level, large dipole moment, and long dephasing time. We observed ROs of excitonic population and polarization in a QD ensemble [1] and showed theoretically that ensemble average of excitonic ROs is changed with the spatial distributions of incident pulses [2]. In this presentation, we show that macroscopic optical response of ROs in a QD ensemble can be controlled by changing spatial distributions of incident pulses.

We have calculated excitonic ROs including the ensemble effect caused by the spatial distribution of incident pulse. The spatial distributions of the incident pulse used in our calculation are rectangular shape (flat-top beam) and Gaussian TEM00 beam. The calculated results show that the average RO excited by the rectangular pulse coincides with the sinusoidal function in an ideal two level system. On the other hand, for the RO excited by Gaussian TEM 00 pulse, the oscillatory behaviour changes drastically and its amplitude decreases compared with the rectangular case. This result shows that a macroscopic coherent response from a QD ensemble can be controlled by changing the spatial distribution of excitation pulses. We have experimentally confirmed the above presented method for macroscopic control of the ROs. Our sample was fabricated using molecular beam epitaxy; it contained 150 layers of InAs self-assembled QDs embedded in 60-nm-thick InGaAlAs spacers on an InP(311)B substrate [3]. Pump-probe and two-pulse four-wave mixing (FWM) measurements were used to investigate the ROs of the excitonic population and polarization, respectively. Excitation was performed using 1.1-ps optical pulses generated by a Ti: sapphire-pumped optical parametric oscillator at a repetition rate of 76 MHz. We measured the differential transmission (DT) of the probe pulse and the FWM intensity as a function of the average area of the first pulse. The area was changed by varying the spatially averaged electric field, while maintaining a constant temporal duration for the excitation pulse. Using a beam shaper we controlled the spatial distribution of the pulse to excite the sample by a flat-top beam. Then we compared the macroscopic ROs excited by the flat-top beam with one excited by a normal Gauss beam. We confirmed that the RO of the excitonic population excited by the flat-top beam shows a clearer oscillation than that excited by the Gauss beam. In my presentation, I will show the detailed results of the experiments and compare with the calculation.

A-0150

PLASMON ENHANCED OPTICAL RECORDING IN AS-SE LAYERS

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Amorphous chalcogenide glasses are well known as optical memory materials where different photo-stimulated process like photo-darkening and bleaching, local expansion or contraction, changes of the reflectivity and index of refraction take place. These are essential for different types of amplitude-phase optical recording. The mechanisms of these processes, even for phase-change type, are still not completely clear, sometimes even contradictory. These can be related to the differences in the real composition and structure of the investigated amorphous chalcogenide layers, which depends on the technology as well. Anyway, some typical compositions and reproducible recording conditions can be selected for further developments, since even the sensitivity at amplitude recording in the best materials like $As_{0.5}Se_{0.5}$ for red laser illumination is rather low due to the absence of internal amplification.

We have succeeded in the enhancement of optical recording process using the plasmon enhancement effect, which is rather widely investigated in systems where the local excitation of the electrons and atomic structure are essential for the resulting effect. From a number of As-Se compositions $As_{0.2}Se_{0.8}$ was selected as a model one, since these layers reveals the giant light-stimulated thickness change and a rather small photo-darkening under He-Ne laser illumination (λ=633 nm) [1]. 30-50 nanometer thick Au layers on transparent substratum were annealed to create gold nanoparticles (GNP) with different shape and dimensions in the 25-60 nm range. They were covered by the thermally evaporated chalcogenide layer. The time and the intensity changes of the optical transmittance and thickness were measured. It was shown that in the case of As-Se film photo-darkening and red shift of the absorption edge, as well as local expansion occurred under low-intensity laser illumination. In the As-Se - GNP system after a stage of faster darkening the optical transmittance starts to increase with decreasing thickness and blue shift of the absorption edge. So the whole recording process reveals enhanced changes of transmission and thickness. The dependence of these effects on the localization of the plasmon peak in the GNP-chalcogenide system, as well as on the intensity of illumination was investigated in order to establish the best conditions for enhancement of the recorded relief and to make suggestion about the mechanism of underlying processes.

This work was supported by NKTH-OTKA grant K67685.

1. M. L.Trunov, P. Lytvyn, V. Takats, I. Charnovych, S. Kokenyesi, Journal of Optoelectronics and Advanced Materials. Vol. 11, № 12 (2009), p. 1959-1962.

A-0151

INFLUENCE OF SILICATE GLASS TYPE ON BLUE-GREEN LUMINESCENCE OF CU$^+$

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Optical materials containing copper ions have become a subject of considerable interest, as they show potential for obtaining tunable laser emission in the blue-green spectral region Cu(I) - as well as in the near infrared Cu(II). The Cu(I) is far less stable and it can be easily oxidized to Cu(II).

We have designed and melted rather simple silicate glasses containing silica, zinc and sodium oxides and various concentrations of cuprous (I) oxide (from 0.01 to 0.3 at.). The glasses were characterized by UV-VIS absorption spectroscopy and photoluminescence (PL) measurements done under various conditions and temperatures. All the glasses exhibited very strong blue-green luminescence typical for the Cu(I), having the maximum intensity between 0.05 and 0.1 at. % of Cu in the bulk glass. Besides the preservation of the oxidation state (I) also oxidation to the state (II) obviously occurred. The typical PL emissions of the Cu(II) at 1200 nm occurred, which intensity, being rather strong at 14 K, decreased only slightly with increasing temperature of the measurement up to the room temperature. Mutual representation of the both copper oxidation states and its dependence on the treatment of the samples will be discussed. The results show that the glasses will be suitable for application in active photonics devices operating in a broad spectral region from visible to near infrared.

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A-0152

DEWETTING-ASSISTED FORMARION OF NOVEL FLUORESCENT AGGREGATES OF RHODAMINE DYES AND THEIR CONTROLLED SWITCHING TO DEQUENCHED STATE

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Pi-conjugated organic dyes have great prospect for photonic applications, as well as electronic devices, because of their high oscillator strength of the pi-pi* transition and its wide tunability in wavelength via molecular design. However in aggregated states, most dye species, including rhodamines (Rh), get quenched and only few species, e.g., those providing J-aggregates, remain to be fluorescent. To demonstrate an in situ fluorescence switching, quasi-stable Rh aggregates were formed utilizing dewetting process on a hydrophilic surface and their fluorescence intensity was traced during annealing.

Every as-grown aggregate of Rh 6G, Rh B, and Rh 101 showed fluorescence, when prepared by the wetting / dewetting process of an ethanol dye solution: dye molecules were accumulated in droplets by a solution flow during a rapid evaporation of solvent ethanol, which was much faster than the conventional diffusion process. This rapid process implies that the dyes in as-grown aggregates have quasi-stable molecular ordering. Upon annealing to 200^{o}C, every particle showed the identical fluorescence decrease down to 5 % irreversibly, which suggests that the self-organized dye aggregate alters its mode of dye ordering from the dequenched state to the specific quenched state (like H-aggregate) when the temperature was raised. The present observation suggests that the original aggregate is in a quasi-stable state, which is consistent with the non-equilibrium nature of the rapid dewetting process.

Fluorescence excitation spectrum of the original aggregate showed a peak at shorter wavelength than that of the absorption spectrum of an ethanol solution specimen, suggesting that the energy band of the aggregate is similar to that of an H-aggregate, and therefore, that the absorption is strongest at the top level of the energy band. Emission spectrum, however, showed a peak, not blue shifted, but similar to that of the solution specimen, which shows that the emission was not from the top of the energy band. We propose a model that the excited state in the aggregate relaxed down to the bottom of the band via exciton-phonon coupling and then emit fluorescence like a J-aggregate. The fact that the emission spectrum was similar before and after the annealing, although the fluorescence efficiency was greatly reduced, suggests that the relaxation process of the excited aggregate may be altered, or hindered by a non-radiant state, after annealing.

A-0153

SENSITIZATION OF ERBIUM PHOTOLUMINESCENCE IN ERBIUM DOPED SILICA WITH LOW SI EXCESS

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Sensitization of erbium photoluminescence in silicon rich silica is usually attributed to Si-nanoclusters, which grow during thermal treatment. Photoluminescence lifetimes from sensitised Er3+ ions are usually short compared to directly excited ones, mainly due to nonradiative processes introduced by nanoclusters, and also to the enhancement of the erbium radiative rate in the proximity of a nanocluster interface. We studied nearly-stoichiometric samples of silicon rich silica containing erbium. For non-resonantly pumped erbium photoluminescence, we observed double-exponential decay transients, with longer component showing time constants similar to directly pumped erbium in silica (about 13ms). Our hypothesis is that this occurs due to energy migration between ions coupled to sensitizers and non-coupled ones. In this way the ions coupled to sensitizers can transfer excitation to other ions which are non-coupled, and the latter can contribute to long photoluminescence lifetimes. To test this hypothesis, we varied the duration of pumping laser pulse, and this experiment provides qualitative proof that excitation via ion-ion energy migration is possible.

A-0154

FABRICATION AND CHARACTERISTICS OF SITE-CONTROLLED (111)B QUANTUM DOTS BY HIGH PURITY MOVPE

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The convergence of several national agency funding has permitted the establishment at Tyndall National Institute-University College Cork of a new, state of the art facility for III-V semiconductor growth. The fully operational Metalorganic Vapour Phase Epitaxy (MOVPE) system is successfully supporting a wide range of projects. One important activity funded by Science Foundation Ireland is the development of site controlled quantum dots for basic physics studies and quantum information development. As high purity -together with a full understanding and control over the epitaxial growth process- are essential when it comes to engineering semiconductors nanostructures, a big effort has been put into establishing Tyndall MOVPE system as one of the “purest” kits worldwide: GaAs quantum wells with significantly improved optical properties were demonstrated, showing linewidths comparable to the best results reported in the literature (but grown with

the more research oriented molecular beam epitaxy techniques); important findings were obtained on position controlled QD growth (Pyramidal QDs), showing record narrow excitonic emission linewidths for site-controlled quantum dots (and MOVPE grown…), while maintaining an extraordinary homogeneous ensemble (inhomogeneous photoluminescence broadening <3 meV). These results are not important only in the field of quantum information, but can impact very positively on more conventional III-V device fabrication, allowing for higher performances both in the photonics and electronics fields.

This talk will review some of our recent results in the epitaxial field and Pyramidal QD optical properties, give an overview of the growth mechanisms involved and discuss future challenges in the field (e.g. incorporation of nitrogen).

A-0155

LUMINISCENCE AND LIGHT STABILITY OF EUROPIUM COMPLEX AND ITS MIXTURES WITH LANTHANUM OR GADOLINIUM COMPLEX IN POLYMER FILMS

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The rise and decay of luminescence and short-lived products of Eu(3+) with thenoyltrifluoroacetone (TTA) and 1,10-phenanthroline (Phen) (Eu(TTA)3(Phen)) and those of mixtures of Eu(TTA)3(Phen) with La(TTA)3(Phen) or Gd(TTA)3(Phen) as well as mixed complexes EuxLa1-x(TTA)3(Phen) or EuxGd1-x(TTA)3(Phen) in polymethyl methacrylate (PMMA) and polyethylene (PE) films were studied by the nanosecond laser photolysis method.

Induced absorption in 450-750 region with maximum at 600 nm and half-life time about 3 ms was observed and assigned to triplet state of TTA. The consumption of short-lived product has a “solid state” kinetics and is described by the model taking into account the nonequivalence of TTA ligands.

The laser induced and steady-state luminescence of the complexes mixtures in PMMA at low concentrations (< 2 mmol/kg) depends only on Eu(TTA)3(Phen) content. At higher concentrations of Eu(TTA)3(Phen) and La(TTA)3(Phen) a weak synergistic effect was observed. The decay and rise of the slow luminescence in PMMA have monoexponential character. The rate of the slow luminescence rise related to transitions from the 5D0 corresponds to the rate of the fast luminescence decay related to transitions from the 5D1 state. A model of phenomenon included triplet-triplet energy transfer from TTA ligands of non-luminescent La(TTA)3(Phen) on Eu(TTA)3(Phen) was proposed. The model well describes the experimental data and allows to predict both the scale of the phenomenon and the ratio between the components for maximal synergistic effect performing.

A strong synergism was observed in PE between Eu(TTA)3(Phen) and Gd(TTA)3(Phen) complexes but only at low Eu/Gd ratio. This effect was attributed to formation of the mixed EuxGd1-x(TTA)3(Phen) complexes or large associates of Eu(TTA)3(Phen) and Gd(TTA)3(Phen).

The main peculiarities of complexes consumption and decrease of the luminescence intensity during photolysis by light with wavelenghth > 320 nm of Hg-lamp were determined. It was shown that relative initial rate of luminescence decreases as a rule substantially higher than the rate of absorption decrease in TTA-band. The relative initial rate of luminescence decreases when the concentration of complexes increases, but the relative quasi-stationary intensity, conversely, grows with concentration. The light stability of mixtures of Eu(TTA)3(Phen) and La(TTA)3(Phen) measured by luminescence decrease equals to that of pure Eu(TTA)3(Phen) and is noticeably higher for the mixture of Eu(TTA)3(Phen) and Gd(TTA)3(Phen). Those phenomena were described taking into account the complexes association and screening action of the complexes and their products.

A-0156

OPTICAL AND ELECTRICAL CHARACTERIZATION OF SOL-GEL-DERIVED SNO_2:EU,SB

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A number of studies concerning rare earth (RE) activated stannia (SnO2) as potential new luminescence material have appeared recently. Yet, the reported luminescence properties and their interpretation are often quite ambiguous, which may be related to the presence of various lattice defects (non-stoichiometry) induced by specific preparation routes, thermal treatments and the requirement of local charge compensation accompanying with trivalent RE doping. For example, it is unclear whether the defects like oxygen vacancies enhance or hinder the host-sensitization of europium in SnO_2. A possibility to clarify the situation is to incorporate a co-dopant to purposefully modify the defect structure or conductivity of the material. Also, proper co-dopant can be expected to improve the solubility of RE ions in SnO2 matrix. Doping with (pentavalent) antimony acting as electron donor is widely used to enhance electrical conductivity of SnO_2.
We employed sol-gel method to prepare SnO_2:Eu (0.5 at%) samples co-doped with various amounts of Sb (0.25 to 1 at%) using tin isopropoxide, Eu-chloride and Sb-chloride as starting materials. Powders, films as well as fibers were prepared such that a combination of optical (photoluminescence, absorption and Raman-scattering) and conductivity measurements could be carried out. As-prepared samples were annealed up to 900°C.
Excitation wavelengths 464 and 266 nm were used to achieve direct and host-mediated excitation of Eu. Well-resolved Eu^{3+} emission in crystalline phase was observed under 266 nm excitation whereas mainly broadband emission characteristic of amorphous environment was revealed under direct excitation indicating that still minor amounts of Eu become incorporated in the crystalline phase. The influence of lattice defects on the emission and excitation properties of Eu in SnO_2 is evaluated based on correlations between optical properties and conductivity.

A-0157

NOVEL FLUORESCENCE EXCITATION KINETIC PROTOCOL FOR FURTHER STUDIES OF PLANT PHOTOSYNTHETIC ACTIVITY

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Photosynthesis is a process converting CO2 into organic compounds, especially sugars, using the energy from sunlight, and is vital for life on Earth. It varies depending on the species and the environment in which the plant is growing. Photosynthesis always starts when energy from light is absorbed and transferred to photosynthetic reaction centers which represent chlorophyll-protein complexes. The absorbed light energy is used mainly for photosynthesis, but part of it is lost as heat and fluorescence. For monitoring the highly important photosynthesis the measurement of chlorophyll fluorescence is a useful tool. However, its feasibility is very much limited by additional factors (e.g. light, other environmental parameters, leaf structure, plant species). Therefore plant researchers are using different measurement protocols to gain more information about the plant physiological state.
The most common technique is based on pulse amplitude modulation (PAM). This kind of instruments applies at least two different light sources. The first light is the so called measurement light, with has a wavelength in the range of the chlorophyll absorption spectrum (below 700 nm), and modulated with several (1-200) kHz frequency. The amplitude and duration of the pulses is chosen so small that photosynthetic process is not induced. The second light source activates photosynthesis, and called actinic light is continuous (i.e.

non-modulated). They register the temporal variation of the emitted fluorescence light amplitudes using synchronous detection. Furthermore, additional intense flashes (ca. 500 W/m2) are applied for a short time (0.1-1 s) at definite time points to saturate the photosynthesis, and thus estimate some important plant physiological parameters (e.g. photochemical and non-photochemical quenching). This method has the disadvantage that the used saturating light level is independent on the sample. Also, its extremely high intensity is unusual for the biological sample.

We developed a new measurement method, which allows fluorescence measurement, at two specific fluorescence bands dependent on the leaf sample. This is achieved by a feedback power adjustment of the fluorescence exciting laser diode. Thus, the intensity of the excitation light is adapted to the actual need of a particular sample for quantum conversion and becomes saturating without applying exaggeratedly high quantum flux density. Our measurement is carried out in two steps. In the first phase (usually ca. 1 second) we keep the laser power constant and record the emitted fluorescence. In this part we measure the rise of the fluorescence kinetic curves, which also has been found to be an adequate technique for measuring plant physiological parameters (so called OJIP technique). In the second phase we measure the laser power simultaneously with the fluorescence at the other wavelength.

This paper presents briefly the measurement techniques in the field of plant fluorometry. Furthermore it is focused on our currently developed, portable instrument which is equipped with the novel fluorescence measurement protocol as well as its wide range of application. The novel protocol is found to allow a new insight into the plant physiological behaviour.

Reference:

Barocsi et al. “Excitation kinetic during induction of chlorophyll fluorescence.” Photosynthetica (2009) 47 104-111.

A-0158

POLYMER-POLYMORPHOUS NATURE OF RELAXATION PROCESSES IN LIQUID AND GLASSY SIO$_2$

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Vitreous SiO$_2$ is widely used in optics and optoelectronics, in particular for the production of radiation-resistant optical fibers which are applied for spectroscopy, transmission of images, as well as high-power laser radiation. SiO$_2$ - is one of the most well-studied glassformers, but still is full of mysteries. Although, considerable progress has been made in understanding the relaxation processes in SiO$_2$ at present years, but in particular, in the process of glass transition, some crucial questions still remain unanswered (Y. Yue, 2007).

Many authors, starting from Lebedev (1921), Tudorovskaya (1938), Deeg (1957), Westbrook (1960), Brückner (1970) has observed the temperature's anomalies dependence of properties of glass which is rich with silica or pure v-SiO2 in the regions of the □-□ - transition in tridymite at 117 ° C, in cristobalite at 240° C and in quartz at 579 ° C (Lebedev - 1921).

Using a small-angle X-ray scattering, Golubkov (1992) has revealed, in v-SiO2, the transformation from quartz- to cristobalite-like structure by heating at 1150 ° C treatment and inversely to quartz-like during the annealing of 900 ° C.

The shape of heat capacity jump from glassy to liquid state are distorted, and Tg (initial value) decreases with increasing number of DSC scans (Y. Yue, 2007) .

These facts of glass anomalous behavior during relaxation processes were not fully explained by existing concepts of glass structure (Zachariasen - 1932, Lebedev - 1921, Porai-Koshits - 1960, Goodman - 1975, as well as in frame of Greaves', Lucowsky's, Galeener's, Wright's models - 1985-1990). The concept of polymer-polymorphous structure of glass and glassforming liquid, suggested by V. Minaev(1991) clarifies physicochemical essense of these phenomena. In accordance with this concept, all relaxation processes have a common physical-chemical nature and characterized by changes in structure and properties of non-crystalline substances, including SiO_2, under external influences such as temperature, pressure, photoirradiation and others. It is characterized by the emergence, decay, interconversion and, therefore, the change of the concentration ratio of the structural fragments (polymorphoids) of different polymorphs (PM), forming this non-crystalline substance, in the direction of the equilibrium corresponding to existing conditions. Polymorphoids haven't translational symmetry (long-range order) of the crystal, but have short- and intermediate-range orders, which characterizing PMs, that taking part in the formation of non-crystalline substance.

A-0159

PRESSURE AND TEMPERATURE TUNING OF RED LASER DIODES TOWARDS YELLOW AND GREEN

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Semiconductor laser diodes are not available in the yellow-green region of the visible spectrum (500nm-600nm). Recently there have been many attempts to access this range from the short-wavelength side i.e. using InGaN lasers. From the long-wavelength side (i.e. using InGaAlP lasers) the shortest available wavelengths are around 625 nm. Quantum wells are shallow at such wavelengths and leakage currents are large so that the lasers only operate at lower temperatures. Since high-pressure/low-temperature tuning can move the red-laser emission down by about 70 nm [1], we performed an effort towards reaching yellow-green lasers by tuning 622 nm and 627 nm red lasers manufactured by LDX Optronics (USA). These were broad area, high power devices (60 micron stripe, powers up to 300 mW) mounted in a piston-cylinder high pressure cell (pressures up to 2GPa). The cell was placed in a simple cryostat allowing to change the temperature from 20C down to -190C. With temperature tuning we were able to reach orange wavelengths down to 600 nm. With combined high pressure of 18 kbar and low temperature of -190C we reached wavelengths below 560 nm with high power and good beam quality. Threshold currents increased exponentially with pressure p (like exp[(ap-DE0)]/kT)), as expected for leakage across the barriers that become lower under pressure. However, compared to our previous experiments with longer wavelength lasers [1] the barriers seemed to decrease more rapidly with pressure, indicating that the dominant leakage was through X minima in the barriers of the laser structure. This is probably due to higher Al content in AlGaInP barriers pushing the X minima below the L-minima. Careful optimization of the barrier and cladding composition is necessary to reach further into the green range using InGaP/AlGaInP laser structures.

[1] “Yellow AlGaInP/InGaP laser diodes achieved by pressure and temperature tuning”, R. Bohdan, A. Bercha, W. Trzeciakowski, F. Dybala, B. Piechal, M. Bou Sanayeh, M. Reufer, P. Brick, Journal of Applied Physics 104, 063105 (2008)

A-0160

PROPERTIES OF FERRITES WITH NONISOMETRIC PARTICLES IN ORGANIC COATINGS

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The pigments based on mixed metal pigments were synthesized at high temperature. The synthesized pigments $XxZnyFe_2O_4$ $XxZnyFe_2O_4$ (where X= Ca, Mg, x+y=1) had particles with a lamellar shape. The other type of synthesized ferrite pigments were core-shell anticorrosion pigments where a layer corresponding to this composition $XxZnyFe_2O_4$/core was applied onto the core - muscovite. The prepared pigments were characterized by means of X-ray diffraction analysis, particle size distribution measurement, and scanning electron microscopy. The synthesized anticorrosion pigments were used to formulate alkyd paints that were tested in corrosion atmospheres. Good anticorrosion efficiency was detected in all of the synthesized pigments.

A-0161

ANALYSIS OF SOME OPTICAL PARAMETERS OF GLASSES OF THE $BI_X(AS_2S_3)_{100-X}$ SYSTEM

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With the aim of characterizing the optical properties of the glasses from the system $Bi_x(As_2S_3)_{100-x}$, for x=0.5,2 and 4 at.% Bi, their absorption coefficients and index of refraction were measured. The extrapolation of the linear parts of the absorption coefficient dispersion curve for the different sample thicknesses enabled the determination of the optical band gap Eg. Also, in view of the range of the values of the absorption coefficients for all three glasses, it was possible to determine the Urbach slope Ee, the width of the tails in the localized states of the optical gap.

The results of the refractive index measurement were treated using the Wemple di Domenico dispersion analysis. Among the others, the effective oscillator energy E0 and the strength parameter of interband optical transitions Ed were determined, the latter being of special importance as it establishes the link with the other physical parameters of the material. In this way, it was possible to estimate the coordination number in the investigated glasses, which enabled the derivation of certain conclusions about the lattice modification caused by introducing Bi into the arsenic-sulfide matrix.

A-0162

ELECTRON AND TRAP DYNAMICS IN GABIAS LAYERS

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Recently, much attention was paid to the investigation of relatively new semiconductor compounds - dilute bismides. The incorporation of just a few percent Bi into GaAs results in such unique features as narrower and insensitive to temperature changes energy bandgap, increased refractive index, and strongly enhanced spin-orbital splitting of the valence band. All these features make dilute bismides prospective for the applications in various long-wavelength optoelectronic devices: diode lasers, electro-absorptive light modulators, photoconductive terahertz (THz) frequency range components, and even solar cells. These applications raise specific requirements for the material parameters. For example, the carrier lifetime must be shorter than 1 ps for THz devices or light modulators and as long as possible for light emitters or solar cells.

In this contribution, we will describe the study of the carrier lifetime in dilute GaBiAs layers and quantum well structures that were grown on GaAs substrates in a solid-state molecular-beam-epitaxy (MBE) system at the substrate temperature ranging from 240 to 350^{o} C. The GaBi part in the alloy was varying from 0.01 to 0.1 %; it was increasing when the growth temperature and/or Bi/As beam-equivalent pressure ratio were decreasing. The carrier lifetime was measured with the femtosecond Yb:KGW laser pulses and the optical pump - THz probe technique.

The samples grown at lower temperatures and at As-overpressure had the electron capture times shorter than 1 ps. The measurement of the shape of optically induced THz absorption transients at different photo-excitation levels was also performed, and the electron trap saturation at higher excitations was observed. The analysis of these results has led to the estimation of the electron trapping cross-section. The values of this parameter were found to be larger than 10-13 cm^2, comparable to the electron trapping cross-section by As-antisite defects in low-temperature grown GaAs (LTG GaAs). The electron trapping time decreased after annealing the samples at higher than 500^{o} C; which has been interpreted in terms of the changes in the trap charge state. Short-lifetime GaBiAs layers were used for the manufacture of photoconductive THz emitters and detectors. THz time-domain-spectroscopy system that was built using these devices has demonstrated a performance superior to that of the traditional system based on Ti:sapphire laser and the LTG GaAs photoconductors.

On the other hand, in the samples grown at higher substrate temperatures the electron trapping times could be as large as 300 ps. Strong room-temperature photoluminescence has been observed both in the bulk epitaxial layers and in the quantum wells grown at these conditions. This observation opens the way to the investigations of long-wavelength light emitting devices made from GaBiAs and other diluted bismide compounds.

A-0163

OBTAINING ZNO/CUINSE$_2$ HETEROSTRUCTURES BY SEQUENTIAL ELEMENTAL EVAPORATION

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We obtained ZnO/$CuInSe_2$ heterostructures and investigated the interface between ZnO and $CuInSe_2$. Firstly, layer of Zn was evaporated on unheated glass substrate by ion evaporation method in vacuum. Needle-shaped nanostructures of ZnO have been grown by thermal annealing in air of prepared Zn films. Secondly, onto these structures Se and In layer were sequential deposited by thermal evaporation method and Cu layer - by ion evaporation method in vacuum. Obtained samples were annealed at 4000C to form $CuInSe_2$ (CIS). Morphological, structural and compositional characterizations of these films were carried out by scanning electron microscopy, energy-dispersive X-ray spectroscopy and X-ray diffraction analysis methods. Photovoltaic properties of these structures were also investigated.

A-0164

CONTROLLING THE MICROSTRUCTURE AND PROPERTIES OF MATERIALS THROUGH NONLINEAR LIGHT PROPAGATION

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While liquid crystals, surfactants and colloidal crystal systems assemble into ordered phases as they attain free energy minima, strikingly complex patterns can also emerge when condensed matter systems are perturbed away from equilibria. This talk will be an overview of research in our group into the dynamics of light beams that propagate while simultaneously initiating free-radical polymerisation in photopolymers. The consequent nonlinear and reciprocal interactions between the optical field and self-induced refractive index changes in the medium elicit a rich family of three-dimensional spatial patterns. These include self-trapping bright and dark beams, beam filamentation due to modulation instability, diffraction rings due to self-phase modulation and the formation of 2-D and 3-D bright and dark optical lattices. Emphasis will be placed on the remarkable potential these non-equilibrium optical phenomena present to spontaneously inscribe complex 3-D polymer architectures that are inaccessible through conventional lithographic techniques and that would have advanced optical applications

A-0165

EPITAXIAL LITHIUM NIOBATE THIN FILMS GROWN BY CHEMICAL BEAM EPITAXY ON SAPPHIRE

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Lithium Niobate ($LiNbO_3$) is a versatile material with a number of remarkable qualities. It finds application in optical modulators due to its electro-optic properties. Nonlinerity opens its use in bio-physical applications where particles or wires of $LiNbO_3$ can be used as highly localized optical probes. Optical frequency conversion is another possible use, as well. One of the current commecial applications of the material is in optical modulators in telecomunication devices. Nowadays bulk crystals of the material are used. However, in order to make devices more compact and affordable it is necessary to be able to produce LiNbO3 films on suitable substrates with sufficient crystalline and optical quality.

Here we present films deposited by means of chemical beam epitaxy (CBE). The films were produced in a high vacuum chemical vapour deposition reactor using lithium tert-butoxide (Li(OBut)) and niobium tetra-ethoxy di-methyl-amino-ethoxide ($Nb(OEt)_4(dmae)$) as sources of Li and Nb atoms. No additional oxygen was used. Deposition took place at 650°C. The reactor is designed for deposition on up to 6” wafers, however smaller (10x20 mm^2) sapphire (0001) substrates were used to facilitate the research. The choice of the substrate was determined both by its suitability for epitaxial deposition, mechanical properites, availability and preferable optical properties (transparency and sufficient refractive index difference for possible waveguiding applications). Optimization of the Li/Nb content ratio was performed using gradients of precursors in a combinatorial way and based on the feedback from X-ray diffraction (XRD) and Raman spectroscopy.

The optimized samples reveal high crystallinity and are highly textured in the <0001> direction. The rocking-curve measurements on the {0006} peak confirmed a high degree of orientation; the broadening of the peak being only 0.03°. The pole-figure XRD measurement confirmed that the film is highly <0001> oriented in the vertical direction and also in plane. Six discreet {012} reflections have been observed instead of three expected for the perfect LiNbO3 structure. This was explained by growth of two equivalent variations of the $LiNbO_3$ trigonal structure rotated by 60°. Additionally, LiNbO3 crystalline quality and phase purity was confirmed by Raman spectroscopy.

TEM observation revealed a very thin transition layer of few nanometres at the film-substrate interface. The formation of the layer is probably due to the large lattice and/or thermal expansion coefficient mismatch between $LiNbO_3$ and sapphire.

The roughness of the film is one of the key factors in the fabrication of high quality, low optical loss devices. The roughness of the deposited films was determined by AFM measurements and the RMS value is ~5 nm for 200 nm thick films.

A second harmonic generation signal was detected, when the film was irradiated with 800 nm light from a femtosecond Ti:sapphire laser, proving the non-linear properties of the films.

Thus, the ability to deposit epitaxial $LiNbO_3$ films with high crystalline quality and low surface roughness using chemical beam epitaxy has been demonstrated and deeper understanding the deposition process has been earned. Further optical characterization of the films is in progress.

A-0166

MICRO-MACHINED FLUIDIC DEVICES FOR TERAHERTZ TIME-DOMAIN SPECTROSCOPY

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Here we present a silicon based, microfluidic device for terahertz frequencies, fabricated using standard lithographic and micro-machining processes in a cleanroom environment. Designed for use in a conventional transmission terahertz time-domain spectroscopy (THz-TDS) arrangement, we present a possible solution to the ‘water problem’ currently hampering the analysis of aqueous and biological systems at THz frequencies. We detail results from a range of experiments, highlighting the device sensitivity and potential, wide-ranging applications.

The analysis of aqueous samples using standard THz-TDS techniques has long been hampered by the optically dense nature of water at THz frequencies. Here, we detail the design, fabrication and testing of a microfluidic device fabricated solely from silicon, a material inherently transparent to THz radiation. Knowledge of the precise optical path length through a sample is paramount in the extraction of the dielectric properties of a material. By utilising the wealth of micro-machining techniques available for silicon, we define this path length to a high degree of accuracy in our device. Minimising the optical path length means strong signals can still be detected, even after interaction with highly polar samples. One vital design aspect was to allow samples to be pumped through the device successively. Our device allows samples to be interchanged quickly, in-situ, with no alignment discrepancies.

To test the sensitivity of the device, a range of experiments analysing alcohol/water mixtures were undertaken. Here, μmol quantities could be easily distinguished between samples, even with the sub-wavelength interaction lengths used. The analysis of commercial whiskeys provides an enticing insight into possible applications for this device, where distinct absorption differences are observed between brands. As all the samples tested contained 40 % alcohol by volume, these differences can be attributed to the individual composition of the whiskeys. The variations observed in the absorption characteristics when testing samples of the same brand, where samples differed by only 2.5 % alcohol content, confirms the sensitivity of the device.

Dehydrated biotin (vitamin B7) is well known to exhibit specific terahertz absorptions. Using our microfluidic device, we have analysed a range of biotin solutions. The results obtained demonstrate broadband absorptions, alluding to different absorption mechanisms for this molecule when in solution. The sensitivity of the device was once again displayed, where variations of 3 nmol could be distinguished between solutions. Given the wealth of THz activity predicted for many biological systems - ranging from the reactions, dynamics and hydration properties of proteins, to the identification of DNA mutations, our device provides a platform for these systems to be investigated using standard THz-TDS techniques. The use of silicon to fabricate the device means further functionality can be easily integrated, such as mixing chambers, anti-reflective structures and plasmonic arrays. By functionalising the silicon surface with specific biological material, the analysis of enzyme reactions at THz frequencies also becomes a distinct possibility.

Keywords: Terahertz, Spectroscopy, Microfluidics

A-0167

OPTICAL ABSORPTION AND SPECTROSCOPIC PROPERTIES OF THULIUM DOPED TEO_2-NB_2O_5-TIO_2 GLASSES

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A new type of thulium doped tellurite based optical glasses was prepared through conventional melt quenching technique. In the experiments, the effect of different Tm3+ ion concentration and glass composition on optical properties of (95-x)$TeO_{2-x}Nb_2O_5$-5TiO_2 glasses have been investigated by using UV-VIS-NIR optical spectrophotometry measurements in the wavelength range 200-2000nm. Considering absorption measurements for the 1.0mol% Tm^{3+} doped 90TeO_2-5Nb_2O_5-5TiO_2 glass, 1G4, 3F2, 3F3, 3F4, 3H5, and 3H4 absorption bands were observed from the 3H6 ground level, at 463, 660, 687, 793, 1211 and 1700nm wavelengths, respectively. Furthermore, spontaneous emission probabilities, and the radiative lifetimes for the 4f-4f transitions of the Tm^{3+} ions were calculated. The spectral intensities were determined in terms of the Judd-Ofelt parameters . Luminescence analysis were realized for the different Tm^{3+} ion concentration (0.2, 0.5 and 1.0 mol%) at room temperature. The relative luminescence band intensities of the 3H4-3H6 and 3F4-3H4 transitions were calculated as a function of Tm^{3+} ion concentration (0.2, 0.5 and 1.0mol%). Furthermore, luminescence data of the thulium doped glass samples were used to determine the compositional dependence of the emission cross sections at 1470 and 1800nm.

A-0168

HYBRID NANOSTRUCTURES OF SEMICONDUCTOR NANOCRYSTALS AND DYE J-AGGREGATES

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Hybrid nanostructures combining properties of inorganic nanocrystals and organic components are a basis for developing new materials for nanophotonics. There are many examples of using monomeric forms of synthetic dyes as an organic part of the nanostructures. However dye J-aggregates (supramolecular ordered structures formed by some dyes) have a number of advantages over monomers. Unique linear and non-linear

properties of J-aggregates, such as high extinction coefficient, narrow batochromically shifted absorption band, resonance fluorescence, giant nonlinear optical susceptibilities make them promising components of hybrid nanostructures.

In the present work we used reverse micelle solutions for self-assembly of hybrid nanostructures “nanocrystal/dye J-aggregate”. This method can be used for preparation both various nanocrystals of controlled sizes and dye J-aggregates. Hybrid nanostructures were produced because of intermicellar exchange on mixing two micellar solutions, one of them containing nanocrystals and the other - J-aggregates of cyanine dye 3,3'-di-(gamma-sulfopropyl)-4,5,4',5'-dibenzo-9-ethylthiacarbocyanine betaine pyridinium salt. Nanocrystals of various compositions (AgI, CuI, PbI_2) were used as an inorganic component. Formation of the hybrid structures resulted in appearance new dye absorption bands corresponding to J-aggregates adsorbed on the surface of nanocrystals. While free J-aggregates showed intense fluorescence in solution, fluorescence of the dye J-aggregates in the hybrid nanostructure was not observed. Fluorescence quenching is a result of an electron transfer from the J-aggregate to the semiconductor nanocrystal in the nanostructure. We found that J-aggregates adsorbed on the nanocrystals efficiently stabilize the size of the nanocrystals as commonly used size stabilizers do. It allowed us to remove the unnecessary components of the micellar solution to obtain stable hybrid structures for further use. The hybrid nanostructures can be isolated from the micellar solution and then dispersed in a solvent or used for preparation of layers. We produced gelatine coatings comprising “AgI nanocrystal/dye J-aggregate” nanostructures. When exposed to light in presence of a reducing agent appearance of absorption band of metallic silver was observed. It confirms that electron transfer process occurs in hybrid “nanocrystal /dye J-aggregate” nanostructures.

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A-0169

OPTICAL PROPERTIES AND CRYSTALLIZATION KINETICS OF TEO_2-ZNO-TIO_2 GLASSES

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Ternary tellurite based glasses in the TeO_2-ZnO-TiO_2 system were prepared and its optical properties and crystallization kinetics investigated by using UV-VIS spectrophometer and differential thermal analysis method (DTA). All the glasses were transparent from visible to near infrared region for different ZnO glass compositions (x=5, 10, 20, and 30 mol%). In the experiments, optical energy band gaps and Urbach energies were estimated from the optical absorption spectra between 300 and 800nm wavelength region. The observed results confirm that the addition of ZnO glass composition from 5 mol% to 30 mol% increases the optical direct energy band gap from 2.94 to 3.0eV. In addition, glass transition (Tg), crystallization (Tp) and melting temperature (Tm) were determined by using the DTA plots. Crystallization activation energies and crystallization mechanism were determined from the DTA curves measured with different heating rates (20, 30, and 40oC/min). Finally, DTA results obtained with a heating rate of 20oC/min show that the peak crystallization temperature increases from 463 to 533oC as the ZnO content increases from 5 to 30 mol%.

A-0170

ORGANIC LIGHT EMITTING DIODES PREPARED FROM TRIS (8-HYDROQUINOLINE) ALUMINIUM(III) (ALQ3) IN DIFFERENT CRYSTALLINE POLYMORPHS

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Organic light-emitting diodes (OLEDs) are now one of the promising devices for the applications to ultrathin flat and flexible panel displays. So far, various factors, which affect the device performances of OLEDs, have been studied; the device performance is found to depend on the fabrication processes, such as deposition rates, annealing of the devices [1]. Purity of materials is another crucial factor for the device performance. In contrast to these investigations, the effect of polymorphs before vacuum deposition has not been investigated.

In this study, we have investigated the device performance of OLEDs with a typical device configuration, ITO/alpha-NPD/Alq3/Cs_2CO_3/Al, using different Alq3 polymorphs as source powders. Since 1987 [2], tris(8-hydroquinoline) aluminum(III) (Alq3) has been widely used in OLEDs as a light-emitting and/or electron-transport material. In addition to the extensive researches on the device applications, fundamental researches on the crystal structures have been progressed for bulk Alq3 powders, relatively recently; the studies reveal that Alq3 have several polymorphs, alpha-, beta-, gamma-, and delta-Alq3 [3,4]. We here used alpha- and delta-Alq3 as source powders. The mixture of alpha-, gamma-, and delta-Alq3 (mixed-Alq3) was also used. From the results of I-V-L measurements, the EL intensities are found to depend on the original Alq3 powders. The current efficiency of the device fabricated from delta-Alq3 was only slightly (~10%) enhanced compared to that from alpha-Alq3. However, the device fabricated from mixed-Alq3 was found to show 40% enhanced current efficiency compared to that from alpha-Alq3. We carried out the same experiments several times to confirm the reproducibility. The enhancement factors slightly change, but the device performance of the three devices are always in the order of the device from mixed-Alq3 > that from delta-Alq3 > that from alpha-Alq3. The emission wavelength of Alq3 is mainly determined by the isomeric state, facial or meridional [4]; Alq3 powders composed of meridional isomers exhibit yellowish-green PL emission, whereas those of facial isomers show blue PL emission. However, all the above three devices show yellowish-green PL and EL spectra. The results suggest that the Alq3 molecules in all the devices are in the meridional isomers, irrespective of the isomeric states before the device fabrications (gamma-, and delta-Alq3 are in the facial state before the device fabrications). The change of the isomeric states is therefore expected to occur during the sublimation process.

In conclusion, we show an easy and unique way to improve device performance without changing materials, device structures, and device fabrication processes.

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A-0171

LUMINESCENCE SPECTROSCOPY OF NANOCRYSTALLINE MAGNESIUM OXIDE

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MgO is among the most suitable materials to investigate nature and relaxation of electronic excitations in nanocrystals because its electronic properties in bulk form are thoroughly investigated [1, 2]. In comparison to their bulk counterparts nanocrystalline materials possess several unique properties caused by large number of atoms located at the kinks, edges and steps of individual nanocrystallites and their interfaces [3]. Most of the materials used in applications are powders, which have high surface to volume ratio increasing a role of radiative and non-radiative relaxation processes at surfaces. Recently we have applied luminescence spectroscopy along with other methods in investigation of properties of electronic excitations of thin ultra-smooth MgO films prepared by pulsed laser deposition [4]. The goal of the present study was to reveal effects due to crystallite size on electronic excitations in MgO:Al nano-powder. Nanocrystalline MgO:Al samples of various dimensions were synthesized using combustion method and characterized by XRD and SEM. After the combustion process, the foam-like powder was pressed into pellets and annealed (up to 1600 °C) to obtain ceramics of varying crystallite sizes. Analysed XRD patterns show, that phase pure MgO was obtained with crystallite sizes up to 80 nm depending on thermochemical treatment conditions. Time-resolved photoluminescence spectroscopy was carried out under VUV excitation in a wide temperature range (6-300 K) at the SUPERLUMI station of HASYLAB at DESY and cathodoluminescence studies of the same samples at our laboratory set-up in Tartu.

Al3+-doped MgO possesses well-known luminescence of VAl-centres at ~5 eV, which is stable up to room temperature and can be used as an efficient probe for monitoring relaxation processes in nanocrystals. Emission of sample with ~80 nm crystallite sizes has nearly similar spectral composition to bulk MgO:Al crystal, with the UV emission blue shifted (to ~5.7 eV) and noticeable redistribution of intensities in visible region. In luminescence excitation spectra considerable intensity reduction and inhomogeneous broadening of excitonic maxima (near ~7.7 eV) were revealed. Even though no self-trapping occurs in bulk MgO, the required conditions of such processes can be achieved in systems with lower symmetry. Therefore, the luminescence band peaked at ~5.7 eV can be tentatively interpreted as the emission of the self-trapped excitons on the surface, which is in agreement with theoretical predictions [5]. Comparison of the properties of bulk and nano-size MgO as well as the discussion of application prospective of nano-samples, analysis of their advantages and drawbacks will be carried out.

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A-0172

WHITE LIGHT ENGINEERING OF PHOSPHOR-CONVERTED SOLID STATE LIGHTING SOURCES

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White LED technology has developed rapidly within the last few years because of its promising advantages with respect to long life-time, beneficial climate impact and novel lighting effects. Today's most common approach for white LED light sources relies on a mixture of blue LED light and respectively excited emission from a surrounding color conversion element (CCE). Latter generally consists of a phosphor embedded in a matrix material, e.g. silicone. Despite the simplicity of the concept at first sight, the device performance in terms of efficacy and the quality of the white light turned out to depend critically on the appropriate shape, composition and arrangement of the color conversion element. As a consequence of the different emission properties of the two light sources that contribute to the white light emission, the Lambertian emission of the blue LED die and the isotropically emitted converted light, a concerted adjustment of the respective emission characteristics is crucial for the development of LED light sources of superior white light quality. This demand can be achieved by optimization of the composition (e.g. the respective phosphor material and the phosphor particle distribution), the shape and the geometric parameters of the CCE as well as the light scattering processes that take place within the CCE. These scattering processes can be controlled e.g. by the differences of the refractive indices of the phosphor and the matrix materials and/or the size of the phosphor particles. Based on simulations by optical ray-tracing, in this contribution we give a comprehensive survey on all these parameters and identify, based on the underlying physical aspects, their respective impacts on the resulting color temperatures, angular variations of the color temperature and the luminous efficacies of white LED light sources.

A-0173

ANALYSIS OF PHASE SEPARATION BEHAVIOR BETWEEN P3HT AND PCBM BY SOLID-STATE NMR

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Regioregular poly(3-hexylthiophene-2,5-diyl) (P3HT) and [6,6]-phenyl-C61-butyric acid methyl ester (PCBM) are used as donor and acceptor materials, respectively, in organic solar cells. The effect of thermal annealing of the organic layers, which consists of P3HT and PCBM, has been well studied and is found to be an easy way to improve the power conversion efficiency (PCE) [1]. However, the origin of the effect of thermal annealing has not been fully elucidated.

We have been carried out the analysis of structure and dynamics of organic materials by solid-state NMR. Solid-state NMR is a useful tool to investigate the local structure, in particular, the amorphous structure of mixed systems. In this study, we have investigated the change of the donor-acceptor structure during the annealing process by solid-state NMR spectroscopy. Sample films consisting of P3HT and PCBM were prepared by the cast method at room temperature and subsequently the cast films were isothermally annealed at 150 °C for 5, 10, and 30 min. First, we carried out the measurements of 1H spin-lattice relaxation times in the rotating frame (T1rhoH) for these samples, which reveal the miscibility on the order of 3 - 4 nm. The P3HT and PCBM in the cast film show different T1rhoH values, indicating that P3HT and PCBM are phase separated. The phase separated structure on the order of several nanometers does not change by thermal annealing up to 30 min. Second, we carried out the measurements of 1H spin-lattice relaxation times in the laboratory frame (T1H). The

experiments reveal the miscibility on the order of 20 - 40 nm. Different from the above T1rhoH experiments, P3HT and PCBM in the cast film show the same T1H values within the experimental errors, indicating that P3HT and PCBM are mixed with each other on the order of several tens of nanometers. During the annealing process, the T1H values of P3HT and PCBM become different, even for 5-min. annealing. The result clearly shows that the phase separated structure on the 20 - 40 nm order develops by the annealing. The structural growth is considered to be closely related to the improvement of PCE by the annealing.

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A-0174

MESOSCOPIC SPECTRAL MODULATION OF LIGHT TRANSMITTED BY A SUBWAVELENGTH APERTURE

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In present communication we study the transmission of light through a multimode tapered metal-coated optical fiber with a subwavelength aperture (SWA). The problem under investigation is the effect of SWA on the spectrum of the transmitted light. According to our experimental findings, one can observe, under certain conditions, a remarkable modulation of the spectrum of the transmitted light. The effect has a mesoscopic origin: the modulation takes place if the number of transmitted light modes is small but exceeds unity, which indicates the occurrence of a phase shift between different modes. In case of a sufficiently small SWA diameter only few modes can pass through the tapered fiber region [1], and their interference can cause the observable modulation in the transmitted light spectrum. In case of larger diameters many light modes can pass out, and no significant spectral modulation can be observed due to the effect of averaging. An observable modulation also disappears for SWA diameters as small as 100 nm, because in this case only one (the fundamental) light mode passes out.

One possible origin of the observed phase shift could be the different propagation speed for different modes in the fiber. Another possible origin is in the (different for different modes) slowdown of the light near the tip with SWA due to the interaction of propagating modes with surface plasmons of the metal coating of the fiber. One can expect that the interaction strength depends on the actual light field configuration in the mode, which results in different modes getting different delays before passing through the tip. To discern between the two possible sources of the phase shift, we proposed to study the fiber length dependence of the output spectrum. [2] According to our findings for a sample of 200 nm SNOM tip, the observed phase shift is mostly caused by the inherent modal dispersion of the multimode fiber rather than by the mode-dependent light slowdown in the tapered region close to SWA. The SWA acts here merely as an effective mode filter. We discuss the ways of improving the sensitivity of the described experimental technique to the phase shift generated in the vicinity of SWA.

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A-0175

STUDY OF INCUBATION EFFECTS DURING SURFACE ABLATION USING PICOSECOND PULSES AT A WAVELENGTH OF 800 NM

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Multiple-pulse ablation thresholds in alumino-borosilicate glass have been studied. The lowered ablation thresholds when exposed to multiple laser pulses in the IR/NIR with a duration in the femto- to picoseconds regime is usually ascribed to incubation effects in the material [1,2]. Here we have studied ablation thresholds for permanent incubation, i.e., time-independent incubation, due to structural change in the material, and the time-dependent incubation, which is affected by the repetition rate of the laser pulses. We also study the difference between surface and thru-bulk focusing and the validity of models for calculating thresholds for multiple pulses in these cases. Effects of material incubation when ablated structures are much larger than the focal volume have been investigated and a hands-on approach to examining the fidelity between design and outcome of ablated structures in glass with dimensions of tens of micrometers will be presented.

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A-0176

SPECTRAL FEATURES OF SPECULAR REFLECTION FROM NANOPARTICLE FILMS

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Metal nanoparticles (NPs) have characteristic optical absorption features in the visible wavelength region due to excitation of surface plasmons, i.e., Localized Surface Plasmon Resonance (LSPR). In this work we analyze the internal reflection (Fresnel reflection) from Au-NPs on the end face of optical fibers. With air ambient, the reflected spectrum resembles the inverted spectra of an absorption measurement in transmission, i.e., a dip in the reflection measurement vs. a peak in the absorption measurement. Changing the ambient refractive index surrounding the NPs results in a spectral change from a reflection dip ($n<1.3$) to a reflection peak ($n<1.6$), with intermediate features in between. A simple model based on transfer-matrix formalism and assuming interference effects due reflections from two interfaces, the fiber-NP interface and the NP-ambient interface, accurately reproduce the reflection spectra when changing the ambient refractive index from $n=1$ to $n=2$, in ~0.1 increments. The gradual change from a dip to a peak can be explained by a gradual change in phase shift upon reflection from a material with a complex refractive index as the refractive index difference at the interface changes sign.

A-0177

OPTICAL PROPERTIES OF AMORPHOUS HYDROGENIZED AND MICROCRYSTALLINE SILICON FILMS PREPARED BY PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION AND RE-CRYSTALLIZED AT HIGH TEMPERATURE

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Amorphous hydrogenized silicon films different in thickness (600 - 2400 nm) were deposited by plasma enhanced chemical vapour deposition on Corning glass substrates at 250 °C using silan 10% / argon 90% gas mixture. The samples were consequently isothermally heated in a high temperature vacuum chamber at 0.1 Pa at temperatures from 590 to 620 °C.

In order to evaluate structural and optical properties of the films X-ray diffraction analysis, optical spectrophotometry and spectroscopic ellipsometry were used. Crystalline state (amorphous-microcrystalline), optical band gaps, refractive indices, extinction coefficients, absorption coefficients were carried out. X-ray diffraction analysis indicated that originally deposited films were amorphous with different degree of homogeneity depending on the film thickness. After the heat treatment the films became polycrystalline with crystallite sizes 40-50 nm. Spectroscopic ellipsometry confirmed the results obtained from X-ray diffraction and furthermore found out residual amorphous phase about 20% in volume. Optical spectrophotometry has shown that the values of refractive indices of thermally treated films approach the mono-crystalline silicon refractive index. Extinction coefficients of the thermally treated films are slightly higher than this for mono-crystalline silicon. Absorption coefficients for thermally treated films reached quite high values near the absorption edge of the original amorphous material which can be advantageous for tandem solar cell technologies.

A-0178

EFFICIENT SINGLE PASS 565 NM GREEN LIGHT SECOND HARMONIC GENERATION RB1-XBAXTI1-Y-ZYBYNBZOPO4/RBTIOPO4 WAVEGUIDE

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Stable and efficient continuous wave (cw) high-power laser sources in blue and green spectral regions are necessary for various applications such as material processing, optical communications or medical diagnostics as well as high-density data storage [ref]. Bulk crystals have been used for nonlinear optical processes, and for bulk crystals with lengths 5-10 mm, relatively loose focusing must be used to achieve maximum conversion efficiency [ref]. The efficiency of these processes can be increased by using a guided-wave device that provides tight confinement of the beams over a length of several millimetres or even centimetres. Another advantage of guided-wave design in relation to non-linear optical materials is the possibility to active the nonlinear optical parameters using lower powers than those used in bulk devices due to the high intensity achieved in waveguide schemes [ref].

Recently, we have grown non-linear optical epitaxial layers, activated with rare earth. In this case, the active layer is (Yb,Nb,Ba) doped RbTiOPO4 (RTP). Rubidium Titanyl Phosphate crystallizes in the orthorhombic system, with space group of symmetry Pna21. This material has important applications in non-linear optics due to its high non-linear optical coefficients. The distribution coefficient of Yb3+ can be increased by codoping with Nb5+ and laser operation of (Nb,Yb):RTP has been demonstrated in 2007 [ref]. The epitaxial layers were grown on the (001) plane of RTP substrate. This is interesting because this plain contains the phase matching

(PM) direction for type-II Second Harmonic Generation (SHG) of ytterbium laser emission (around 1050 nm). Previously, we demonstrated that Yb:Nb:RTP/RTP system guides light in TM polarization only [ref]. We codoped this epitaxial layers with Ba, in adition to Nb and Yb with the objective to obtain type II SHG phase matching , which mean that it is necessary guide light in TM and TE polarizations at the same time. We grown epitaxial layers by Liquid Phase Epitaxy technique, the composition used for epitaxial layer growth was [BaO]-[Rb2O]-[P2O5]-[TiO2]+[Nb2O5]+[Yb2O3]-[WO3] = 0.88-43.02-23.61-20.70-0.45-1.35-10.00 (mol %). The epitaxial layers obtained were polished until 15 μm thickness. This thickness was enough to ensure the guiding of light in the IR region. For 632.8 nm we observed 4 TM modes and 3 TE modes. In figure 1 we can see the dark-mode spectrum for TE polarization. In order to investigate single pass type-II SHG, light from a longitudinal mode pulsed OPO laser was coupled into the waveguide using microscope objectives. Figure 2 shows the image obtained with a CCD camera of guided green light generated by type-II SHG in the waveguide. In this way we excited the TE00 and TM00 modes at 1130 nm simultaneously and TE00 of green light at 565 nm was generated. We also use a power meter and filter with the aim to measure the efficiency, we estimated the efficiency to be around 69%.

We also calculated which is the wavelength of the phase matching wavelength in front of the angle of the propagating light, in the (001) plane using the Sellmeier curves.

A-0179

SILVER DOPED AS_2S_3 CHALCOGENIDE FILMS - A DIFFUSION STUDY

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Heterostructures of Ag and As_2S_3 have been obtained by vacuum thermal evaporation onto glass substrates. The effect of the cold tungsten-halogen lamp spectra on the sandwich stuctures prepared in two configurations has been followed. The XRD peaks of the initially formed crystalline phases have vanished upon irradiation with the tungsten-halogen light.

The photo-diffusion of the Ag in the As_2S_3 matrix has been characterized by monitoring the diffusion front's evolution for different illumination times.

A structural model of the As_2S_3 matrix and its interaction with the doping Ag is proposed, in order to contribute to the understanding of the complex fenomena which may occur upon the silver diffusion process in this glassy matrix, such as interatomic or molecular bond reconstruction and nanoscale phase separation.

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Keywords: silver, diffusion, chalcogenide film.

A-0180

PHASE-CHANGE MATERIALS FOR OPTICAL RECORDING: GLASSES AND THIN FILM CHALCOGENIDES WITH SILVER

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Glasses were prepared with the compositions $SnSe_2$:Agx, GeTe:Agx and $GeSb_2Te_5:Ag_x$ (x=0.1 - 1.0) by rapid cooling the melts. Thin amorphous films have been deposited from these glasses by thermal vacuum evaporation, and pulsed laser evaporation (PLD).
The optical switching was checked by monitoring the reflection properties when irradiated by YAG:Nd laser spots.
The physico-chemical properties of the samples have been correlated with the switching properties.
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Keywords: phase-change, chalcogenide film, silver.

A-0181

BISMUTH-GERMANATE OXIDE GLASSES CONTAINING SILVER NANOPARTICLES

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Glass compositions in the system Bi_2O_3-GeO_2-Ga_2O_3-BaO-AgCl have been systematically studied as a function of the AgCl content. Thermal and structural properties of glasses have been investigated by DSC and Raman spectroscopy while optical properties have been studied by M-Lines, UV-Vis and luminescence spectroscopies. Results had shown that the color of the glasses is strongly dependent of the casting temperature even for composition free of silver. Samples with different percentages of AgCl have been submitted to thermal annealing during different times and the optical properties of such glasses have been studied by UV-Vis spectroscopy. Annealing process, performed below Tg does not change the optical properties of the glasses. For thermal treatments above Tg (450 oC), the Uv-Vis spectrum os the glass is characterized by an absorption band around 495 nm. The intensity of such band is dependent of the time of treatment. That absorption has been attributed to the presence of surface plasmon resonance (SPR) suggesting the formation of Ag-based nanoparticles. This assumption has been confirmed by transmission electron microscopy (TEM). Annealing induces the growth of quasi spherical nanoparticles with sizes around 5 nm. However, the size can be tuned by controlling the time of treatment. These glasses are suitable for non-linear optics and such properties are under investigation.

A-0182

RAMAN SPECTRA AND THIRD-ORDER NONLINEAR OPTICAL Z-SCAN PROPERTIES OF MO-NB2O5-TEO2 (M=ZN, MG, CA, SR, BA)

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An enormous number of researches on tellurite (TeO_2)-based glasses have been done because of their high refractive index and nonlinear optical properties. It is reported that the third-order nonlinear optical susceptibilities of the glasses were by several orders of magnitude larger than that of conventional silicate and borate glasses, and thus several applications to nonlinear optical devices are expected, such as optical wavelength converter, optical switching, Raman amplification, and so on. Also, other material-characteristics of a family of tellurite glasses, such as a low melting temperature, high density and wide infrared window, make them attractive in a variety of the practical applications mentioned above. It is well-known that TeO_2 is difficult to be vitrified alone but once other metal oxides are doped into it, amorphous network system composed with TeO_2 main frame (chain-like structure) in considerably wide varieties of constituents can easily be obtained at a usual cooling rate, which is quite different from other glass system (silicate, borate, phosphate etc.). This glass formation is singular because metal oxides doped play a role as the network-modifier oxide or the intermediate oxide. The unit structures in TeO_2-based crystals and glasses are also unique. Tellurium (Te) element is positioned in a trigonal bipyramids (tbp; denoted as TeO_4) structure which has a 5s2 lone electron pair in the equatorial position. Moreover, Te also takes a trigonal pyramid (tp; denoted by TeO_3) structure besides TeO4 (tbp) in alkali tellurite crystals. It was found in lituratures that these two structures both exist in glass phase, which was revealed by analyzing the structures of tellurite glasses including various oxides such as the alkali, alkali-earth and Pb oxides. Several systems based on TeO_2 component, such as TeO_2-Nb_2O_5, TeO_2-ZnO, and TeO_2-Nb_2O_5-PbO, have been demonstrated to have excellent optical performances. In these systems, it is reported that ZnO and Nb2O5 can improve optical nonlinearity, vitrification, chemical durability and thermal stability. Therefore, it is important to research the optical characteristic of three component glasses that contain both Nb2O5 and ZnO. In this paper, the third-order nonlinear optical susceptibilities, □(3), of tellurite glasses with MO-Nb2O5-TeO2 system (M= Zn, Mg, Ca, Sr, Ba) was investigated by Z-scan measurement using Ti:Sapphire femtosecond laser pulses. The relationship between the nonlinear optical properties and the glass structures, estimated by Raman spectroscopy, was discussed. The value □(3) of these tellurite glasses increased as the stretching Raman band of Te-Oax in TeO_4 increased, while the stretching band of Te-O in TeO_3 decreased. This indicates that the amount of Te-Oax in TeO_4 (tbp) is deeply related to □(3), which is consistent with the theoretical prediction of higher (3)□hyperpolarizabilities for TeO4 than for TeO_3. It was also found that higher was obtained with decreasing TeIV-eqOax-TeIV band, indicating that when alkali-earth ions (M2+) was doped in Nb2O5-TeO2 binary network system the break in TeIV-eqOax-TeIV chain structure necessarily occurred but the terminations of -TeIV-Oeq- M2+ O--NbVI-Oax-TeIV- were more preferentially induced with an assist of NbO_6 polyhedron than -TeIV-Oeq- M2+ O--TeIII-.

A-0183

EFFECT OF CSBR ADDITION ON STRUCTURAL AND LUMINESCENCE PROPERTIES OF GE-S-GA:ER GLASSES

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Erbium-doped glasses based on the Ge-S-Ga system have been studied by Raman, photoluminescence (PL) and transmission spectroscopy. Nominal compositions of chalcohalide $(Ge_{0.25}Ga_{0.10}S_{0.65})_{0.9}(CsBr)_{0.1}$, $(Ge_{0.23}Ga._{0.12}S_{0.65})_{0.9}(CsBr)_{0.1}$ and chalcogenide $Ge_{0.23}Ga._{0.12}S_{0.65}$ glasses have been selected as host materials. The influence of Er (in a wide concentration range) and Ga concentrations have been investigated together with the addition of CsBr. The bond vibrations and local ordering in the glasses have been determined by Raman scattering in the range of 50-550 cm^{-1}. The strong influence of Er-concentration on the PL intensity of both the base glass and 4f-4f radiative transitions has been studied. A quenching of the host glass luminescence in the range of 1000-1400 nm has been observed with increasing Er content in the $Ge_{0.23}Ga._{0.12}S_{0.65}$ host, while new Er related PL bands are found for the CsBr-containing samples in the same region. The latter peculiarities are discussed in the context of up-conversion mechanism. The addition of CsBr leads to a considerable PL narrowing of 4I13/2□4I15/2 radiative transitions of Er^{3+} ions as compared to these transitions in Ge-S-Ga:Er glasses. This observation nicely demonstrates the increasing ceramics like nature of Ge-S-Ga-CsBr system.

A-0184

CUBR BLUE LIGHT EMITTING ELECTROLUMINESCENT THIN FILM DEVICES

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Semiconductor optical emitters play an essential role in numerous domains including high resolution gas spectroscopy, environmental monitoring, precision surgery, optical communications, high density optical storage and most recently in solid-state lighting systems [1]. Currently, the majority of solid-state white lighting systems are based on down-converting the emission from a blue-UV InGaN based optical emitter to a longer wavelength using phosphor(s) [2]. These InGaN devices are typically fabricated on very expensive and highly lattice mismatched substrates (e.g. Al_2O_3 or SiC), thus there is a need for the development of an efficient alternative blue-UV emitter at a lower cost.

The cuprous halides (CuCl and CuBr) present possible alternatives to the III-N or ZnO based devices. These I-VII compounds have large direct bandgaps (Eg_CuCl ~ 3.4 eV and Eg_CuBr ~ 3.1 eV) and posses outstanding properties that surpass those of many related wide band gap materials such as ZnO and III-N. These include large excitonic binding energies (~ 190 meV and 108 meV for CuCl and CuBr, respectively), improved structural and lattice compatibility with Si or GaAs substrates and relatively low temperature depositional processes [1, 3].

In this study, we report on the development of a blue thin film electroluminescent device (TFELD) based on physical vapour deposited CuBr thin films. We commence with fundamental studies of the CuBr thin film optical and structural properties leading to the integration of these films into a working TFELD.

CuBr thin films of ~ 300 nm was deposited on a variety of substrates including glass, Si, GaAs, Cr and ITO coated glass substrates using Edward's vacuum evaporator at a base pressure of the order of 10-6 mbar. Room temperature absorption measurements on CuBr thin films manifest the typical Zf and Z3 excitonic features. Blue Zf free excitonic emission occurring at ~ 415 nm was observed using photoluminescence, x-ray excited optical luminescence and AC electroluminescence techniques at room temperature. In addition to this 415 nm peak, several peaks corresponding to Cu+ emissions via 3d94s - d10 transitions were observed at 325 nm, 410 nm, 427 nm, 451 nm and 590 nm in the AC electroluminescence spectra.

Temperature dependent optical and electrical properties of CuBr thin films using both AC and DC characterisation techniques have been carried out. Optimised CuBr thin films are then integrated into a TFELD based on Metal/GaAs/Cubr/Metal Structures.

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A-0185

ON RF MAGNETRON SPUTTERING OF SB-RICH GE-SB-TE THIN FILMS

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Materials from Ge-Sb-Te ternary system are currently dominant materials applied for rewritable phase-change based non-volatile data storage. The reversible phase change between amorphous and crystalline state and vice versa is achieved by optical pulses (CD-RW, DVD+-RW, DVD-RAM, HD DVD-RAM, BD-RE discs) or by electrical pulses (PC-RAM/P-RAM/C-RAM/OUM(R) devices), while the detection is based on different optical reflectivity or electrical resistivity between amorphous and crystalline state.

Thin amorphous films of Ge-Sb-Te system were deposited by RF (f = 13.56 MHz) magnetron sputtering in argon plasma. Targets of composition $Ge_2Sb_2Te_5$, $Ge_2Sb_{2.3}Te_5$, $Ge_2Sb_{6.3}Te_5$ (better known as $Ge_{15}Sb_{47}Te_{38}$) were utilized for deposition process. Composition and chemical homogeneity of prepared thin films were traced by Energy Dispersive X-Ray analysis coupled with Scanning Electron Microscope (SEM-EDX) and by micro X-Ray Fluorescence (u-XRF). SEM technique was also used for surface morphology observation. Crystallinity of prepared thin films was studied by X-Ray diffraction (XRD). Optical parameters of prepared thin films (optical band gap energy, refractive index spectral dependence) and film thickness were established via UV-Vis-NIR spectroscopy and Variable Angle Spectroscopic Ellipsometry (VASE).

Influence of target composition as well as influence of deposition conditions to thin film properties (composition, optical properties, crystallinity) and to parameters of sputtering process (deposition rate) were established and discussed.

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Keywords: Thin films, RF magnetron sputtering, Ge-Sb-Te, SEM-EDX, optical properties, VASE, crystallinity, XRD, data storage.

A-0186

OPTICAL CHARACTERIZATION OF TIO(2-X) FILMS AND TIO2/TIO(2-X)/TI HETEROSTRUCTURES

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The origin of ferromagnetism in oxide materials such as TiO_2, pure or doped with transition metals (TM), is under intense discussion. The main models correlate the ferromagnetic behavior of these oxides to structural defects, mainly oxygen vacancies. In order to contribute to the discussion of the role of the O vacancies and its relationship to the TiO_2:TM magnetic properties, TiO_2 films and $TiO_2/TiO_{(2-x)}/Ti$ multilayers were deposited, and their optical and magnetic properties were analyzed in detail.

Amorphous silica and $LaAlO_3$ substrates and different Ar/O_2 flow ratios were used in film preparation by RF magnetron sputtering technique. The films and multilayer total thickness were 700 nm. The multilayer films (10 to 20 periods) consists of TiO_2 layers (~30 nm), followed by $TiO_{(2-x)}$ (~4 nm) and Ti layers (~1 nm). The optical characterization was performed using transmittance measurements at normal incidence in the 1100 - 190 nm wavelength range. In the single layer films, computational routines based on coherent multiple reflections in the films and incoherent multiple reflections in a finite substrate were used to determine the refractive index and absorption coefficient as a function of the photon energy. The spectra of the single films show regular interference fringes, indicating thickness and refractive index homogeneity. The optical gap values of ~3.3 eV does not significantly change with the ratio of Ar/O_2 mass flow rates (40/0.2; 40/6.0) used. On the other hand, the absorption coefficient showed a systematic increase with the decrease of the O_2 partial pressure, indicating the formation of electronic defects, probably related to O vacancies. A similar modification in the absorption edge was also noted after annealing in vacuum at 750°C. Up to this moment the SQUID magnetization (MxH) measurements showed a departure from pure diamagnetic behavior in the oxygen depleted samples but did not indicate clear ferromagnetic signature.

The transmittance spectra of the heterostructures also show interference fringes, however, the overall transmittance has decreased and a maximum in the mean transmittance is noted at ~500 nm (T~0.60). Broad absorption bands are observed for wavelengths > 500 nm in the spectra (Dealta(T)~0.10) of the different heterostructures and are being investigated as due to improved vacancy densities in the TiO_x/Ti interfaces or to confined levels in the 2D $TiO_{(2-x)}$ layers.

A-0187

NONISOTERMIC HIGH-TEMPERATURE SYNTHESIS OF CDSE SPHERICAL NANOCRYSTALS AND TETRAPODS

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In recent years colloidal semiconductor nanocrystals or quantum dots are of great interest for both fundamental research and technical applications due to their strong size-dependent properties. The size-dependent emission is the most attractive property of the quantum dots.

Emitting nanocrystals can be used for many purposes, such as light-emitting diodes, lasers, biomedical labels, etc. Due to quantum size effect the emission color of the nanocrystals CdSe shifts continuously from red to blue as the size of the nanocrystals decreases. Exciton Bohr radius of CdSe equals to 5.6 nm, so the quantum size effect is observed when nanoparticle sizes are in the range of 1.5 - 5 nm. Since the emission color of

semiconductor nanocrystals is strongly dependent on size and shape, the color purity of the emission becomes dependent on the size and shape distribution of a nanocrystal sample. Synthesis of high quality semiconductor nanocrystals has been playing a crucial role in this field.

In 1993 extremely efficient high-temperature colloidal synthesis was suggested. Since then it has been significantly changed because of using different ligands and precursors to produce high-quality quantum dots. In the present work completely another modification of this method was suggested. It was shown that quantum dots with narrow size distribution can be achieved by controlled decreasing temperature during the synthesis.

Lowering of temperature results in decreasing of substance solubility and critical nucleus size. Controlled temperature decreasing allows us to avoid additional injection of reagents and to produce highly uniform quantum dots in the size range of 1.5 - 5 nm with size distribution about 7 %.

Tetrapods are the most interesting of currently produced anisotropically-shaped nanocrystals. They are promising for assembly of complicated structures and practical use, for example, as components of solar cells. The basis for formation of such structures is polymorphism - ability of a solid material to exist in more than one crystal structure. In this work modified high-temperature method is used for CdSe tetrapod synthesis. Control of a crystal phase of growing particles at different stages of the synthesis allows us to reduce the synthesis time and make it cheaper. Common high-temperature tetrapod synthesis gives a mixture consisting of different nanostructures (dots, rods, tetrapods), maximal content of tetrapods being equal to 50-60%. Our method allows producing tetrapod-shaped nanoparticles with high yield up to 90 % without additional selection. It was confirmed that fluorescence Stokes shift value allows express-controlling of anisotropically-shaped particles formation.

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A-0188

THE GROWTH MECHANISM OF MICROCRYSTALLINE SILICON THIN FILM -MOUNDED SURFACE GROWTH

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The growing surface of hydrogenated microcrystalline silicon (μc-Si:H) thin film by chemical vapor deposition processes is not a self-affine surface but a mounded surface from the roughing evolution analysis [1]. The formation of mound structure is related to the shadowing effect, which leads to the less density of μc-Si:H film with plenty of micro-voids. Understanding the growth mechanism is important for optimizing the structure and the opto-electrical properties of μc-Si:H as well for solar cell application. Here we focus on the role of H on the mound surface growth of μc-Si:H, which presents the insight observation for μc-Si:H film growth, although the effect of H on the crystallization of μc-Si:H has been widely studied from different aspects.

Microcrystalline silicon films were prepared by rf-PECVD. The effect of H was investigated by varying the H dilution ratio (RH=H2/SiH4) or RH modulation at the initial growth stage. The surface evolutions of the μc-Si:H films were detected by tap-mode AFM. The power spectral density (PSD) curves were obtained from the two-dimensional Fourier transform of the surface topography. The time dependence of optical emission spectrum (OES) of species in plasma was measured during the initial stage of the film growth.

The PSD curves for μc-Si:H films exhibit the characteristic peaks. The peak intensity decreases and shifts to the high frequency as RH increasing. Meanwhile, the FWHM of the PSD curve is broadened. These observations imply that the H dilution promotes the crystallinity and postpones the mound structure formation as well. We suggest that shadowed etching of H weakens the shadowing growth and retards the formation of the mound structure. The AFM image for the film with proper RH modulation represents the smaller surface features compared with the sample without RH modulation, although they have similar volume fraction of crystallinity. This is probably due to the high nucleation density under high RH in the initial growth stage. The OES measurements indicate that the emission decrease with time greatly under the constant RH□intensity of SiH* and H condition. By tuning the RH in the initial 2 min, a steady emission was achieved. The results involved opto-electrical property indicate that RH modulation is an affective approach to postpone the mounded growth and then improves the film quality.

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A-0189

MICROCRYSTALLINE SI NANORODS BY GLANCING ANGLE HOT WIRE CVD AND APPLICATION IN ORGANIC/INORGANIC HYBRID SOLAR CELLS

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Silicon nanorods (SiNRs) provide the possible applications in organic/inorganic hybrid solar cells due to the enhancement of light absorption and charge collection. To realize the application, well-orientation, diameter and density controlling and crystallization of silicon nanorods are important. The isolated nanorods structure can be obtained by the oblique flux incident and substrate rotation in Glancing Angle Deposition (GLAD).

The Si nanorods were deposited in the hot wire chemical vapor deposition chamber with a flux incident angle of 85 degree respects to the substrate surface. Polished Si wafer, glass and patterned Si wafer (covered with SiO_2 nanospheres monolayer) were used as the substrates. The morphology, diameter, number density, crystallization and optoelectronic properties of Si nanorods varying with the glancing angle, deposition pressure, hydrogen dilution and substrate were systematically investigated by scanning electron microscopy (SEM) and Raman scattering. The total optical reflectance was measured on a UV/VIS/NIR spectrophotometer equipped with an integrating sphere.

The SiNRs grown on polished Si wafer show typical characteristic of nanorods prepared by GLAD. The nanorods with inverse nanocone structures are well orientated. The diameters of the nanorods vary between 50 to above 100 nm. The density of SiNRs is $0.9\sim2x10^{10}$ cm^{-2}. Unlike on the polished silicon wafer substrate, SiNRs growing on patterned Si wafer exhibit uniformity of diameter along the growth direction. The phenomenon of stop growth and joint of SiNRs, usually appears on the flat substrate, are seldom observed.

By using hydrogen dilution, crystallized Si nanorods with the crystalline volume fraction (Xc) of above 50% was achieved under a substrate temperature less than 200□. Increase in pressure, the growth rate of the nanorods is enhanced but the Xc is reduced. Optical reflectance measurements show that the total reflectance for Si nanorods with 200 nm length is less than 10% in the wavelength of 300 to 1000 nm. For the photovoltaic application, 3-hexylthiophene (P3HT) was spin coated into the SiNRs array to form a SiNRs/P3HT contact. The perfect penetration of P3HT in to silicon nanorods is particularly important for the performance of SiNRs/P3HT cell. The influence of density and length of SiNRs on the penetration of P3HT and the performance of SiNRs/P3HT solar cell were investigated. A power conversion efficiency of 0.2% was primarily obtained for hybrid solar cell with a structure of metal grids/ITO/P3HT/SiNRs/c-Si/Al.

A-0190

FABRICATION OF (ER,YB):LU2O3 NANOCRYSTALS EMBEDDED IN POLYMER MICROCOLUMNS USING A SILICON TEMPLATE

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The synthesis of new hybrid composites using micro- and nanostructured templates has attracted increasing interest during the last years due to their potential applications for functional devices [1]. In order to develop these applications, structures have to be fabricated with the suitable dimensions and periodicity. Porous silicon templates are important because porosity and pore size can be controlled by electrochemical procedures [2]. Vacuum infiltration of polymers into porous silicon templates has been used to obtain new hybrid structures, with special interest to develop photonic crystals, etc. The efficiency of erbium doped systems can be improved by codoping with ytterbium, assuring a high absorption at 980 nm, where high power diode lasers are commercially available. This class of composite materials have already been reported for planar optical amplifiers [3]. The cubic RE_2O_3 (RE=rare earths) are known as excellent hosts for active lanthanide ions due to their optimal thermal and spectroscopic properties. Furthermore, the Yb-Er couple is well-known for their up-conversion mechanisms, converting IR light to visible light. The green and red emissions achieved in erbium samples, by exciting in IR light or higher energies, opens the possibility to these composites for being used as up-converters or down -converters for solar cell applications and also, lightening applications.

We report the formation of two dimensional disordered arrays of poly(methyl)methacrylate (PMMA) microcolumns with embedded monodispersed size-distribution $Lu_{0.990}Er_{0.520}Yb_{0.490}$ nanocrystals using a disordered porous silicon template. The synthesis of cubic (Er.Yb):Lu_2O_3, which crystallize into the cubic system with space group, were achieved by the modified Pechini method [4]. Then, these nanoparticles were dispersed in a PMMA/toluene solution and by infiltration the microcolumns were obtained by vacuum infiltration.

The nanocrystals embedded in the PMMA matrix were structurally characterized by micro X-ray diffraction. We observed that the (Er,Yb):Lu_2O_3 embedded in PMMA microcolumns present the diffraction peaks attributed to the cubic phase The distribution and crystallinity of the nanocrystals inside of the disordered PMMA microstructures were observed by electronic microscopy. The histogram for (Er,Yb):Lu_2O_3 nanocrystals is well represented by a lognormal distribution with mean size of 33.1 nm and a size dispersion of 44%. Moreover, the sample presents good homogeneity but the nanocrystals build aggregates that lead to high particle size dispersion.

The cathodoluminescence spectra of (Er,Yb):Lu_2O_3 nanocrystals in the visible range were also investigated. It is observed mainly the red emission, assigned to the f-f transition of Er^{3+} ion. The high erbium concentration and the nano size dimensions of the embedded nanocrystals are the factors which enhance this red emission in concurrence with the green emission, more dominant in bulk single crystals [5].

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A-0191

THERMAL HOLOGRAPHY AND MICRO-STRUCTURING AT A WAVELENGTH OF 10.6 MICRONS

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Long period gratings (LPGs) have found many applications such as optical fiber sensors for temperatures and refractive-index measurements because of their capability of coupling light between core and cladding modes at the resonant wavelengths.

The fabrication of LPG relies upon the introduction of a periodic modulation of the guiding properties of the optical fiber. This may be achieved by modification of the refractive index of the core of the fiber through UV exposure or by geometrical deformation of the fiber. Periodic modulation has been achieved by ultraviolet beam exposure with an amplitude mask, electrical discharges, irradiation by infrared femtosecond pulses and point-by-point writing method with UV exposure or with CO_2 laser pulses in a point by point writing technique.

We propose a new method for micro-structuring of waveguides using a holographic technique at a wavelength of 10.6 microns. A diffractive optic element (phase-mask) is made in ZnSe and used to diffract a focussed single-frequency laser beam from a CO_2 laser. The diffraction pattern can be imprinted into a surface through heat generation by absorption of the radiation in the fringe pattern. If an optical fibre is placed immediately behind the phase-mask a micro-structured long-period grating (LPG) is inscribed into the fibre in a single pulse of 700 milliseconds. Surprisingly, the 20 mm exposure of the 125 micron diameter fibre tapers to a minimum diameter of 40 microns and extends by a factor of 3, whilst maintaining a periodicity in the microstructure, however of a different period than the phase-mask. The new thermal holographic technique is therefore proposed for fabricating a self-tapered fiber long-period fiber gratings (STFLPG) using the CO_2-laser and a phase mask.

Compared the transmission spectrum of the STFLPG with one in a standard fiber, in which only one cladding mode resonance appears at this wavelength region, several modes exist in the range of 1520 and 1570 nm. The single sided exposure for the STFLPG results in an asymmetric deformation of the fiber, leading to an excitation of a complex set of cladding modes. With the appearance of the tapered zone, the decreasing of the cladding changes the effective index of the core mode continuously, increasing the number of the cladding-mode resonances. When the beam propagates through the non-adiabatic transition region, the core diameter becomes smaller gradually and the optical field expands into the cladding layer rapidly until forms a multimode region. Then, in the uniformed tapered region, the fundamental mode can be coupled to many higher order modes and the number of cladding modes also increases due to the increased overlap of the modes.

This unique STFLPG has the added advantage of increased sensitivity for sensing applications due to the smaller diameter and expanded core-mode. Our new holographic technique requires short exposures and should find applications for micro-structured a variety of devices that have a strong absorption at the exposure wavelength.

A-0192

ERBIUM DOPED GLASS CERAMIC MATERIALS AND WAVEGUIDES

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Nowadays, in many fields of optoelectronics and photonics, the research activity is focused on discovering and developing better combinations among materials and fabrication processes, in order to reduce the costs and increase the performances of the final devices. With particular reference to optical communication systems, erbium doped materials - whether in glassy or crystalline structures - have been widely investigated for several years because the peak emission of the Er^{3+} ions falls into the so-called C-band, where the attenuation of the silica fibres is lowest [1]. This lucky circumstance opened the development first for the Erbium Doped Fibre Amplifiers (EDFA) and then for the Erbium Doped Waveguide Amplifiers (EDWA), where a planar guiding structure is able to optically confine the light inside a thin layer with low propagation losses.

One of the major requirements for an EDWA is to provide a flat gain over a broad amplification band, in order to guarantee the same optical amplification for all the WDM or DWDM channels allocated into that band. In comparison with crystals, Er^{3+}-doped glass materials better satisfy this request due to their amorphous nature. Nevertheless, in an EDWA the possibility to obtain high optical gain for shorter length units is strongly related to the solubility of the Er^{3+} ions inside the glass matrix. But at high rare-earth ion concentrations clustering phenomena may occur, which increase the ion-ion interactions and generate undesirable luminescence quenching, thus reducing the efficiency of the active material and compromising the performance of the related device. In this context, Er^{3+} -doped glass ceramics with active ions embedded in the crystalline phase could represent a valid alternative to purely amorphous or purely crystalline host materials. In fact, they have the potential of combining the mechanical and optical properties of the glass with a crystal-like environment for the Er^{3+} ions. The latter characteristic is also useful to avoid the aforementioned parasitic effects.

Among all the fabrication processes, the sol-gel route - based on wet chemistry procedure - has proved to be a versatile and reliable technique. This low-cost fabrication process allows the deposition of high quality optical films within a broad range of chemical compositions. From a structural point of view, the crystallites have to be small enough (a few nanometers) in order to reduce scattering losses in the optical waveguide. For this aim, the sol-gel film must generally undergo a carefully controlled heat treatment. The aim of this lecture is to give a review concerning Er^{3+} - doped glass-ceramic materials and waveguides, with particular reference to the activities performed in our laboratories, concerning different silica based glass-ceramic binary systems [2,3].

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A-0193

HIGHLY VERSATILE, NOVEL ORGANOSILICATE NANOPARTICLE BASED FILMS FOR PHOTONIC APPLICATIONS

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We report on a novel organosilicate nanoparticle (OSNP) based film for photonic applications. Entropy driven formation mechanism employed to fabricate these films offer highly tunable physical and optical properties that can be customized for individual applications. These coatings are fabricated from colloidal dispersion of PMSSQ nanoparticles with ultra small sizes (3-5 nm) dispersed in thermally labile polymer suspensions. These nanoparticle - polymer composites are subjected to temperatures above the decomposition temperature of the polymer and the entropic gain experienced by the nanoparticles in this rubric is harnessed to fabricate novel nanoporous films composed of nanoparticles. The films, with properties which are both temperature and substrate surface energy dependant, allows a tight control on the final film porosity (refractive index) as well its thickness which are highly desirable for photonic applications. In addition, controlled refractive index grading have been achieved through this approach not only across the film thickness but also in the lateral dimensions opening up new avenues towards novel on-chip photonic structures and lenses simply through controlling the temperature distribution across the substrate. We have been able to fabricate coatings with refractive indices as low as 1.048 (and tunable up to 1.38) together with a great degree of control on their grading.

As the first example, we demonstrate the successful fabrication of a chip based liquid core waveguide with an aqueous core employing surface directed flow design. Surface tension and capillary effects alone are exploited to form microchannels of water confined only by two physical channel walls, both coated with the nanoporous OSNP films to function as the low index cladding layer. Cladding on either side of water channel (virtual walls) is formed by air (n =1.0) resulting in a highly efficient light waveguide system.

Another unique aspect of these films is the ability to achieve high resolution micropatterns of distinct porous - non porous regions through controlled pore collapse. Micropatterning nanoporous films through conventional photolithography followed by wet chemical etching or plasma etching has been known to incur significant damage to their highly sensitive surfaces and subsequent loss of functionality. This is an especially important consideration for the development of photonic biosensors wherein the high surface area of these films is widely utilized to achieve high areal density of bound biological moieties. Herein, we report a unique patterning technique harnessing the surface energy dependant porosity property of our OSNP films to achieve high resolution micropatterns while preserving its pristine surface functionality and optical properties. We demonstrate this through patterning the substrate surface energy of the underlying substrate followed by OSNP film deposition and curing/calcination which spontaneously forms the patterned porous/non-porous regions on the substrate. We further demonstrate that the surface functionality and film integrity is well preserved post patterning and that the porous micropatterns can be efficiently used to immobilize high density of biological moieties. An order of magnitude increase in fluorescence intensity was observed in the porous regions compared to the collapsed pore region when fluorescently tagged Protein A molecules were immobilized on the patterned films.

A-0194

WHITE UPCONVERSION LUMINESCENCE IN NANOCRYSTALLINE (HO3+,TM3+,YB3+):KLU(WO4)2 PHOSPHOR

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Trivalent rare-earth (RE) ions, such as Ho^{3+} and Tm^{3+} are suitable candidates for the Upconversion (UC) processes due to their abundant energy levels and narrow emission spectral lines. Ytterbium ion acts as sensitizer allowing the possibility to be excited at 980 nm and followed by efficient energy transfer (ET) to the visible where holmium and thulium ions emit. Several examples of the use of these three ions in different hosts can be found in the literature [1,2]. On the other hand, nanocrystals have received special interest in enhanced intensity of emission detected for smaller size particles [3] and their size expands the possibility to construct new architecture devices.

Monoclinic ordered $KLu(WO_4)_2$ (hereafter KLuW) host is a well-known material for laser applications. Its main advantages are the high absorption and emission cross section of active lanthanide ions in this host and the possibility to be highly doped with lanthanides ions, with low concentration quenching due to the relatively large RE-RE distances in the structure [6].

In this paper, we report for the synthesis of lanthanide doped KLuW nanocrystals by the sol-gel modified Pechini method using a maximum calcination temperature of 973 K. X-ray powder diffraction patterns show that these nanocrystals present the monoclinic structure with the C2/c space group. Rietveld refinement using the fullprof program has been used to refine the unit cell parameters, leading a = 10.597(1) Å, b=10.229(1) Å, c=7.4967(8) Å and =130.746(6)º . Raman spectroscopy was used to study the vibrational structure of the nanoparticles during the transformation from precursor powder into a crystalline monoclinic phase.

Electronic microscopy has been used to study the size dispersion and morphology of the obtained nanocrystals. The crystallite size determined by X-ray diffraction line broadening correlates well with TEM observations, indicating that the particles are individual nanocrystals.

On the first design of white UC luminescence in (Ho^{3+},Tm^{3+},Yb^{3+}) doped KLuW nanocrystals was $KLu_{(1-x-y-z)}Ho_xTm_yYb_z(WO_4)_2$ (x = 0.005, y = 0.01, z = 0.01). These lanthanide ion concentrations were optimized in a previous work in bulk single crystal [7]. The nanocrystals photoluminescence under Ti-sapphire laser excitation of 930 nm shows a white emission composed by the red thulium emission 3F2,3-->3H6 and 1G4-->3F4, and red holmium emission 5F5-5I8, the green holmium emission 5F4,5S2-->5I8 and the blue thulium emission 1G4-->3H6. Suitable emission control of the relative intensities of the three

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A-0195

NEW MATERIALS AND STRUCTURES FOR OPTICAL DETECTION OF IONISING RADIATION

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Ionising radiation encompasses X-rays, gamma rays, charged particles and neutrons. Solid-state detectors of such radiation either function electrically through directly detecting the charge which is generated by the passage of an ionising particle through a solid, or indirectly, by detecting the emission of light which occurs when the generated electrons and holes recombine. Radiation detection materials which are based on the indirect optical scheme include scintillators, phosphors, storage phosphors, and thermoluminescent substances; these are coupled with optical detectors ranging from photomultiplier tubes and photodiodes for single pixel detection, to CCD's and CMOS arrays for radiation imaging. A common performance requirement for all such radiation detector materials is high optical transparency, since this leads to optimal light harvesting, and in the case of imaging, optimal pixel-to-pixel coupling between the detector material and the imaging array to achieve high spatial resolution in the image. Single crystal materials offer high transparency, but are impossible, impractical or very expensive for large area or volume applications such as medical imaging, so alternative composite or polycrystalline structured materials are of considerable interest.

In this talk, recent developments in alternative radiation detection and imaging materials will be surveyed with examples drawn from our own work on scintillators, phosphors and storage phosphors. Ceramic scintillators are a viable alternative to single crystals, but birefringence in most materials leads to strong optical scattering from grain boundaries and poor transparency. Cubic structured materials have an isotropic refractive index, but few are good scintillators. We have found that barium chloride, ordinarily orthorhombic, has the useful property that it can be prepared in the cubic phase, normally stable only above 925˚C, at room temperature by adding a fraction of lanthanum trichloride, and that the resulting ceramic materials form good transparent scintillators and phosphors when additionally rare-earth doped. Cerium doped and stabilised cubic barium chloride ceramic is a fast scintillator (50 ns) with an output of 7000 photons/MeV. Europium-doped lanthanum-stabilised cubic barium chloride is a transparent phosphor ceramic with a light output at least that of current commercial phosphors.

Transparency in non-cubic materials can also be achieved by incorporating radiation sensitive nanoparticles in glasses to form glass ceramics, or as a bulk nano-crystalline ceramic. In both cases transparency generally requires the particle size to be smaller than or comparable with the wavelength of light. We have tested a few examples of bulk nano-crystalline ceramics though have not observed particularly effective scintillator performance, but many glass ceramics combinations show good transparency and phosphor/ storage phosphor performance, and have the traditional fabrication benefits of glasses: cost effectiveness and ability to form arbitrary shapes (fibres etc). Here we present recent results from our work on fluorozirconate, heavy-metal oxide glass ceramics as phosphors and storage phosphors, and lithium and boron containing glass ceramics for neutron detection. Finally, preliminary results from experiments aimed at micro-fabricating internal glass and ceramic structures in imaging plates are described.

A-0196

EXAMINATION OF VALENCY CONVERSION OF RARE-EARTH IONS IN VARIOUS DIVERSE MATERIAL SYSTEMS UNDER EXPOSURE TO HIGH DOSE SYNCHROTRON RADIATION (X-RAYS)

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There are many biomedical applications in which we need to measure very high dose levels, for example, ~1000 Gy, and, at the same time, measure the variation of the dose over a scale of a few microns. For example, in Microbeam Radiation Therapy (MRT), tumors are irradiated with microplanar arrays of synchrotron-generated x-rays. For such applications we need to have a high-resolution, high-dose detector. As part of the work for developing a suitable detector for MRT, we have examined the radiation induced conversion of rare-earth ions, especially Sm^{3+} to Sm^{2+}, embedded in suitable media. We have exposed a variety of rare-earth (Sm^{3+} and Eu^{3+}) doped media, from single crystals to glass-ceramics, to a high dose radiation at the Canadian Light Source to examine a possible conversion in the rare-earth ion valency. Filtered bent magnet radiation from a synchrotron (Canadian Light Source) was used to irradiate the samples. Different sets of filters were selected to produce various spectra, each with a different peak in the range 20 - 50 keV. We have used the distinctly different signatures in the photoluminescence emission spectra of the two valency states to identify the rare-earth ions and whether a valency conversion has taken place. We report the results from these experiments, which show that the conversion of Sm^{3+} to Sm^{2+} is not universal and depends very much on the host material. We discuss possible reasons for the presence and lack of radiation induced valency conversion of Sm-ions, and identify the challenges that must be overcome to develop a high-resolution, high dose detector.

A-0198

COBALT DOPED ZNO NANORODS AND NANOTUBES FOR ENHANCED OPTICAL SENSITIVITY IN THE VISIBLE RANGE

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ZnO is an important material for optoelectronic applications such as solar cells and sensors due to its wide band gap and functional properties. Optimizing the growth mechanisms of ZnO nanorods as grown in a low temperature, wet chemical method will allow for an enhancement of material, optical, and electronic properties in a low cost production method. Our group fabricated nanorods on indium tin oxide (ITO) and glass substrates. The alignment and optical properties of the ZnO nanorods depend greatly on the initial seed layer of (doped) ZnO as well as the growth parameters. In this study we investigated the changes in the optical absorption properties of ZnO nanorods doped with Cobalt. Cobalt doping was achieved by adding a prescribed amount of cobalt chloride to the chemical bath solution of Zinc nitrate and hexamethylentramine. Optical absorption, Raman spectroscopy and energy dispersive X-ray measurements reveal that optical absorption of ZnO nanorods extends from 385 nm to 700 nm when doped with cobalt from 0.1 at. % to 9.7 at. %. In addition, we investigated the selective etching of ZnO with various molar concentrations of potassium chloride solution. Higher molar solution concentration produced ZnO nanotube structures that can be used for enhancing optical and chemical sensitivity. We will present fluorescent and absorption profiles of ZnO nanotubes doped with cobalt and decorated with metallic nano particles of gold and silver as well as quantum dots of various diameters.

A-0199

HYBRID PHOTOCHROMES WITH FULGIMIDE AND DIHETARYLETHENE FRAGMENTS

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Dihetarylethenes are effective thermally irreversible photochromic systems for the design of 3D optical memory materials and molecular switches that form the basis for new-generation computer technology and large-capacity data recording, storage and processing systems. A special role among these photochromes is played by maleic anhydride and maleimide derivatives, because they have exceptionally high thermal stability of both forms and their fatigue resistance reaches tens of thousand. Besides, these compounds can be readily converted to derivatives of related structures, which extends the range of useful service properties of photochromes. Another type of photochromes similar to dihetarylethenes with regards to both the structure and the phototransformation mechanism are fulgides and fulgimides, derivatives of maleic anhydride and maleimide. The hybrid photochromes were synthesized by the reaction of amino derivatives of fulgimides with dihetarylmaleic anhydrides.

The hybrid photochromes having 2,5-dimethylthiophene substituents in both initial compounds were obtained by refluxing fulgimides with anhydride in ethanol in the pres-ence of molecular sieves. However for hybrid photochromes with a dibenzothienylethene moiety we could succeed in synthesizing the products only applying a high-pressure (10 kbar) technique.

The phototransformations of the hybrid compounds in toluene were studied by spectral kinetic measurements in detail. The absorption spectrum of the initial form of a typical hybrid compound shows two absorption bands with maxima at 335 and 410 nm. On exposure to UV light, the inten-sity of the short-wavelength absorption band of the initial form decreases and a band in the visible region with a maximum at 525 nm appears simultaneously. All compounds proved to be thermally irreversible photochromes providing multiple repetition of the photocoloration-photobleaching processes. It was indicated that the introduction of the separating phenyl fragment almost does not affect the spectral behavior of the initial and photoinduced forms of the hybrid compounds confirming a lack of conjugation between the fulgimide and dihetaryl frag-ments in the hybrid molecules. Presumably, both fragments participate in the photocoloration reaction, as indicated by the photoinduced change in the UV absorbance: in short-wavelength range at 325 nm where photoinduced decrease in the absorbance takes place and at 350-380 nm where the absorbance increases similarly to the photoinduced changes for the fulgimide and dihetaryl moieties, respectively.

When one benzothiophene fragment of the dihetarylethene moiety is replaced by indole fragment, the long-wavelength absorption band of the initial form shifts to longer wavelengths from 410 to 460 nm, while the position of the absorption band of the photoinduced form is retained. The ratio of the rate constants for photocoloration and photobleaching (k1/k2), which is equal to 1 for all of the above compounds, implies that their efficiencies are commensurable.

A-0200

OPTICAL RECTIFICATION FOR TERAHERTZ GENERATION

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The applications of terahertz-frequency electromagnetic radiation are growing rapidly, driven by developments in sources, detectors and optics suited to the THz-frequency region. Much of the advance is in the field of THz time-domain spectroscopy in which ultrashort pulses of near-infrared radiation are used in a pulse-probe arrangement to realise both the emission and detection of the THz radiation. One technology for THz generation by ultrashort pulses involves the photoconductivity mechanism [1]. This requires the emitter to have suitable electrodes provided on the surface and a suitable biasing arrangement to be employed. However, even bare semiconductor crystals may produce THz radiation when excited by ultrashort optical pulses. The two principal physical mechanisms are current surges or transient currents on the one hand and optical rectification on the other. The former tend to saturate as the excitation fluence is increased thus at high excitation fluences optical rectification dominates. While the generation of THz radiation by optical rectification has been known for some time, earlier theoretical and experimental results have been limited to simple crystallographic directions. A general theory has recently been presented and compared with experimental data for (N11) crystal faces of GaAs [2]. The experiment and theory taken together demonstrate that the THz emission observed cannot be accounted for simply by bulk rectification but requires the consideration of surface-field induced optical rectification and moreover that the surface fields on the A and B faces of GaAs are oppositely directed. In the case of epilayers of GaBiAs, the surface-field induced optical rectification is seen to enhance the bulk optical rectification effect [3].

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A-0201

PHOTOSTABILITY FOR PLD FILMS BASED ON GE-AS-SE FOR NON LINEAR OPTICAL PROPERTIES

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Chalcogenide glasses are known for their good transmission from visible (sulphide) or near infrared (selenide, telluride) to middle 2-3), and one particularly~infrared. Their refractive index is generally high (important potential rely on their photosensitivity to band gap light. Chalcogenide have also attracted significant attention in recent years as a promising nonlinear material for all optical devices [1-4]. These chalcogenides can be deposited in amorphous thin film for optical coatings but also for opto-electronic components or opto-chemical sensors considering complex integrated optical structures. The photoinduced refractive index change of chalcogenide films can be exploited for selective writing of Bragg gratings or channels waveguide. Integrated all-optical devices rely on operation based on a third-order nonlinearity (e.g., ultra fast Kerr effect) for realisation of reconfigurable optical, for instance. Within this framework, we studied selenide PLD films based on Ge-As-Se glassy system well known for presenting high nonlinear refractive index n2. A photo-stable glass, which is not easily affected by exposure to light, is needed for many applications based on nonlinear properties. Indeed, potential applications of chalcogenide have been restricted due to the drift in their optical properties with exposure to light. Compositional, morphological and structural characteristics of bulks and films were studied using scanning electron microscopy, energy dispersive spectroscopy and Raman scattering spectroscopy. Optical properties as band-gap energy or refractive index were also estimated from the analysis of ellipsometric data obtained using variable angle spectroscopic ellipsometer. The photosensitivity of Ge-As-Se PLD films were investigated by irradiating (diode laser of wavelength =660nm) five thin layers of variable composition. Using those different techniques of characterization, we were able to select the most photostable composition suitable for nonlinear optical development. We will also present the results of Z-scan measurements (1064 nm, 17 ps) of nonlinear refractive indices and nonlinear absorption coefficients of the PLD films.

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A-0202

LIGHT INDUCED 2D CHIRAL STRUCTURE ON THE SURFACE OF AZO-POLYMER FILMS

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Chiral molecules play key role in our life. All key biologically active molecules and macromolecules like amino acids, peptides, enzymes, proteins as well as DNA, RNA and sugars, polysugars, terpenes and biologically active heterocyclic molecules are chiral. These molecules and macromolecules exist and are biologically active under only one of the two possible mirror images. For instance essentially only the L-amino acids and only the D-sugars like ribose and deoxyribose (the key constituents of RNA and DNA macromolecules and the chiral sites of their monomeric units) are biologically active.

These chiral molecules and macromolecules are able to rotate and change the polarization state of light. So a chiral system is optically active. Chiral expression at surface (2D) has attracted increasing attention in recent years. In 2D systems, the chirality is restricted to the asymmetry of objects lying in a plane. Papakostats et al. fabricated 2D chiral media using direct-write electron beam lithography in metallic and dielectric films and experimentally showed that such 2D chiral systems also able to affect polarization state of light [1].

In this experimental work we will present a simple method for fabrication of 2D chiral system. It has been shown that illuminating of an azo-polymer film with a single uniform laser beam can create self-organized surface relief pattern on the surface of the film. More recently we showed that the self-organized structure formation of surface relief patterns on the surface of azo-polymer films are very sensitive to the angle of incidence [2]. For different state of polarization different structures has been obtained. Let us consider the case of 45° polarization. In this case at incidence angle of ~33°, formed structure is asymmetric and it does not have a symmetry axis in 2D plane. The AFM images of these patterns are not superimposable with their mirror images if we rotate the images in their planes. On the other hand the mirror images of Fourier Transform of AFM images also are not coinciding with Fourier Transform of AFM images. Consequently this structure is a 2D chiral structure. These patterns show the capability to rotate the polarization state of diffracted light in the transmission regime. The changes in the polarization state of light associate with the chirality of sample. This is a one-step very simple and reversible method to fabricate 2D chiral systems.

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A-0203

STRETCHED EXPONENTIAL RELAXATION PROCESSES IN HYDROGENATED AMORPHOUS SILICON AND HYDROGENATED POLYMORPHOUS SILICON

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Stretched exponential relaxation processes have been extensively investigated in disordered systems such as amorphous semiconductors. In this paper we deal with these processes observed in hydrogenated amorphous silicon (a-Si:H) [1] and hydrogenated polymorphous silicon (pm-Si:H)[2]. The latter material has received much attention from the viewpoints of physics and applications, i.e., as one of promissing materials for efficient and stable solar cells[3]. This material is a heterogeneous material consisting of a relaxed amorphous network and a small fraction (about 2 %) of nanocrystallites 2 - 3 nm in size. We consider the stretched exponential relaxation processes associated with defects such as silicon-dangling bonds in amorphous network, particularly light-induced defect creation processes in a-Si:H and pm-Si:H [4]. The amorphous network is different in structure between a-Si:H and pm-Si:H, so that difference affects the relaxation processes involved in light-induced defect creation in these materials. We have already reported experimental results on the stretched exponential relaxation associated with the light-induced defect creation processes in a-Si:H [1] and pm-Si:H [2], i.e., dispersion parameter beta and characteristic time tau. In this paper we review the results in connection of amorphous network and hydrogen movement, and discuss them in terms of stretched exponential relaxation processes involving defect-creation processes and defect-annihilation processes associated with hydrogen movement under illumination.

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A-0204

MULTI-BANDS ACTIVE MEDIA ON BASIS OF BAY2F8 FOR UP-CONVERSION SOLID STATE LASERS WITH DIODE PUMPING

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Now the basic problem in development completely solid-state compact lasers for visible and UV spectrum ranges in which as active elements ionic crystals are used is the limited choice of solid-state sources of a pumping. The second problem concerning to UV a range is the solarization of the active element under the influence of UV radiations and leading to fast degradation of medium. The use of up-conversion mechanisms of excitation RE could solve simultaneously both problems: to avoid or considerably to reduce solarization processes and to apply convenient sources of a pumping, namely, laser diodes that will allow to create compact laser devices for short-wave ranges of a spectrum [1].

In this report we represent multi-bands up-conversion luminescence Pr^{3+} and Ce^{3+} in a range of a spectrum from 230 to 650 nanometers, excited by radiation 960 nm, 840 nm and 405 nm of laser diodes.

The possibilities of cooperative multi-ion energy transfer from IR to UV region of spectrum by 2F7/2→2F5/2 (Yb^{3+})→1G4 (Pr^{3+})→3P1 (Pr^{3+})→5d (Pr^{3+}) scheme in system (Pr^{3+}, Yb^{3+}): BaY_2F_8 are shown [2]. The first step

provide the energy transfer from Yb^{3+} ions to Pr^{3+} ions as a result of Yb^{3+} absorption near 960 nm. It is well known the ability of Yb^{3+} to transfer the energy another RE ions by efficient ion-pair interaction[3-4]. The dependence of the intensity such transfer from the Pr^{3+} (range 0, 2-0, 7% at) and Yb^{3+} (range 0, 4-3% at) concentrations has been studied in order to determine coordination between the optimum ion concentrations and the involved mechanisms. The second step provides the ESA of the 1G4□3P1,transition of Pr^{3+}. The dependences of the intensity this step from correlation of Pr^{3+} and Yb^{3+} concentrations and the pump power of 840 nm laser's diode were measured. The third step provide the energy transfer from level 3P0 (Pr^{3+} ions) to lowest 5d band of Pr^{3+} by 405 nm laser diode. The energy transfer rates in dependence from pump power of 405 nm laser's diode for this transition were determined.
The scheme for excitation UV luminescence of Ce^{3+} in crystals (Yb^{3+}, Pr^{3+}, Ce^{3+}): BaY_2F_8 by three beams from laser diodes (940 nm, 840 nm, 405 nm) is 2F7/2→2F5/2 (Yb^{3+})→1G4 (Pr^{3+})→3P1 (Pr^{3+})→5d (Pr3 +) →5d (Ce^{3+}) [2]. The fourth step provide ion-pair interaction between Pr^{3+} and Ce^{3+}, because first 5d band of Pr^{3+} almost completely coincides with third 5d bands of Ce^{3+}.

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A-0205

DOPING ISSUES FOR OPTOELECTRONIC TRANSPARENT CRYSTALLINE AND AMORPHOUS OXIDE

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Effectiveness of doping of carriers or active ions is a critical issue in functioning materials for electrical and photonic applications. Highly efficient carrier doping via substitution with impurity in crystalline Silicon is the most successful example. Another historically well-known success is chemical doping in polyacetylene thin films by Heeger, Shirakawa, and McDiarmid. Exposure to Br_2 or I_2 gas converted them from an insulator to a metallic conductor.
In this talk, I discuss doping issues in crystalline and amorphous wide gap oxides. Oxides have more complex chemical constitutions, polarity and structure than the above systems, in general. In this talk I discuss doping issues in crystalline and amorphous transparent oxides and show versatile approach toward functioning oxides by introducing our results such as electron-doping to a ultra wide gap insulating crystal $12CaO•7Al_2O_3$ and doping of optically active ions in amorphous SiO_2.

A-0206

A NOVEL MULTIPLEXED FIBER BRAGG GRATING SENSOR WITH APPLICATION IN MATERIALS HEALTH MONITORING

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In this paper, we propose a novel multiplexed fiber Bragg grating (FBG) sensor technique for investigating the location and severity of any random strain to the monitored substrate. This will be achieved by analyzing the axial and transversal effects of strain on the FBG sensor from its output reflected spectrum. The synthesis of FBG structure from its reflected spectrum is proposed as an ideal means for obtaining information about the structural changes of the sensor that is subjected to external perturbations. This information can then be used for estimating the severity and shape of the anomaly. Our goal in this paper is to demonstrate through numerical simulations how to verify and validate our proposed methodology.

Presently the “orthogonal array” technique is by far the most viable solution for monitoring a substrate in two dimensions. In this method a series of wave division multiplexed (WDM) FBG sensors are orthogonally placed on the monitored substrate. Therefore, any random anomaly can be positioned and monitored by the corresponding sensors based on the grating sensitivity. This FBG grid sensor system has several advantages such as simplicity, reliability and feasibility. However, some disadvantages still remain such as the use of an optical switch for each dimension, which would lead to a relatively long measurement time, and the use of WDM sensors corresponding to each dimension that would double the number of sensors. Therefore, there is still an urgent need for a new multiplexed technique to overcome and eliminate the above disadvantages.

For health monitoring applications, the FBG is capable of measuring the severity of the strain in axial dimension. The transversal strain induces a birefringence on the optical fiber due to the deformation of the dielectric waveguide and refractive index change. Therefore, the reflected peak at the Bragg wavelength of the sensor splits into two separate ones, each relative to a polarization axis. The characteristics of a fiber subjected to a transverse strain are different than those from an axial one, and so it is important to evaluate the effects of each component on the output reflected spectrum. The reflected spectrum of the FBG sensor due to the applied strain can be determined directly by using the T-matrix method. On the other hand, the strain distribution of the FBG can be obtained from its own reflected spectrum. This approach is known as the inverse approach, which is based on calibrating the parameters of a mathematical model to reproduce the observations.

In our work, among a number of different inverse methods in the literature genetic algorithm is selected. This method requires only the intensity information of the reflected spectrum of the FBG sensor to reconstruct any uniform or non-uniform discontinuous distributions along the fiber. Our analytical results demonstrate the potential for the use of an FBG sensor for applications such as structural damage identification of smart structures envisaged to be used in aircraft and other aerospace systems.

A-0207

SOLID PHASE SYNTHESIS IN AMORPHOUS CHALCOGENIDE MULTILAYERS FOR OPTOELECTRONICS

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Chalcogenide glasses, amorphous layers are rather widely investigated and applied in electronics due to the number of peculiar effects like optical and electrical memory, optical nonlinearity, transparency in infrared spectral region. Optically induced effects of darkening-bleaching, mass transports and change of the refractive index are promising for fabrication of integrated optical elements. All these effects and applications depend essentially on the composition and microscopic structure, technology and macroscopic structure of the elements, as well as on the possibilities to stimulate their changes by temperature, optical or electrical fields.

Bulk materials of the most known As(Ge)-S(Se,Te) systems can be obtained by the conventional liquid-phase method of direct syntesis from elemental components. Thin film of these materials usually are prepared by thermal evaporation in vacuum, but decomposition of the original multicomponent glass can change the parameters of layers obtained at different temperature conditions.. These can be eliminated in a number of nanomultilayers structures via solid phase synthesis during the interdiffusion of different adjacent layers prepared from different compositions (elemental or compound chalcogenides, metals or even dielectrics), which undergo heat- or light-, electric field treatments. New multicomponent phases with optimalised parameters and laterally or vertically distributed structures can be obtained this way.

We have developed the technology of vapor phase deposition of thin film nanolayered, compositionally modulated structures, which consists of stacks 1-10 nm thick sub-layers (from elemental Se, Te, binary As-(S,Se,Te) and some more complex chalcogenides, as well as Sb, Bi, Cu, Au metals and SiOx oxides, deposited on special glass, sapphire, silicon substrata.

They were used for investigations of optical and electrical parameters (transmittance, refractive index, conductivity, permittivity), their change under the influences of laser irradiation, ion and e-beams, current pulses.

The main result of these stimulated solid state processes is the well localized change of optical and electrical parameters which in turn can be used for optical recording, amplitude-phase relief and (in some cases) surface pattern formation.

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A-0208

OYGEN IN CSBR:EU^{2+}: ITS INFLUENCE ON PHOTOSTIMULATED LUMINESCENCE

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X-ray storage phosphors in form of image plates have gained a considerable role in the field of medical diagnostics. For future applications the spatial resolution has to be increased and the photostimulated luminescence (PSL) sensitivity has to be optimized. The material CsBr:Eu^{2+} which is presently under investigation has a high potential for use in high-resolution x-ray imaging plates due to its excellent x-ray sensitivity [1] and the ability to be formed in needle-structures to eliminate light scattering [2]. However it has been shown that the imaging characteristics are strongly influenced by incorporated defects, in particular oxygen [3] and water [4]. Therefore the understanding of the role of lattice defects and impurities on the photostimulated luminescence (PSL) process is essential.

In this talk, the effect of oxygen and water in non-doped and europium doped CsBr is investigated. It will be shown that non-doped CsBr, as obtained from chemical suppliers, contains significant levels of oxygen defects, regardless of purity or dryness of sample. These defects are involved in trapping processes of radiation induced electrons and holes and display both photoluminescence (PL) under UV excitation as well as PSL following x-irradiation and optical excitation. The oxygen impurities can be removed using a high-temperature reduction reaction with NH4Br and subsequently can be reincorporated with a controlled concentration following doping with CsOH. The effect of such controlled amounts of oxygen on additional doping with europium ions will be discussed. A variety of different emission wavelengths are found and their relation to the PL and PSL will be presented. An attempt of a model for the PL and PSL mechanism will be derived.

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A-0209

TRIVALENT ER AND SM IONS IN FLUOROCHLOROZIRCONATE GLASSES

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We have investigated the optical properties and x-ray luminescence of fluorochlorozirconate glasses and glass-ceramics with a base composition 53% ZrF_4, 20% NaF, 3% AlF_3, 3% LaF_3, 1%InF_3, (20- x)% BaF_2 and x% $BaCl_2$ with x varying from 0% to 19% (all in atomic %) and doped with addition of $ErCl_3$ or SmF_3 into the initial mixture of constituents. The annealing at moderate temperatures (T≥2200C) transform the glasses with x ≥10 into glass-ceramics containing nanocrystals of $BaCl_2$. The spectral positions of rare earth related absorption and emission bands show that these ions are always trivalent, i.e. Sm3+ or Er3+. The photoluminescence (PL) emission spectra show multiple bands in the visible and near IR range which give a good and potentially interesting match to Si detectors. Surprisingly, the x-ray stimulated luminescence (XL) may be detected only in samples doped with Sm while Er doped samples remain inactive. The XL has a tendency to increase with the increase of x; the relative Cl-to-Br content. The XL may be also substantially increased by appropriate annealing, in contrast to PL and optical absorption which seem to be unaffected by thermal treatments. The observed effects are discussed in terms of the reconstruction of the host glass which improves the excitation transfer of energy from the glass to embedded Sm^{3+} ions.

A-0210

PROPERTIES AND APPLICATIONS OF SOL-GEL DERIVED ACTIVE PHOTONIC CRYSTALS

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Photonic crystals (PCs), or photonic bandgap materials, are composite artificial structures with a periodicity (in 1-, 2- or 3-dimensions) in their refractive index, on a linear scale of the order of the optical wavelengths. The periodicity in the index originates optical gaps (stop bands), which are frequency ranges where light does not propagate in the composite due to Bragg reflection, although the individual materials are transparent. The introduction of controlled defects (for example creating pass bands) increases the functionality of these structures. Sol-gel is an inexpensive, versatile technique to prepare both 1-D and 3-D PCs. Potential applications include, among many possibilities, light filtering, optical amplification and optical sensing.

Erbium/ytterbium-doped PC materials and structures have been prepared by sol-gel processing in the form of 1-D microcavity structures, both single (Fabry-Perot) and double (coupled), consisting of multilayer quarter-wave stacks of silica and titania as low and high index materials, respectively, deposited by spin-coating on silica glass or single crystal silicon substrates. Their optical reflectivity and photoluminescence (PL) spectra have been measured in the near infrared range, revealing cavity resonances with a quality factor as high as 250. It was found that suitably designed coupled microcavity structures are able to significantly broaden the Er3+ emission at 1.5 mm (irrespective of the excitation wavelength, at 514.5 nm or 980 nm), which may be useful in applications where broadband emission is necessary, for example in all-optical amplification in Dense Wavelength Division Multiplexing systems. A remarkable full-width-at-half-maximum of 183 nm has been achieved for the Er3+ emission peak at 1.5 mm (compared to 48 nm for the Er3+ PL outside the coupled microcavity structure), together with a simultaneous PL intensity enhancement by a factor of ~ 6.

3-D direct, infiltrated and inverse opal structures, on the other hand, have been studied for possible strain sensing applications, based on strain-induced stop band frequency shifting. Self-assembly of polystyrene microspheres has been achieved by sedimentation on flexible polyimide tape substrates, leading to organized 3-D direct opal templates, which have been infiltrated with silica by sol-gel dip-coating or CVD and, ultimately, inverse opal structures have been obtained following chemical dissolution of the polymer template. The structural and optical properties of these PCs have been studied by scanning electron microscopy (FE-SEM) and UV/visible spectroscopy under variable degrees of strain. FE-SEM evidenced ordered domains of ca. a hundred square microns or more. A mechano-optical effect was observed in terms of strain-induced blue-shifting of the photonic stop band peak wavelengths by up to 50 nm in transmission mode, due to the changes in interplanar spacing upon bending of the flexible PCs. Strain optical response cycles have also been studied, indicating the possible use of these materials in reversible photonic strain sensors, integrated in low cost sensor/actuator devices. Finally, some results concerning $Yb^{3+} \rightarrow Er^{3+}$ energy transfer in Er/Yb-activated 3-D inverse opal PCs are also presented.

A-0211

MULTILAYER WAVEGUIDE POLYMERIC OPTICAL STRUCTURES FOR PERSPECTIVE NANOPHOTONIC DEVICES

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Researchers of functional nanomaterials used in information systems need to look for new ideas and radically new constructive solutions to ensure efficient device operation, record-breaking high speed and integration of elements. It is one of the ways of nanotechnologies. On the other hand, functional elements being formed in nanometer range require landmark approaches. It refers especially to formation of information-logical devices at molecular level.

One of the basic techno-systematic problem in such developing is the necessity to use “macro-nano” and “nano-macro” interfaces to put in the original information and deduce final results. The advantages of the small-size molecular elements can’t help to ensure access to them. Probably the only effective way to arrange the bonding with molecular system is to use optical interaction.

The techno-systematic approaches aimed at perspective nanophotonic devices based on multilayer structures are described. Multilayer waveguide optical polymeric structures with elements of integral optics; based on photochromic protein bacteriorhodopsin and synthetic photochromic compounds; are developed. Bacteriorhodopsin which has unique technological potential and its optical properties allow the use of optical input-output devices and create molecular appliances based on self-organization principles. The optimization and enhancement of functional parameters of multilayer structures by, first, using additional nanostructuring of molecular media, and, second, by introduction of new functional elements - hybrid nanostructures (making it possible to further realize a new class of optical information systems based on self-organizing oscillatory and auto wave hierarchical processes in BR-containing nanocomposites) are suggested.

The optimization and enhancement of functional parameters of multilayer structures by, first, using additional nanostructuring of molecular media, and, second, by introduction of new functional elements - hybrid nanostructures (making it possible to further realize a new class of optical information systems based on self-organizing oscillatory and auto wave hierarchical processes in BR-containing nanocomposites) are suggested.

A-0212

CHALCOGENIDE GLASS PHOTONIC CRYSTAL FIBERS

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Chalcogenide glasses are known for their large transparency in the mid-infrared and their high linear refractive index (>2). They present also a high non-linear coefficient (n2), 100 to 1000 times larger than for silica, depending on the composition. An original way to obtain single-mode fibers is to design microstructured optical fibers (MOFs). In addition, these fibers present unique optical properties thanks to the high degree of freedom for designing the geometrical structure. A classical method to make MOFs is the stack and draw technique. However, that technique induces high optical losses (several dB/m) in chalcogenide glass MOF, due to the poor quality of interfaces between capillaries. Then, we have developed a new casting method to fabricate the chalcogenide perform, which leads to optical losses as low as 1 dB/m at 1.55 µm and 0.3 dB/m in the mid-IR.

Our group has prepared various chalcogenide microstructured fibers operating in the IR range in order to associate the high non-linear properties of these glasses and the original MOF properties. For example, fibers with small effective mode-area (Aeff < 10 µm^2) have been realized to enhance the non-linear optical properties for telecom applications such as signal regeneration and supercontinuum sources. On the contrary, for military applications in the 3-5 and the 8-12 µm windows, large effective mode area and single mode fibers are requested to permit the propagation of high power Gaussian laser beams.

A-0213

PHOTO-DEFORMATIONS IN AS2S3 GLASS: FROM ATOMIC, NANO, TO MACROSCOPIC

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It has been demonstrated that, upon light illumination, soft photosensitive materials such as chalcogenide glasses and dye-doped organic polymers exhibit several kinds of deformations (shape changes of samples) [1-3]. Some are isotropic (scalar) and the others are anisotropic (vector). Or, some are transitory and the others are memorable.

What is the deformation mechanism? A deformation is produced by motive forces and fluidity (or elasticity). And, we have assumed that the motive force has an atomic origin. For instance, the deformation in some polymers is triggered by photoinduced trans-cis isomerization of azo-benzene molecules [3].

Recently, Tanaka and coworker discovered macroscopic (probably, the most prominent) vector deformations in As2S3 flakes and films which are laid on viscous grease, i.e. the sample being semi-free from substrates [4,5]. Upon illumination of a linearly polarized bandgap beam, the flake anisotropically curls and elongates with screwing [4], and the film wrinkles orthogonal to the light polarization [5]. Nevertheless, the deformation mechanism, specifically the motive force, remains far from understanding [1,4,5].

In the present talk, after a brief review of the photo-deformation, I assert the importance of <optical forces>, including photon pressure and angular momentum, as the motive force. The idea will open a new shaping method of viscous materials.

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A-0214

ADVANCES IN WHITE ORGANIC LIGHT EMITTING DEVICES

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The current use of lighting in buildings and streets accounts for a significant percentage of the electricity consumed in the world at present and nearly 40% of that is consumed by inefficient incandescent lamps, only about 15 lm/W. This has created interest in investigating more efficient sources of white light. Much research efforts are made in developing more cost effective and efficient white organic light emitting devices (WOLEDs) [1-3]. The simplest design of a WOLED is to have a single emissive-layer stack sandwiched between electrodes and the charge transport layer with the challenging task of finding optimum emitting materials, manipulating the charge carrier balances and location of the recombination zone and energy transfer. The first WOLED fabricated [1] had a single poly (N-vinylcarbazole) emission layer doped with three fluorescent dyes. To achieve higher power efficiency, a combined use of blue fluorescent and green and red phosphorescent emitters in WOLEDs has been made recently [2-3]. This is based on the coincidence of a physical phenomenon of formation a singlet spin configuration with probability 25% and triplet with 75% between an electron and hole injected from the opposite electrodes of a device with that of a natural phenomenon that white light consists 25% of blue light and 75% of red and green lights. Thus, the above combination of fluorescent and phosphorescent emitters is capable of reaching 100% internal quantum efficiency of white light emission by harvesting 25% singlet emission and 75% triplet emission. Although by trial and error experimental techniques on WOLEDs the triplet recombination is captured by a heavy atom compound (phosphor) that enhances the spin-orbit interaction and hence triplet radiative recombination, the mechanism has not been fully understood theoretically until recently [4].

In this paper, the radiative recombination of triplet exciton is revisited by introducing the recently invented new exciton-spin-orbit-photon interaction operator [4] and calculating the rates of spontaneous emission in several phosphorescent materials. Based on such results a study towards the optimal design of WOLEDs is presented.

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A-0215

PHOTOINDUCED AG DIFFUSION IN CHALCOGENIDE GLASSES - COMPARISON OF VISIBLE, X- AND GAMMA IRRADIATION

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Photoinduced effects are some of the most important characteristics of chalcogenide glasses, which have demonstrated their potential for a number of optoelectronic functions. Among them Ag photodiffusion is of particular interest for applications in memory devices like programmable metallization cell (PMC). Whereas the effects of visible light have been investigated extensively, there is little data about the influence of electromagnetic waves of much shorter wavelengths like x-rays and gamma rays. This knowledge is important not only for extending the applications of chalcogenide glasses but also to assess the reliability of their processing with x-ray or gamma-radiation.

In this work we present our results related to photoinduced Ag diffusion in fourfold coordinated chalcogenide glasses. First we briefly review the effects of illumination of chalcogenide glasses with wavelengths ranging from visible to x-ray and gamma rays. We identify differences in the nature of these phenomena in relation to the wavelength of electromagnetic waves. We discern the changes in the structure of the chalcogenide matrix as a result of silver diffusion and determine the diffusion products.

Raman spectroscopy reveals profound reorganization of the backbone of chalcogenide glass matrix structure due to the depletion of the chalcogen atoms which react with the diffused silver. The Raman spectra demonstrate the formation of ethane-like structural units and reduction of the number of corner-sharing and edge-sharing building blocks. The X-ray diffraction studies show predominant formation of binary Ag chalcogenides under illumination to visible light. Irradiation with X-rays leads to a preferential formation of ternary chalcogenides with Ag. A rather limited phase separation is discerned by x-ray photoelectron spectroscopy. For example, the analysis of Se 3d core level spectrum shows that most of Se (81 at.%) is within Ge-Se-Ag fragments, where Ag atoms are in between the Se atoms from different ethane-like units. The available data are not conclusive as weather the Se-Ag bond has ionic or covalent character, merely suggesting that the Ag atoms are in non-metallic bonds. The study in this respect is further developing. Similar results occur upon irradiation with gamma rays. For the latter case atom force microscope studies demonstrate changes in the surface roughness caused by radiation.

The results are discussed based on radiation induced defect formation and ionization phenomena in mixed covalent-ionic system in the presence of silver. These effects are differentiated depending on the specific radiation conditions.

A-0216

COMPUTATIONAL ANALYSIS OF THE AMPLIFICATION FEATURES OF ACTIVE PLASTIC OPTICAL FIBERS

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Plastic optical fibers (POFs) have raised a great interest in applications such as local area networks, sensors and, more recently, also in the field of fiber lasers and amplifiers in the visible region when they are doped. The lower manufacture temperatures of POFs as compared to glass fibers make it possible to embed a wide range of dopant material in the fiber, which has been the subject of incipient research. Organic dyes can be easily dissolved in the main material employed for the POF core, namely poly(methyl-methacrylate) (PMMA), but not in silica glass. This fact allows a reduction of the length of the fiber laser or amplifier from a few meters to a few centimeters or even shorter.

As in conventional lasers, the most important properties of a fiber laser are the lasing threshold and the efficiency. The aim of this work is to analyze theoretically the dependence of lasing threshold and efficiency of doped plastic optical fibers on the fiber length. For that purpose, we have analyzed the effects of the pump power on the emission properties of the doped plastic optical fibers. A computational analysis which is based on a set of partial differential equations, initial and boundary conditions has been carried out. The independent variables have been three: the length [z] along the fiber axis, the time [t], and light wavelength [λ].

The study allows us to obtain the best length so that it can be fulfilled the best relationship between high conversion efficiency and a threshold of low power. The analysis has been performed in plastic optical fiber doped with Rhodamine 6G.

A-0217

PHOTO-INDUCED DICHROISM AND THE LACK OF A FIELD EFFECT

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The phenomenon of photo-induced dichroism in glassy chalcogenides requires a structural rearrangement of atoms in the localized region where the photon is absorbed. Theories posit that the structural change is initiated by the recombination of the electron-hole pair and the consequent energy release. The dichroism is induced because regions that preferentially absorb the incident polarization will be those that suffer the atomic rearrangements thus bleaching the material for that polarization. A strong electric field should break geminate pairs and transport the electron and hole away from the absorbing region which should quench the photo-induced dichroism. We have searched for such a field effect in glassy arsenic selenide at fields up to 10 V/um. No decrease in the rate of induced dichroism is observed (the rate actually increases by about 10%) and no change is observed in the stretching parameter in the fits to a stretched exponential. These results are consistent with those of other researchers who also failed to find a field effect. We will discuss the implications of these results for the theory of photo-induced dichroism.

A-0218

FLUORINE DOPED ZINC OXIDE THIN FILMS DEPOSITED BY CHEMICAL SPRAY: EFFECT OF THE AGING TIME OF THE STARTING SOLUTION

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Fluorine doped zinc oxide thin films, ZnO:F, were deposited on sodocalcic glass substrates, starting from zinc pentanedionate and hydrofluoric acid, by the chemical spray technique. The effect of the aging time of the starting solution on the electrical, structural, morphological and optical characteristics of the ZnO thin films was studied. Uniform, adherent, and mirror-like films were deposited at different days. A high electrical resistivity was found in the films deposited the first day. However, a decrease in the resistivity, until a minimum, in the order of $3x10^{-2}$ ohm-cm was reached for films deposited after the starting solution was aged for 12 days. The films fit well with the hexagonal, wurtzite-type ZnO structure, with a (002) preferential growth. Variation in the grain size was observed as a consequence of the aging of the solution. An average crystallite size varied between 17 nm to 23 nm due to aging effect, and some variations in surface morphology were encountered. All the films are highly transparent in the near UV-visible range, with an average transmittance oscillating between 83-90.

Keywords: Zinc oxide; Thin films; TCO

A-0219

PHYSICAL PROPERTIES OF AL-DOPED ZINC OXIDE THIN FILMS DEPOSITED BY CHEMICAL SPRAY

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Aluminum-doped zinc oxide thin films, (ZnO:Al) were deposited on sodalime glass substrates by the chemical spray technique, starting from zinc pentanedionate and aluminum chloride. The effect of the substrate temperature on the structural, morphological, optical, and electrical properties was studied. A constant [Al]/[Zn]= 3 at. % ratio was used. As the substrate temperature increases, the electrical resistance decreases, reaching a minimum value, in the order of 3e-2 ohm-cm, for as-grown films deposited at 475 °C. The Hall mobility and carrier concentration for these films were around 0.6 $cm^2/(V\text{-}s)$, and 3.42e20 cm^{-3}, respectively. Further decrease in the resistivity, in the order of 1.5e-2 ohm-cm, was observed after a heat treatment in vacuum, during 1 h, at 400 °C. All the samples were polycrystalline, with a variation in the preferential growth. Samples deposited at 450 °C show a (002) preferential growth whereas films deposited at higher temperatures present a significant contribution of the other planes. As the substrate temperature increases, the morphology shows slight changes, since the grain size increases. The transmittance in the visible region (400-700 nm) is high, typically of 85% at 550 nm, and band gap values oscillated around 3.3 eV. These results show that zinc pentanedionate can be a good candidate for the manufacturing of transparent conductive ZnO:Al thin films.

Keywords: Zinc oxide; Thin films; Chemical spray; TCO.

A-0220

HIGHLY ORDERED ZNO NANOSTRUCTURES FOR NOVEL PHOTONIC DEVICES

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ZnO as a direct band-gap material (3.37 eV) having high exciton binding energy (~60 meV) is a promising material for light emitting devices operating in the blue/UV wavelength region. Moreover, ZnO in nanostructured form shows further interesting features. For instance, room temperature UV lasing was observed on ZnO nanowires (NW) [1] as well as on ZnO air-hole photonic crystal slab [2]. The former one was ascribed to the laser cavity effect in the naturally formed NW-s, while the latter one is to the strongly localized defect modes near the photonic band gap edge.

The presentation reviews the latest results on UV photonic crystal slabs and light emitting nanorods (NR)/nanowires. It also introduces a novel synthesis method for highly uniform, on-demand patterned vertical ZnO NRs. The prism shaped single crystals are grown from aqueous solution on an electron-beam patterned ZnO substrate or thin film. The length and diameter of the NRs can be finely tuned in the 0.5-3 um and 60-250 nm ranges, respectively [3]. The fabricated NR arrays were investigated by several optical methods such as laser diffractometry, spectroscopic ellipsometry, microphotoluminesce spectroscopy, and near field scanning probe microscopy. The results agreed well with the three-dimensional finite-difference time-domain simulations (3D-FDTD).

Beside periodic nanorod arrays, a new concept for inverse designed aperiodic photonic structures will also be discussed. Our proof-of-concept device was optimized for focusing a near-surface light beam (wl=633 nm), which propagates parallel to the metal top surface [4]. The device is put together by an array of scatterers whose specific positions are set to maximize the intensity at the focal spot, set 10, 20, and 30 microns away from the surface of the lens. The fast and effective two-dimensional optimization procedure was carried out by a powerful combination of two-dimensional (2D) multiple scattering theory and genetic algorithm. The

experimentally obtained focal distances as well as the light intensity distribution pattern were verified by 3D FDTD calculations. The demonstrated approach can provide inter- and intra-chip optical connections in the next generation ZnO NW-based integrated photonic devices.

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Keywords: ZnO nanorod, photonic crystal slab, aperiodic photonic crystal, microphotoluminescence, FDTD, inverse design.

A-0221

RECENT ADVANCES IN ER-DOPED FIBRE AND PLANAR DEVICES

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The glasses for erbium doped lasers and amplifiers are modified to improve the rare earth ion doping concentrations and efficiency of operation of short, compact- fibre and planar waveguide devices. Large optical gain and tunable laser operation in the C and L- bands of optical communication were obtained with short lengths (10-30 cm) erbium doped tellurite glass optical fibres with single and multicores. For planar waveguide applications however, the tellurite glasses were modified using phosphates to form mixed glass former hosts for Er-ion doping and for achieving large gain per unit length and broadband amplification. Optimized phosphate modified tellurite glasses were found to outperform tellurite glasses without phosphate in terms of pump inversion and gain per unit length. We also used such engineered glasses for femtosecond laser inscription of waveguides and demonstrated their potential for waveguide amplifiers. For future integrated photonic devices development an approach based on dissimilar materials integration and engineering is imminent. In this respect we investigated the growth of glass thin films on semiconductor and polymer substrates and their patterning to demonstrate planar devices. Waveguides fabricated by pulsed laser deposition of glass thin films on semiconductors using an excimer laser ablation process, which were then patterned using reactive ion etching, is a promising step for electrically pumped amplifiers and lasers. Femtosecond (fs) laser deposition of nanoporous glass thin films for random lasing is another interesting application of erbium doped glasses. A waveguiding structure of thin films of nanoporous erbium doped tellurite glass was prepared with a fs-laser ablation technique. Broadly wavelength tunable lasers were demonstrated in such thin films with a simple pump scheme using a continuous wave diode laser. These mirror less lasers in two dimensions are a subject of very interesting physics and applications.

A-0222

OPTICAL WAVEGUIDE BIOSENSORS FOR PROTEINS AND CELLS

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In recent years several optical resonator structures have been suggested for sensor applications, most of them are based on planar optical waveguides where the optical modes of a thin dielectric film are excited. Typically, the sensors are used for measuring biological substances, such as proteins, lipid bilayers, polymers, DNA or even bacterial and mammalian cells on a detector surface in real time without the need of any labels. Planar optical waveguide based sensors are often termed High Resolution Molecular Microscopes (HRMM). This name emphasizes the fact that these sensors are not simple refractive index sensors or picogram sensitive mass detectors. Using these techniques valuable structural and kinetic information can be obtained about the above mentioned biological objects and their in-situ behavior. These include - for example - the size and shape of adsorbed molecules, their anisotropy, assembled layer density and inhomogeneity, cell signaling, cell-substratum adhesivity. The presentation reviews the status of the filed and spots the most challenging and exciting application areas.

A-0223

LIGHT EMISSION DUE TO IMPULSIVE DEFORMATION OF POLYMERS

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Mechanoluminescene (ML) is a type of luminescence induced during any mechanical action on solids the physical process which play an important role in the ML excitation in polymeric materials is not thoroughly understood in the present investigation the ML was studied, in Polyvinylidene flouride, Polyethylene polypropylene, polystyrene, polymethylmethacrylate and polyethylmethacrylate polymers. The size of the polymeric crystals used was 3x2x2 mm3. It was found that when these polymers are impulsively deformed by dropping a load from different height then initially the ML intensity increases with time attains maximum value at a particular time and then decreases with time. In the present paper it is discussed that the charging of newly created surfaces may be responsible for the light emission produced during fracture of polymers.

A-0224

NANOSILICON: A NEW PLATFORM FOR PHOTONICS

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On chip integration of electronic and photonic functionalities will satisfy the requirements of future ICT society for faster and faster communication and computing capabilities. In this view silicon photonics is no more an emerging field of research and technology but it becoming a reality with commercial product available on the market. To add more complex functionalities to the next generation of silicon- based photonic devices few fundametal limitations of silicon have to be beated and low dimensional silicon (nanosilicon or nano-Si) could be the way to achieve these goals.

After a brief introduction of the silicon photonics state-of-the-art, recent results of the Nanoscience Laboratory

research activity in this field will be presented. The talk will briefly describe optical properties fundamentals of nano-Si and its use as main building block in photonic devices (waveguides, modulators, light source and detectors). Recent advances of nanosilicon devices such as waveguides, optical resonators (linear, rings, and disks) and non-linear optical effects which enable fast all-optical switches will be described. The development of high efficiency light emitting diodes for interchip bidirectional optical interconnects is presented as well as the recent progresses to exploit the use of nano-Si in solar cells applications.

A-0225

APPLICATION OF THE PHOTOMODULATED REFLECTION TECHNIQUE TO THE MONITORING OF METAL LAYERS

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In the latest decades a new measurement technology, the photomodulated reflection technique appeared to monitor and qualify different layers on silicon wafers; the technique is a non-contact, optical method which is based on the changes of optical reflection of the surface[1]. The sample is irradiated by a modulated pumping laser which periodically changes the density of excess carriers and temperature at the surface; as a result, the refractive index profile also changes, which modifies the reflection. These reflection changes are measured by another laser beam.

As the index of refraction is sensitive to crystal defects created by ion implantation, the method can be used to monitor ultra-shallow ion implants in silicon. PMR signals measured after ion implantation, and before the following annealing step correlates to the dose [2]. After further developments the PMR method became capable to analyse ultra-shallow junctions formed during a rapid thermal process (RTP). Due to their lock-in measurement technique these instruments are highly stable and very sensitive. The use of well focused laser beams allows high resolution (1-2 µm) mapping of the measured parameters.

In our work we present further developments, which allow the monitoring of metal layers deposited to the surface of silicon. During these measurements the pumping beam periodically heats the surface which leads to the formation of thermal waves. Changes in the temperature affect the conductivity of the material, which in turn affects the reflection of the probe beam from the surface. Since the parameters of thermal waves depend on the properties of the metal layer, these properties can be measured by the PMR technique.

A finite element method based computer model has been created to study effects of the properties of the metal layer on the PMR signal. The model shows that the signal is sensitive to the thickness, density and specific heat capacity of the metal layer. This makes it possible to detect small changes of these parameters. The model also shows that the PMR signal depends on the heat exchange coefficient between the metal and the substrate. This might be useful to monitor the barrier seed layer.

The results of the computer simulations were confirmed by actual measurements. Layers of different metals in different thicknesses were deposited to silicon wafers coated with oxide layers of different thickness. Measurements on these sets of samples have proven that the PMR technique can be used to monitor the metallization of semiconductors.

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A-0226

CRYSTALLISATION KINETICS OF PHASE-CHANGE MATERIALS

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Phase change materials have a unique combination of structural, electronic, and optical properties [1]. The amorphous and crystalline states exhibit a large difference in optical reflectivity and electrical resistance, while the transition between the two phases can be achieved on very short timescales. Ternary alloys based on Ge-Sb-Te (GST) are widely used as optical phase-change data storage materials, and also have a great potential for use in a new generation of random access memory devices. In this work we use the nucleation switching model [2] to study the kinetics of crystallisation of phase-change materials. In the nucleation switching model the nucleation rate of crystalline materials is dependent on the applied electric field. We compare the results of the nucleation model with the rate equation model [3], which has been developed to study the temporal evolution of the crystalline nuclei distribution during the phase-change process. We have identified the material parameter set where the electric field has a pronounced effect on the crystallisation of phase-change materials.

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A-0227

CHEMICAL VAPOR DEPOSITED DIAMOND - THE MATERIAL FOR OPTICS AND OPTOELECTRONICS

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Diamond, a wide band gap material, possesses exceptional optical, thermal and electronic properties such as transparency in broadest spectral range (from 225 nm to radio frequencies), record high thermal conductivity (2000 W/mK @R.T.), high mobility both for electrons and holes. All this together with extreme radiation hardness, mechanical strength and chemical inertness makes diamond promising for advanced optical and optoelectronic devices and components. Currently optical quality large size polycrystalline diamond thin films and wafers can be grown by chemical vapor deposition (CVD) technique. The microwave plasma assisted CVD process which allows production of most pure diamond films will be briefly presented. Some data on material characterization will be given with further focus on applications in high power IR laser optics [1], Raman shifters with Nd:YAG laser pumping [2] and solar-blind UV detectors based on poly- and monocrystalline diamonds [3]. Finally, optical properties of color centers in CVD diamond such as nitrogen-vacancy or Si-vacancy defects with stable and very bright photoluminescence will be considered in view of an interest to their potential use as biomarkers and in quantum informatics [4].

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A-0228

QUANTUM DOT PHOTONIC DEVICES FOR ULTRAFAST SIGNAL TRANSMISSION AND PROCESSING SYSTEMS

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High speed photonic devices operating at a bit rate beyond 40 Gb/s have been developed extensively so far primarily using the combination of conventional device elements. However, the network demand will soon require a system throughput exceeding 100 Gb/s, and this will need novel photonic devices based on novel materials and device principles. Quantum dot materials are expected to play a critical role in this direction due to their fundamental advantages in high linear- and nonlinear-optical gain, high-speed response and high temperature stability originated from the sharp electron density of states in three-dimensional quantum confinement. Although basic device demonstrations have been reported on lasers, semiconductor optical amplifiers (SOAs) and all-optical modulators/switches using GaAs- and InP-based quantum dot materials, further research and development on material growth and device design and fabrication are necessary for their applications in real world.

This paper describes recent progresses in the quantum dot growth technique based on molecular beam epitaxy (MBE), and discusses their application to photonic devices for ultrafast signal transmission and processing systems such as SOAs and all-optical switches. An important issue in quantum dot SOAs is polarization sensitivity primarily caused by the flattened shape of quantum dot. We have introduced our unique approach of strain-controlled columnar quantum dot technique which enables a control of the shape and strain of quantum dots. In optimized devices, polarization-independent SOA performance with a polarization gain difference less than 0.4 dB has been demonstrated at the wavelength of m including error-free operation at 40 Gb/s. Also we describe our recentμ1.55. result of a quantum dot based vertical structure all-optical switch which consists of a vertical distributed Bragg reflector cavity incorporating a quantum dot nonlinear medium. A basic device in reflection geometry has been fabricated and characterized by pump-probe measurements. A switching speed improvement has been achieved by utilizing the excited state transition in the quantum dot and all-optical switching with a time constant of 23 ps has been demonstrated. Based on these examples, we illustrate the unique prospects of quantum dot devices for the application to ultrafast signal transmission and processing systems.

A-0229

NUMERICAL INVESTIGATION OF SLOW LIGHT IN THE COUPLED RESONATOR OPTICAL WAVEGUIDES USING THE LOCALIZED FOURIER MODAL METHOD

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The photonic crystal is a one or multi dimensional structure in which the refractive index distribution has the periodic modulation. This periodic distribution in the refractive index forms band gaps where the propagation of light is forbidden. A defect in the periodic distribution of the refractive index can be used in various applications. A row of artificially missing holes or rods in the photonic crystal results in the photonic crystal waveguide. The modal size of the photonic crystal waveguide is smaller than that of the conventional dielectric waveguides. In addition, the photonic crystal waveguide has the extremely low bending loss, allowing for highly integrated optical circuits.

In particular, it is known that small perturbations in lattice structures near the core of a photonic crystal waveguide can lead to the ultrahigh Q optical resonator with the small modal volume. The perturbation includes the lateral shift of the position of the lattice holes or rods, and small change in the refractive index of the lattice structure near the core of the photonic crystal waveguide. The multiple reflection occurring in the perturbed region forms a photonic crystal resonator inside which photon is trapped for long life time. In addition, the group velocity of a optical pulse through this kind of photonic crystal resonator can be dramatically reduced. There has been considerable research on the fundamental principle and practical applications of the photonic crystal resonator.

These studies on the photonic crystal resonator are accompanied with large scale numerical investigations such as the finite-difference time domain (FDTD) or the finite element method (FEM). These algorithms are based on the Maxwell differential equations in the real space domain. It is thus inevitable that they require tremendous memory space proportional to the scale of the geometry. On the other hand, the localized Fourier modal method (LFMM) deals with the Maxwell equation in the Fourier domain. As a result, the required memory space does not increase dramatically. This distinguished feature can be efficiently used to examine the enhancement of performance of the coupled resonator optical waveguides (CROW). This is because the overall response of the cascaded photonic crystal resonator in the CROW can be easily obtained by the simple mathematical process in the LFMM, called the extended Redheffer star product. In this report, we present the ultrahigh Q optical resonator based on the CROW configuration by using the numerical simulation of the LFMM. The dependence of the photon life time and the dispersion relation in the CROW on the number of the cascaded photonic crystal resonator and the coupling distance is also provided.

A-0231

TEMPERATURE DEPENDENCE OF THE THRESHOLD CURRENT DENSITY OF A GAN BASED QUANTUM DOT LASER

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Group III nitride-based optoelectronic devices are used in a wide range of applications due to their large band gap energies. III nitride-based heterostructures form the active layer in blue-green LED's and laser diodes commercially available today [1]. Quantum dot (QD) structures could still improve their performance enormously [2]. In particular, III nitride-based QD lasers are expected to have low threshold current densities and better temperature stability compared with conventional blue lasers with III nitride-based quantum wells (QW) [3].

In this work, a detailed theoretical analysis of the temperature dependence of threshold current density of a GaN based semiconductor quantum dot laser (QDL) is given. Temperature dependences of the threshold current density components associated with the radiative recombination in QD's and in the optical confinement layer (OCL) is calculated. Temperature dependences of the optimum surface density of QD's and the optimum thickness of the OCL, minimizing the threshold current density, are obtained.

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A-0232

COLOSSAL PHOTOSTRUCTURAL CHANGES IN CHALCOGENIDE GLASSES. ATHERMAL PHOTOINDUCED POLYMERIZATION IN $AS_XS_{(100-X)}$ BULK GLASSES REVEALED BY NEAR-BANDGAP RAMAN SCATTERING

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Near-bandgap Raman scattering was used to induce and study photostructural changes in $As_xS_{(100-x)}$ bulk glasses (x=5,10,15,20,25,30,35,40) revealing a new photoinduced polymerization effect. Raman spectra were recorded also in off-resonant conditions allowing for a detailed comparison between the "equilibrium" glass structure and the metastable one induced by illumination. It is shown that in S-rich glasses structural changes involve the athermal scission of S_8 rings and their polymerization to Sn chains. The fraction of bonds involved in this effect is surprisingly high, being one order of magnitude higher than the corresponding fractions reported up to now in photostructural studies in chalcogenide glasses.

A-0233

OPTICAL LIMITING PROPERTIES OF NOVEL COII, CUII AND DOUBLE-DECKER LUIII PHTHALOCYANINES

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Among the nonlinear optical applications of phthalocyanines, their optical limiting (OL) performance is the most promising. The phenomenon of optical limiting is based on attenuating the light beam when it exceeds a threshold value and transmitting the ambient light with low absorption. A change in the central metal atom in a phthalocyanine (Pc) can lead to considerable variation in the relevant nonlinear optical (NLO) and OL properties. In this study, three tetra-substituted Pc compounds with same peripheral substituent groups but different central metal atoms have been synthesized[1]. The optical limiting characteristics of the synthesized cobalt, copper and lutetium Pc compounds have been studied by means of the open-aperture Z-scan technique with nanosecond pulses at 532 nm[1]. The nonlinear response demonstrated that Cu and Lu phthalocyanine compounds exhibited strong reverse saturable absorption whereas the cobalt phthalocyanine compound showed negligible nonlinear absorption. The results indicate that Cu and Lu phthalocyanine compounds are good candidates for optical limiting applications.

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A-0234

TUNING LIGHT-MAGNETO-OPTICAL MATERIAL INTERACTION BY MAGNETOPHOTONIC CRYSTALS

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Magnetophotonic crystals (MPCs) are shown to be unique development in the field of nanophotonics. They are composed of magnetic elements periodically introduced into the crystal lattice. Existence of magneto-optical response, photonic bandgaps and localized states in the spectra of MPCs brings possibilities for additional degree of freedom for operating the state of polarization of light by the external magnetic field. In this work we demonstrate MPCs with various designs. Particularly, we show that tailoring of surfaces of MPCs provides a new approach to engineer responses of known materials. 1D MPCs with structures of (SiO_2/Ta_2O_5)*5/(Bi:YIG/SiO_2)*5 and (SiO_2/Bi:YIG)*5/Au were fabricated onto quartz substrates using sputtering. Parameters of these multilayers were chosen such that they supported spectrally narrow localized surface states, the so-called optical Tamm states (OTSs). The OTSs were spectrally located within photonic band gaps and were associated with a sharp transmission peak in measured spectra of the MPCs. Substantial enhancement of the Faraday rotation for the wavelength of OTS was experimentally observed and attributed to strong light coupling to Bi:YIG constituents of the MPCs. Another representatives of MPCs under our study were autocloned (Bi:YIG/SiO_2)*7 multilayers with a quasi-2D structure. They were fabricated via sputtering onto e-beam lithography patterned substrates. Polarization-resolved transmission spectra showed that light coupling occurred from a superimposition of different diffraction planes existing in these multilayers. For the so-called multiple Bragg diffraction regime, enhancement of Faraday rotation was detected together with a large reverse rotation. Large absolute modulations of the Faraday rotation were observed in extremely narrow spectral ranges corresponding to neighboring photonic bandgaps' overlaps. This work shows that the conventional magneto-optical activity of materials can be substantially modified when tuning light-magneto-optical material interaction.

A-0235

RECENT ADVANCES IN HIGH POWER OPTICAL FIBERS

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In the past years we have witnessed remarkable advances in optical fiber laser and amplifier technologies. Optical fiber lasers of output powers beyond a kilowatt or multi-kilowatt with high beam quality have already been demonstrated and started to be deployed in industries. This rapid progress has been stimulated by the exceptional power-handling capability of optical fibers as gain media as well as the availability of powerful diode lasers for use as pumps. The progress was first made at around 1.1 microns with Yb-doping, next around 1.6 microns with Er-doping, and most recently at wavelengths around 2 microns with Tm-doping. Optical fiber lasers have numerous attractions over the more conventional “bulk” lasers in terms of energy-efficiency, power-scalability, thermal-management, flexibility and controllability in spatial/spectral/temporal domains, compactness, cost-effectiveness, and more. Indeed, this optical fiber photonic circuitry combined with pump-diode technology provides a unique high-gain environment for robust designs, which are also all-solid state, compact, reliable, and reproducible. Here we review the recent advances in high power optical fibers with a particular focus on rare-earth-doped optical fibers in conventional double-clad, large-core designs as well as in novel microstructured designs for more refined performances. We also review some passive-type optical fibers particularly devised for high-power operations, e.g. double-clad passive-core fibers for Raman conversion, single-clad fibers and microstructured fibers for four-wave mixing, photonic bandgap fibers for beam delivery. We discuss their fundamental aspects and future prospects, also presenting our up-to-date experimental results based on various high power optical fibers developed at the ORC.

A-0236

THE DISORDERING EFFECT OF PERIODICALLY POLED NONLINEAR CRYSTALS ON PARAMETRIC DOWN CONVERSION

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Recently it has been shown [1,2] that periodically poled nonlinear crystals(PPNC) are leading to Quasi Phase- Matching in photonic conversion processes and particularly are also highly promising for generation of nonclassical states of light and open interesting view for applied Quantum information. We investigate spectral properties and multimode structure of joint states of photon pair produced by pulsed parametric down conversion in PPNC with linear dispersive segments, with adding random length to each domain. The initial manner to this approach is the idea manipulating overall group delay mismatches between various fields in structured materials for syntheses of twin photon state [3].Most of experimental arrangements [4] consist of the periodic assembly of half number of total segments are second order susceptibility crystals of equal length with positive and negative susceptibilities and the other half number crystals with zero susceptibility.

In this work we studied the tolerance placed on the periodic structure effects quasi phase matching. For this purpose, we assume that the mismatch functions and lengths are not the same in each domain and varies randomly.It considered that the length of linear and nonlinear segments vary randomly in the length of the crystals. We investigate that the probability of the twin photon spontaneous parametric radiation has extremum values for perfect structure and it thrown down by increasing fluctuation coefficient. It means that, the perturbation existence in periodic structure - length decreases the output amplitude.

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A-0237

A NEW TRANSPARENT CONDUCTING ZINC OXIDE FILM CO-DOPED WITH BORON AND ALUMINUM FOR THIN FILM SOLAR CELL APPLICATIONS

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Transparent conducting oxide (TCO) has been widely used for optoelectronic applications such as solar cells and flat panel displays. ITO has been widely used as TCO due to the low resistivity and high transmittance. Recently, various TCOs have been investigated due to relatively expensive cost of ITO. Al-doped ZnO (AZO) films have received considerable attention due to low material cost and suitable electrical and optical properties. Although AZO exhibits high transparency and low resistivity, the optoelectronic property and electrical stability should be improved for practical applications. The purpose of this paper is to report new boron-doped AZO (BAZO) films for thin film solar cell applications, which have not been reported. Also we have investigated the electrical stability of BAZO films. Our experimental results showed that BAZO film showed better electrical property and stability than AZO film. BAZO films with various boron content have been deposited on glass (Eagle 2000) by magnetron co-sputtering of AZO (2wt. %) and boron-doped ZnO (BZO, 3wt. %) ceramic targets. All films with

thickness of 250nm were prepared at 150°C. The boron content was controlled by the RF power to BZO target from 30 to 120W, while DC power to AZO target was fixed to 300W. X-ray photoelectron spectroscopy (XPS) analysis showed that boron content increased with the increase in RF power on BZO target. X-ray diffraction (XRD) indicated that BAZO films revealed highly preferred orientation along the c-axis compared to AZO film. The FWHM decreased and (002) peak intensity increased with boron-doping, implying that the film crystallinity of AZO film was improved. Hall measurement showed that Hall mobility and carrier concentration increased with boron-doping. The resistivity of BAZO film was 1.33E-3 ohm*cm, while that of AZO film was 1.7E-3 ohm*cm. In terms of optical property, all films showed average transmittance of about 85% in the visible region, implying that the additional boron-doping was not sacrifice the optical transmittance of AZO film.

Electrical stability of AZO and BAZO films have been investigated by heat treatment of 300°C for 1 hour in atmospheric-air. The resistivity of AZO film increased from 1.7E-3 to 5.49E-3 ohm*cm due to the oxygen chemisorptions on grain boundaries and surfaces. The Hall mobility of AZO film decreased due to the distortion of crystallites. In addition, the carrier concentration decreased by the recombination of native n-type defects with oxygen. However, BAZO film showed a decrease in resistivity from 1.33E-3 to 7.64E-4 ohm*cm rather than an increase in resistivity after heat treatment in atmospheric-air. The incorporated boron atoms performed a role of passivating the grain boundaries so that the BAZO films were less affected by the oxygen chemisorptions as evidenced by XPS analysis. The heat treatment supplied the thermal energy required to improve the crystallinity of the BAZO films, which corresponded to increase in Hall mobility.

We have successfully fabricated the new BAZO films with better electrical property and stability than AZO film, and it will be promising especially for the improvement in the stabilized efficiency of thin film solar cells.

A-0238

THERMAL IONIZATION ENERGY OF DEFECT CENTRES IN COPPER BASED TERNARY CHALCOPYRITE PHOTOVOLTAIC MATERIALS

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Ternary Cu-III-VI2 (III = Ga, In, VI = S, Se, Te) chalcopyrite compounds are important materials for thin film photovoltaic applications. An important characteristics of these materials is the thermal ionization energy of defect (donor and acceptor) centres, controlling their electrical properties. While a great amount of data is available for the thermal ionization energies of various defect centres in most of these materials, however the dependence of these energies on the concentration of the centres is not properly established yet. Here the results of an analysis of the dependence of the thermal ionization energies of various defect centres in ternary Cu-III-VI2 chalcopyrite compound semiconductors are presented. It is established that this dependence can be satisfactorily described by using a simple electrostatic interaction model between the charged centres.

The electrostatic interaction model suggests that the thermal ionization energy decreases proportionally to the cubic root of the ionized centres, which in turn in the low temperature limit is approximately equal to the concentration of the compensating centres. Further on the proportionality constant should scale with the reciprocal of the static dielectric constants, which contention has been confirmed analyzing the available large amount of data for group IV, III-V and II-VI semiconductors.

Using Hall data for ternary chalcopyrite compounds Cu-III-VI_2 collected from the literature I have evaluated the above relationships for various donor and acceptor centres in order to establish the correlation between the thermal activation energy and concentration of the centres under consideration. Where found necessary the original carrier concentration versus reciprocal temperature curves were reanalyzed using standard but appropriate models.

The results of this analysis support the applicability of the above model four of the six compounds studied. Relevant data for $CuGaSe_2$ (~60 meV and ~150 meV acceptors), for $CuGaTe_2$ (~100 meV acceptor), for $CuInS_2$ (~155 meV acceptor), and for $CuInSe_2$ (~40 meV and ~60 meV acceptors) neatly fit the above indicated trend. For the two remaining compounds ($CuGaS_2$ and $CuInTe_2$) it was not possible to find enough data for meaningful analysis.

A-0239

AN EIGENVALUE-BASED TRANSMISSION-LINE METHOD FOR SIMULATING HIGH-CONTRAST PHOTONIC CRYSTALS

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A spectral transmission-line method has been developed for calculating the band diagrams and Bloch modes of two-dimensional photonic crystals. The present approach is based on analyzing the matrices that are formed by applying steady-state conditions and periodic boundaries to the time evolution equations of the discretized unit cell. The resulting complex-valued scattering matrices are spectrally decomposed using a carefully designed hybrid eigenvalue algorithm based on the power and Arnoldi methods. This algorithm exploits the latent structure of the transmission-line scattering matrices, which are large, sparse, and unitary under the inner product that generates the energy norm.

Simulations conducted using this algorithm on several unit cells showed excellent agreement with those of the Rayleigh multipole [1], plane wave [2], and time-domain transmission line methods [3]. Moreover, the algorithm was found to have favourable characteristics to each of these conventional methods. For example, while the algorithm's speed was found to be comparable to that of its time-marching counterpart, it requires no additional frequency-domain computation to recover associated Bloch modes.

Extensive numerical investigation showed that this technique holds considerable computational advantages over the plane-wave method for problems characterized by high dielectric contrast or rapidly varying spatial detail, with the runtime and memory requirements in many cases reduced by orders of magnitude. This was demonstrated for unit cells comprising structures of lithium niobate, a high permittivity material that has recently received considerable interest for use in photonic crystals due to its non-linear optical properties that may be exploited to realize tunable devices [4]. Consequently, this method is expected to be relevant to such emerging directions in photonic crystal research.

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A-0240

IMAGING POLARIZATION DYNAMICS AT GHZ FREQUENCIES: NON-CONTACT ELECTROSTATIC SCANNING PROBE MICROSCOPY WITH PARAMETRIC EXCITATION

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One goal of scanning probe microscope (SPM) techniques is to illustrate spatial variations in characteristic properties of a sample surface, realizing this goal at submicron length scales that are on the order of (or better than) nanometres. Although the family of SPM approaches includes a range of “dynamic” techniques, most of these are limited by the frequencies associated with the mechanical resonance of the probe. The SPM technique discussed has been developed with a view to overcoming these bandwidth limitations.

This non-contact electrostatic technique has the capability of exciting and responding to electronic processes

far in excess of the mechanical resonance of the probe. The polarization dynamics within the surface and near-surface regions of a sample are activated by applying a modulated electrical signal to the SPM cantilever and using the frequency components associated with the cantilever resonance as a “carrier” signal for the response components at the (higher) frequency of interest. For enhanced sensitivity, this work was conducted in modest vacuum (on the order of 0.01 mTorr). Under such conditions the unloaded quality factor of the SPM cantilever resonance is on the order of 10,000. Initial studies showed the capability of this technique to image the polarization responses of a surface acoustic wave within a commercial 434 MHz filter [1] and the capacity of the technique to determine the resonant frequency and quality factor of a micromachined resonator some ten times greater than the resonant frequency of the probe [2]. This second illustration has applicability in the non-destructive testing of micromachined devices that are still in the prototype stage and/or do not have operational or functioning surrounding circuitry to facilitate excitation for characterization purposes.

The possible range for ‘pseudo-spectroscopic’ investigations of the dielectric character of materials is illustrated with more recent images showing polarization responses due to the propagation and interference of 1.6 GHz surface acoustic waves. Further illustrations and pathways to a complete model of the surface/probe interaction are provided from studies of simple grating structures. In these data, the dynamic SPM response to regions with different dielectric character is shown as an apparent inversion of the topographic features obtained from a standard contact-mode image of the sample.

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A-0241

NOVEL SILICATE GLASSES FOR 1,3 µM REGION

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Various photonic devices used in communication, sensors and lasers operate in the region around 1,3 µm. From a wide range of possible hosting matrixes for laser active ions there are several factors why a silicate glass is a very good option: low costs, high moisture resistance, very similar refractive index as optical fibres, low absorption of the silicate materials at 1.3 µm wavelengths.

This work presents several novel silicate glasses m region. We focused on various transition element ions,µemitting in the 1,3 e.g., nickel, bismuth, chromium and copper, which emit in the desired NIR spectral region. Searches for the optimal concentration of every pertinent ion were done for every set of glasses. Formation and stabilization of the eligible oxidation states of the particular ions was studied for two relations: A) to the suitable composition of the glass matrix; B) ion implantation of the silicon and oxygen ions (silicate glass network forming elements) into the materials already containing transition optically active elements. The ions implanted into the glasses already containing d-elements were able to change the d-elements optical properties by changing their oxidation states in that way generated thin surface layer and so, besides the formulation new suitable glasses, gave us an idea about the properties of pertinent silicate glass matrices. Both tasks are helpful in designing and proceeding efficient active photonics devices.

In this work absorption and photoluminescence studies on 4 sets of silicate glasses doped by Bi, Ni, Cr and Cu ions in dependence to the laser active ion content, glass matrix composition and ion implantation of the glass network elements into the thin surface layer of the glasses are presented.

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A-0243

PHOTOINDUCED MASS TRANSFER IN SOFT MATERIALS

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An interaction between laser light beam with high intensity gradient and soft materials (amorphous chalcogenide and organic polymer films, organic and water liquid solutions) was studied. The single light beam focusing and two coherent beam interference were used for light intensity modulation with high gradient. Under intensive illumination the formation of relief structures on the surface of amorphous films and concentration redistribution of dissolved substances in liquids due to lateral mass transfer regarding the light propagation direction have been observed [1, 2]. The possibility to apply this phenomenon in surface nanopatterning, chemistry for separation of substances and other branches has been discussed.

The influence of the amorphous film thickness, recording laser wavelength (266 nm, 325 nm, 441.6 nm, 532 nm, and 632.8 nm), grating period, light intensity and polarization state on the relief formation process in amorphous inorganic and organic films was studied. It was shown that the efficiency of the surface-relief formation strongly depends on the recording light polarization state (two p-linear, s-linear, identical circular or orthogonal circular polarized beams). We have found that in s-s and p-p polarized writing conditions, a significant grating modulation enhancement can be achieved if an incoherent assisting light beam with orthogonal polarization is used [2]. The relief grating profile on amorphous films was analyzed by means of atomic force microscope (AFM).

The mechanism of the direct recording of surface-relief gratings on amorphous chalcogenide and organic polymer films based on the photo-induced anisotropic plasticity of amorphous films and the optical gradient force induced mass transfer has been discussed.

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A-0244

ACOUSTO-OPTIC MATERIALS FOR SPECIAL APPLICATIONS WITH ULTRA-SHORT OPTICAL PULSES

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Acousto-optic devices are versatile tools for a very high number of general applications: modulation, steering, filtering, combination of optical beams. We report here new acousto-optic designs dedicated for applications in the edge of today's research: femtosecond pulse shaping, laser pulse picking and highly stable laser beam scanning. We treat the design of new interaction geometries and device configurations that serve the fulfillment of criteria like minimization of material and angular dispersion and maximization of diffraction efficiency, acoustic bandwidth and optical phase stability. The treated applications include shaping of sub 20 fs pulses at arbitrary repetition rate, pulse picking of femtosecond laser pulses to lower their repetition rate and scanner units for a two-photon neuron microscopy.

For shaping ultra-short laser pulses we use several acoustic frequency channels simultaneously in a transversal acoustooptic configuration, where acoustic and optical beams propagate nearly perpendicular to each other. The different acoustic frequencies have independently controllable phase and amplitude, and there is a direct transfer to the phase and amplitude of the spectral components of the optical pulses. The combination of the acoustic frequency components results in the formation of differently shaped acoustic pulses: the effect will be insensitive to the optical pulse repetition rate when the optical beam is expanded through the cell to always contain a number of steering acoustic pulses within its aperture.

Our calculations show that 20-50 independent acoustic channels provide fairly acceptable resolution for the desired temporal shaping of the pulses. We demonstrated experimentally the use of four-twelwe channels to manipulate 20 fs long pulses from Ti:sapphire oscillators. In one case the resulting pulse shape was a temporal optical pulse train with variable relative amplitude and temporal distance of the spikes, having special applications.

Pulse picking of femtosecond pulse trains means pulse frequency reduction by selecting single pulses from the pulse train at equal temporal distance. We demonstrated pulse picking from a 80 MHz femtosecond pulse train from a Ti:sapphire laser using both TeO_2 and fused silica acousto-optic modulators. The modulators had a rise-time < 5 ns without focusing, dispersion GDD< 1000 fs2 and modulation efficiency between 5-30%. The pulse energy difference between the picked and the first following pulse was of more than 10 dB.

A third application combining acousto-optic and femtosecond laser technology is the realization of a 3D two-photon microscope with acousto-optic scanners. Special combination of acousto-optic deflectors allows uniquely high scanning speed in 3D dimensions, including focal plane shifting as scanning in the z direction.

This application puts a high accent on dispersion compensation techniques needed to eliminate material and angular dispersion introduced by the acousto-optic and other optical elements. In these experiments TeO_2 devices were used, but application of GaP devices with much higher scanning speed is planned. Summary: we overview a few important applications where acousto-optic devices from different materials are used with femtosecond laser pulses. Main material parameters such as acousto-optic figure of merit and dispersion should fulfill a strong tradeoff, therefore the optimum material choice is a main issue of these applications.

A-0245

LINEAR AND NONLINEAR OPTICAL PROPERTIES OF AS-GE-SE THIN FILMS

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Studying of non-crystalline solid state is of great importance from the point of view of the fundamental science as well as many practical applications. Chalcogenide vitreous semiconductors are very interesting materials of this class and investigations of them occupy one of the leading places in modern solid state physics and chemistry. Besides physical properties inherent to glassy state they possess also a huge variety of other properties unparalleled by other solid state material such as broad transparency in the infrared region of spectrum, a variety of photoinduced phenomena and high optical nonlinearity which made them very perspective in such practical applications as telecommunications, sensors, optical data storage, etc. Measurements of nonlinear refractive index have shown that their values can be from 100 to 1000 times higher of that in silica glass. This unique combination of physical characteristics can be exploited in all optical signal processing devices to enhance the performance of telecommunication systems. For these practical application is important fact that their production and treatment are cost effective and they are stable in various media.

In the present work we have examined chalcogenide films of two compositions: $As_{10}Ge_{22.5}Se_{67.5}$ and $As_{12}Ge_{33}Se_{55}$. Initial bulk glasses were prepared by direct synthesis in evacuated quartz ampoules. Thin films were prepared by thermal vacuum evaporation onto the glass substrate at room temperature.

Structure of glasses was investigated by Raman spectroscopy. Nd-YAG laser beam ($\lambda = 1064$ nm) was used for excitation. The main band in the spectra of both studied glasses is located near 200 1/cm and it is a characteristic of As-Ge-Se system. The band near 200 1/cm and the mode at 215 1/cm correspond to the vibrations in corner-shared and edge-shared Ge-Se tetrahedra, respectively. However, for As12Ge33Se55 glass, this band have more complicated shape. The most distinguishable difference is the feature near 178 1/cm which gives evidence to the presence of Ge-Ge bonds from the Ge-Se ethane-like structural units forming nanophase. This phase appears to be demixed from the network of the glass and form separate nanophase inclusions in the glassy backbone.

Optical transmission spectra of these films were obtained in the 400 – 2500 nm range. Optical parameters and thicknesses of thin films were determined from transmission spectra using the Swanepoel method. Optical band gap was determined from the Tauc law.

Nonlinear refractive indexes at standard telecom wavelength (λ = 1500 nm) were estimated from the relation proposed recently by Sanghera et. al. [1]. Very high values n2 = 3.7·10-17 m2/W for $As_{12}Ge_{33}Se_{55}$ film and n2 = $1.2 \cdot 10^{-17}$ m^2/W for As_{10}Ge22.5$Se_{67.5}$ film were found. Such high values of third order nonlinearity make these glasses suitable to be considered as perspective materials for all-optical switching and other optical signal processing applications.

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A-0246

ZNO NANOWIRES DEPOSITED BY THE METHOD OF ARC DECHARGE

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The dimension reduction of materials to a nanometer scale gives rise to several advantages. Crystalline nanostructures such as nanotubes and nanowires have received increasing attention due to potential applications in solar cells, nanoscale electronics, optics, sensing devices and medicine. It is expected that the application of these nanostructured materials in different devices can improve their properties, enlarge their operation possibilities and reduce their price. This explains the interest in the elemental and compound semiconductors such as Si, Ge, SiC, AlP, GaAs, GaN, BN, InP and ZnO.

ZnO is recognized as one of the most promising oxide semiconductor materials, due to its good optical and electrical properties. It is used as a transparent highly conducting oxide in thin film solar cells. Nanostructured ZnO can be obtained with different morphology (nanowires, nanobelts, tetra pods, nanocombsand nanoneedles), by different methods. The preparation methods, which determine the structures of the particles, their placement relative to one another; and their shape and size, play important roles.

In this work the preliminary results about preparation of ZnO nanostructures by the method of arc discharge deposition is reported. An arc discharge between closely situated carbon electrodes and a very low temperature gradient between them is employed to produce ZnO nanostructures. The working atmosphere is pure Ar, with a pressure of 3x104 Pa. The cross-sectional area of the cathode is 6 mm^2. The anode, with a cross-sectional area of 12 x 4 mm, has 4 mm opening, placed 1.5 mm behind the electrode front surface. During the ZnO sample preparation, the opening was filled with a ZnO powder. No catalyst or hydrogen for ZnO nanostructure stabilization and stimulation are used in the experiment. The DC arc was ignited by touching the electrodes together and then separating them. Polished c-Si wafers are used as substrates. Influence of the substrate temperature on the structure of grown ZnO films is performed - the substrate temperature is varied between 100 ^{o}C and 600 ^{o}C. The deposited ZnO materials are studied by SEM (Jeol-SEM JSM 6390).

The higher substrate temperature of 600 ^{o}C is stimulated formation of the seeds and growth of the identical nanowires with a hexagonal shape perpendicular to the substrate. The surface morphology is very homogeneous. The hexagonal wires are 0.4-0.6 μm thick and 6-10 μm long. In the temperature range of 300-500 ^{o}C the substrate temperature is not high enough to stimulate growth with well oriented wires. At those temperatures, probably, the vapors of the oxide are weakly stuck to the substrate and the resulting wires are only 100-200 nm long. In this case the wires have defect structure, only some of them are perpendicular oriented to the substrate and they have different thickness on their length. When the substrate temperature is lower than 300 ^{o}C the arriving ZnO vapor are cooled down and they make condense on the substrate consisting of grains with very small size < 500 nm. Experiments on growing of ZnO nanowired structure on the conductive substrate are in progress.

A-0247

SENSITIVE ELEMENTS FOR LUMINESCENT CHEMICAL SENSORS BASED ON NANOCOMPOSITE STRUCTURES BACTERIORHODOPSIN-SEMICONDUCTOR QUANTUM DOTS CDSE/ZNS

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Perspective materials for the creation of the chemical sensors are the materials based on photochromic bacteriorhodopsin, in which under the influence of the minor vapours-gaseous and (or) liquid chemical additives the change of the photocycle parameters occurs. The bulk and thin-film nanocomposites inorganic matrixes created by sol-gel technology with immobilized purple membranes and thin-film polymeric gelatin matrixes with bacteriorhodopsin, are used as elements sensitive to chemical components. Creation of the highly sensitive optical elements based on the listed materials, however, requires high optical quality of the samples and demands to use the additional actinic light sources, for the starting of photocycle.

Introduction into material that contain photochromic bacteriorhodopsin, of the semiconductors quantum dots with the emissions of the photo- and (or) electroluminescent radiation spectrum, which coincident with the absorption band of the ground state of bacteriorhodopsin (bR570), leads to the creation of the fundamentally new type of the material. This new material contains, as a components, both an emitters (quantum particles) and photosensitive elements (nanosized purple membrane fragments). Based on such materials the possibility of creation of chemical sensors without using of the external actinic light is represented. The start of the photocycle in such elements is done by emission radiation of the quantum dots.

Materials containing bacteriorhodopsin and quantum dots CdSe/ZnS obtained in the form of bulk and film samples in polymer inorganic (sol-gel SiO_2) and organic (gelatine) matrices. With electronic, atomic force microscopy and X-ray chemical analysis shows that the obtained samples have developed microporous structure and uniform distribution of bacteriorhodopsin and quantum dots throughout the volume. The spectrums of the photoluminescence and transmission in the obtained samples are studied. Under the action of the emission radiation of the quantum dots the photocycle in bacteriorhodopsin is started, and, at change of humidity such parameters of the photocycle as absorption and storage time vary. Effect of the small concentrations of ammonia on the indicated parameters is also measured. The obtained results allow recommending developed materials for the creation of the sensitive optical sensors with the simplified construction and low cost.

A-0248

THRESHOLD INTEGRAL-OPTIC CHEMICAL SENSOR WITH SENSITIVITY CONTROLLED BY EXTERNAL ILLUMINATION

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Photochromic materials on the base of bacteriorhodopsin (bR), integrated into the organic polymer or sol-gel nonorganic matrix, are investigated actively and in the recent years the investigations were carried out on the influence of the different chemical components, which are in the small quantities in the gas media and water solutions, that lead to the photocycle parameters change, which is characteristic for bR. All these facts are the wonderful base for the creations of the new materials and constructions of the optical sensitive chemical sensors. The most convenient structure are the integral-optic ones.

In this work the results of the constructions evaluation of the chemical sensor are given and its optimization is performed for the multilayer sensitive element on the base of the nanostructural composite layer with bR.

Carried out calculations of the planar waveguide structures on the base of films containing BR will allow the creation of the optimized integral-optic sensors of chemical components which influence the bR photocycle, for the gas and liquid environments. Sensor is based on the dependence of refractive index and correspondingly transmission of the bR films on the value of the illumination power density and concentration of the chemical component influencing the film.

In this case the change of the refractive index leads to the arise or disappear of the zero mode in structure $\Delta n = \Delta nlt + \Delta nch$, where Δnlt, change of the refractive index due to actinic light; Δnch , change of the refractive index due to actinic light influence of the chemical component. Thus, specifying the power density of the external illumination of the covered bR layer on the all length of the waveguide, it is possible to control the concentration of the chemical component which leads to the exciting of the single mode waveguide.

Construction parameters of the integral-optic sensor, i.e. the thickness and the refractive index of the waveguide layer are used in a such way, that at the simultaneous action of the chemical reagents in the environment medium and lighting ($\Delta n=0.003$), depending on the construction, the zero mode TE0 arisen or disappeared.

The localization energy coefficient in the waveguide for the first construction is 16.4% in the initial position and 0% having simultaneous action of the chemical reagents in the environmental medium and lighting, for the second construction 0% and 1,58% accordingly.

The analysis of the received results of the calculation showed, that for the realization on practice the best is the structure, containing the integral optic waveguide, made using the standard sol-gel technology $Si_xTi_{(1-x)}O_2$, covered with the BR film in the gel matrix – during the investigation and monitoring of the gas media or in the sol-gel matrix – during the investigation of the liquids. The advantage of the given constructions is that using the sensitive film on the base of BR as a covering material there are no special demands to it concerning the optic homogenity and thickness homogenity on the contrary of the construction, where the film on the base of BR is used as a waveguide.

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A-0249

OPTICAL PARAMETRIC PROCESSES IN NONLINEAR DISORDERED MEDIA

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It has been well known that efficient energy transfer in nonlinear parametric optical processes such as second harmonic generation require phase-matching between the interacting waves. In order to fulfill this condition various methods have been developed, including the quasi-phase matching (QPM) technique which relies on the spatially periodic poling of ferroelectric crystal which induces modulation of the sign of nonlinearity. However such periodic structure is only effective for the particular choice of the wavelength of interacting waves. It turns out that broadband operation can be achieved utilizing random ferroelectric domain structures formed naturally in ferroelectric crystals which exhibit multi-domain structure with domains having random distribution of size and orientation. Such a disordered nonlinear medium is equivalent to an effective QPM system with almost infinite set of reciprocal wave vectors enabling to quasi-phase-match any parametric process, e.g. second harmonic generation or sum-frequency mixing in an ultra-broad frequency range.

In this talk we present our recent experimental results on second and third harmonic generation in such random nonlinear structures formed in as grown strontium barium niobate crystals. We will consider various types of interaction geometry, discuss properties of the emitted harmonic wave and the possible application of this process in short-pulse monitoring.

A-0250

TEMPLATE-ASSISTED FABRICATION AND CHARACTERIZATION OF PHOTOLUMINESCENT CONDUCTING POLYMER NANOPILLARS

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In the last years, photoluminescent conducting polymer micro- and nanostructures have received a considerable attention because of their interesting optoelectronic properties and potential applications such as sensors, polymer light-emitting diodes, polymer solar cells, etc. Different synthesis methods have been proposed for the fabrication of polymer nanostructures: template-assisted [1], nanoimprinting, nanolithography and electro-spinning. Among them, template-assisted is an easy, low cost, and highly versatile method to fabricate nanostructures for a variety of materials: polymers, metals, inorganics, semiconductors and their multi-functional composites. This method entails microporous or nanoporous materials used as templates. The synthesized nanostructure is achieved by infiltration of the material within the pores of the template. After deposition, the template can be selectively removed either partially or completely to produce a nanostructure array or freestanding nanostructures [2-3]. In addition, template-assisted techniques possess the advantage of being able to readily create large-area, ordered nanostructures and, in some cases, vertically aligned structures having high aspect ratios.

Anodized aluminium oxide (AAO) has become one of the most common nano-templates for the preparation of different nanometer-sized structures attractive because of its simple and highly controllable fabrication method. Dimensions as well as geometry of the nanostructures such as pore diameter and interpore distance can be controlled by selecting appropriate anodization conditions [4].

One interesting consequence of the polymer nanoconfinement inside the pore is the polymer chain orientation or crystallinity of polymer. It has strong effects on charge transport, optical properties and overall device performance. However, a comprehensive understanding and control of chain orientation in nanostructured polymers remains not clear.

Herein, we report the fabrication and characterization of photoluminescent conducting polymer nanopillar arrays via template-assisted method. Different type of polymer nanopillar arrays were fabricated: poly(thiophenes) and polyfluorenes such as poly(9,9-dioctylfluorenyl-2,7-diyl- co-bithiophene) (F8T2), poly[2-methoxy-5-(3',7'-dimethyloctyloxy)-1,4-phenylenevinylene) (MDMO -PPV) and poly(3-hexylthiophene-2,5-diyl) (P3HT), poly(9,9 '-dioctylfluorene-co -benzothiadiazole) (F8BT), and poly(9,9-dioctylfluorenyl-2,7-diyl) (PFO).

Self ordered porous alumina oxide prepared by two-step anodization process was used as template [5]. The geometric features are controlled by adjusting of anodization voltage, temperature, anodization solution and acid concentration. The resulting nanostructures present pore depths between 150 nm to 1000 nm and pore diameters between 50 nm to 300 nm.

The resulting polymer nanostructures are analyzed in detail by ESEM (environmental scanning electron microscopy) and AFM (atomic force microscopy) images. The effect of the nano-confinement on the electrical and optical properties is analyzed by current sensing atomic force microscopy (CS-AFM), photoluminescence and UV-Visible spectroscopy. In addition, the orientation of the polymer chains inside the nanopillar is also characterized by Raman spectroscopy and X-ray diffraction (XRD). The results are discussed and compared with polymer thin films.

Acknowledgments

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A-0251

DISCRETE OR CONTINUOUS ENERGY DETUNING OF AMPLIFIED SPONTANEOUS EMISSIONS FROM PI-CONJUGATED POLYMER THIN FILMS

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Conductive pi-conjugated polymer films are promising material also for photonic applications: large transition moment that accompanies with the long pi-electron conjugation assures the advantage of the material. Based on the successful demonstration of the material's versatility, e.g. luminescence energy tuning by molecular structure design, energy tuning of the same polymer film [1] will be the next challenge.

In this respect, most of the reports on amplified spontaneous emissions (ASE) from pi-conjugated polymer film described the emission at the energy presumably corresponding to the 0-1 transition between the vibrational modes along the pi-conjugation that is strongly coupled to the electric polarization oscillating at the optical frequency in excited states of the molecule. Since the nyu = 0 state in the ground level is almost full with electrons at room temperature, induced emission is expected as the 0-1, 0-2, etc. transitions. Energy selection to the 0-1 transition was assumed to reflect the optically allowed transition of a harmonic oscillator based on the quantum mechanical model. There have been only few reports which detected weak ASE at 0-2 transition. In the present study, efficient ASE's as 0-2, 0-3, or 0-4 transitions was successfully observed using thicker polymer films (> 100 nm), presumably as different guided modes nearly at critical angles. Previous report [2] on thick film ASE described that the ASE energy can be varied continuously depending on the film thickness, where the ASE was achieved as a leaky mode of the polymer film cavity and, therefore, the ASE energy was argued to be near the cutoff energy of the guided mode in the cavity. We have deposited a poly[2-methoxy-5-(2'-ethyl-hexyloxy)-p-phenylene-vinylene] (MEH-PPV) film on a glass substrate, where the optical confinement in the polymer film was found to be insufficient: majority of the emission was observed on the edge of the glass substrate, which indicates that the ASE leaked from the polymer film and that the glass substrate served as a waveguide. When the film thickness was thinner than 100nm, the observed energy of ASE was always at 630 nm, which seemed to correspond to 0-1 vibrational transition. While the film thickness was thicker than 100nm, however, the ASE exhibited itself at different energies that seemed to correspond to the 0-2, 0-3, and 0-4 vibrational transitions.

On the other hand, when the optical excitation power was incremented above the ASE threshold, the ASE energy increased continuously, which was an indication of phase space filling of the excited states: under higher excitation power, more electrons are pumped up to the excited states whose band will be filled with electrons from the bottom, leading to ASE from higher energy states in the excited band.

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A-0252

CONTROL OF DISCRETE CAVITY SOLITONS IN COUPLED CAVITIES

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We consider an array of coupled nonlinear waveguides with kerr nonlinearity where mirrors at the input and output facets backfold the light path, thus forming an array of coupled-waveguide resonators, which is excited by an external driving field. Properties of their nonlinearly localized modes frequently termed discrete cavity solitons differ cvonsiderably from those of their continuous counterparts[1].

We assume that the operating frequency is close to a resonance of identical high finesse cavities and that the nonlinearly-induced field variation is small per round trip. Then a mean-field approach can be applied [2].

It is expected that the interplay of the effects of discreteness and dissipation yields interesting new results compared to conventional planar cavities.

System exhibits a stationary plane wave (PW) , pattern and localized solutions. Linear stability analyzes is used to probe the stability of solutions. We numerically found both stable and unstable bright and dark discrete cavity solitons whit different width which propagate along the array whit different amplitude.

It is clear that in both regimes (self-focusing and self-defocusing) modulational instability, pattern formation, and the formation of localized solutions will differ.

We study displacement of soliton in the presence of intencity gradient and local phase gradient. It was observed that superposition of appropriate Gaussian control beam and plane wave holding beam can be used to control the position of discrete cavity soliton that develope as an the important issues of light control and all optical switching. Also we observed that its possible to write and erase solitons with appropriate Gaussian beam.

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A-0253

ORGANIC SEMICONDUCTORS AND LIGHT EMITTING DIODES IN APPLICATIONS

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Organic semiconductors have opened the possibility of a wide range of exciting applications, especially for large area device technologies. Despite material and device technologies being perfected rapidly, manufacturing processes are in need of innovation and investment. Without factories and clear markets the beginning of printed electronics has lagged expectations. The talk will review recent advances in this field, in particular as it relates to opportunities for commercialization. Many organic semiconductor technologies need to find a niche to be able to enter real life applications. One rapidly emerging example is lighting for design and architectural purposes, which is on the verge of being the forerunner of mainstream OLED lighting.

A-0254

SPECTROSCOPY AND STRUCTURAL PROPERTIES OF AMORPHOUS AND THERMALLY INDUCED NANOCRYSTALLINE SILICON CARBIDE THIN FILMS

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Nanocrystalline silicon carbide (nc-SiC:H) is an interesting material due to a variety of applications in optoelectronic devices; because of its wide bandgap it has for instance been used as a window layer in Si based thin film solar cells. Other excellent properties known to crystalline Si carbide (c-SiC), such as high electron mobility, a high break-down field and a high conductivity make this class of materials attractive for applications in high-speed, high-power or high-temperature electronic devices. High quality c-SiC is prepared at high substrate temperature above 1000 C. Recently the deposition of microcrystalline SiC thin films has been reported by several groups at substrate temperatures between 200 C and 325 C. This contribution will report on the spectroscopy and structural properties of hydrogenated amorphous SiC: and nc-SiC; they have been processed by the hot-wire chemical vapour deposition (HWCVD) technique. Depositions were performed from a mixture $SiH_4/CH_4/H_2$ onto Corning glass 7059 and c-Si (100) substrates and subsequently annealed at 900 C in Argon ambient. The substrate and filament temperatures were 410 C and 1600 C respectively. While the as deposited films were amorphous, the crystalline phase was induced by the post deposition thermal annealing. The thicknesses of the films were measured by a Dektak profilometer while the optical characteristics (energy gap, refractive index and absorption coefficient) were determined from UV-visible spectroscopy. The IR spectra of as deposited films show the predominance of SiHn and CHn in contrast to the annealed samples where hydrogen effuse from the films and SiC vibration bonds appear. Strong oxidation peaks of Si-O-Si and Si-O stretch modes ascribed to porous Si and SiC nanocrystallites were observed in the latter films. Raman scattering results agree with the above-findings; a narrow peak of c-Si towards the 520 cm^{-1} wavenumber and a broad peak at around 960 cm^{-1} attributed to 3C-SiC LO phonons dominate the spectra in annealed films while the spectra for the as deposited material mainly shows a broad peak below 500 cm^{-1}, characteristic of a-Si:H. This peak is however red shifted from the well known 480 cm^{-1}, a fact we attribute to the inclusion of small SiC nanocrystals in the a-Si: H matrix. For chemical analysis, the films have been characterized by X-ray photoelectron spectroscopy (XPS) and Energy Dispersive X-ray spectroscopy (EDX); while the first confirms that the surface composition is made of Si, C and oxygen as expected, the second shows interestingly that the C-content is decreasing from the film surface towards the film-substrate interface. Room temperature photoluminescence (PL) experiments for dynamic studies of carriers after excitation were performed; the time resolved PL spectra are better fitted by a stretched exponential decay function. While short PL lifetimes between 300 and 700 ps have been observed in as deposited films, the decay times of carriers in annealed samples are longer and greater than 1000 ps. They will be correlated to the PL emission spectra recorded in a band ranging between 430 and 600 nm.

A-0255

SYNTHESIS AND PROPERTIES OF $NA_3YSI_2O_7:EU^{3+}$ PHOSPHOR FOR FLUORESCENT LAMP

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Recently, the phosphors is utilized various lighting systems. Especially, phosphors for lighting systems are much used in the application of fluorescent lamps. The phosphor for fluorescent lamps are blue-, green- and red (RGB) tricolor phosphors and be excited with 254 nm. However, conventional red phosphors excitable with

254 nm are only YVO_4:Eu^{3+} and Y_2O_3:Eu^{3+}. In this study, we researched the red phosphor excited with 254 nm and paid attention to $Na_3YSi_2O_7$:Eu^{3+}. $Na_3YSi_2O_7$:Eu^{3+} exhibited intense red emission at 614 nm, which is originated from the 4f - 4f transition of Eu3+ ion, by 393 nm and 467 nm sharp excitation bands. In addition, this phosphor has broad excitation band between 200 - 330 nm. This excitation band is ascribed to the Eu - O charge transfer. Therefore, $Na_3YSi_2O_7$:Eu^{3+} was excited with 254 nm and exhibited red emission. We expect that $Na_3YSi_2O_7$:Eu^{3+} is used as red phosphors for fluorescent lamp.

A-0256

PHOTOPLASTIC EFFECT, GIANT PHOTODEFORMATION AND MASS TRANSPORT PHENOMENA IN AMORPHOUS CHALCOGENIDES

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Several properties of chalcogenide glasses (ChG) exhibit prominent photoinduced changes when illuminated with light having energy comparable to their band-gap [1]. Among photoinduced effects, changes in mechanical properties, termed as photoplastic effects [2], are of high importance posing challenges for both the understanding of the structural changes involved and the possible technological applications. A special case of photoplastic effects, i.e. the photoinduced fabrication of giant surface relief gratings (SRGs) on ChG films has been reported recently [3,4]. It means that these materials reveal surface deformation and giant SRGs formation effects when hologram is recorded or single beam laser illumination is applied.

This talk will review an effort in studying of photoplastic effect in ChG [5] and the effect of photoinduced fabrication of SRGs on amorphous ChG films (mostly through $As_xSe_{(100-x)}$ and $As_{40}S_{60}$ compositions) by in situ and real time atomic force microscopy [6]. It has been found that different kinetics of SRGs formation relative to the film composition and light polarizations takes place and the maximum surface modulation amplitude reaches giant scale (of the order of the film thickness). We demonstrate that the compositional trends of light stimulated vectorial surface deformations are the highest in Se-rich glasses and in As40S60 composition and confirm their increasing to giant magnitude by additional illumination during holographic recording. The magnitude of this increase depends on the light polarization.

We have shown that photoinduced mass transport phenomenon in amorphous chalcogenide films can be triggered by the light polarization. For a given intensity interference pattern, additional light with orthogonal polarization give rise to opposite direction of mass transport. So, modulating the light polarization by recording beams and additional illumination allows us to induce alternating matter migration giving rise to surface relief modulation. The direction of mass motion generated in either (p-p or s-s) polarization scheme of recording may be increased by s - polarized or decreased by p- polarized additional light. Thus, one combination of recording (p-p+S) induces the matter motion toward bright fringes and we detected opposite situation (the matter motion away from bright fringes) for another one (s-s+P). SRGs formation is explained by the optical gradient force/ surface potential model and by the polarization-dependent photoplastic effect enabling the directional mass transport as the result of structural transformations. In this talk a particular emphasis is given to the giant mass transport (including a comparative short overview for azobenzene-containing polymer films) which can give some new insight to the mechanism of these special surface deformation processes.

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A-0257

TELLURIDE FILMS AND WAVEGUIDES FOR IR INTEGRATED OPTICS

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Due to their unique property of transmission in the infrared region, chalcogenide glasses are very promising materials for the realisation of micro-components for infrared integrated optics. These components are particularly attractive for applications as environmental metrology for the detection of pollutant gases or spatial interferometry for the detection of exoplanetary systems. In the last case, the spectral window to be explored extends up to 20 microns. Telluride glasses are then the only appropriate materials. The first part of the talk will deal with the elaboration and characterization of Ge-Te glasses. Two different quenching techniques were used: (i) the twin roller quenching for bulk flakes and, (ii) the co-thermal evaporation for films. The last method has hardly ever been used to produce chalcogenide films while it allows an easy tuning of the composition by a precise monitoring of the evaporation temperature of each element. Moreover it allows producing amorphous films with thickness up to 15 microns. Thick films and bulk materials have similar thermal properties as demonstrated by similar responses during differential scanning calorimetry experiments (similar glass transition and crystallization temperatures). The change in refractive index with the composition of the films was investigated, thanks to M-lines and electron probe micro-analysis experiments.The second part of the talk will deal with the elaboration of single-mode chalcogenide waveguides for the spectral window [6-20microns]. Waveguides based upon the stacking and further etching of GeTe thick films were fabricated. The substrate was a Te75Ge15Ga10 bulk glass, a material with a remarkable transmission in the infrared region and a good thermal stability. The three main steps of the waveguide elaboration, i.e. the deposition of thick films with controlled composition and refractive index, the deep etching of the films, and the preparation of the input and output facets , will be described. Finally our achievement in terms of optical characterization will be discussed.

A-0258

SILK PHOTONICS: BIOPOLYMER OPTOFLUIDICS AND APPLICATIONS

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In this invited talk, I will speak about the material, optical, and biochemical properties of silk. I will present some preliminary results in realizing photonic structures from silk, including those with active biochemistry. Silk fibroin, the structural protein derived from the cocoon of the silk moth caterpillar, has a host of material and optical properties that make it an ideal material for photonic structures. Silk fibroin can be evaporated from aqueous solutions into thin, robust films. These films can be patterned on the sub-nm scale with high fidelity using simple contact lithography, forming photonic structures. Silk can house biologically active molecules, integrating biochemistry with photonics. This properties render silk fibroin a unique photonic material, with potential applications in medical optics, health and sensing.

A-0259

SYSTEMATIC ‘SMART MATERIAL’ DESIGN : DATA-MINING REVEALS NEW CLASSES OF HIGH-PERFORMANCE ORGANIC NON-LINEAR OPTICAL MOLECULES

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This paper presents the discovery of a range of high-performance organic non-linear optical (NLO) materials, that arises from ‘smart material’ design and systematic search strategies. This systematization circumvents the previous use of iterative discovery methods, which can only ever afford incremental improvements to currently known NLO materials, and they have no capacity to reveal entirely new classes of suitable NLO materials. This new approach employs data-mining, using the world’s repository of all published organic crystal structures as a representative set of chemical space.

Two independent search strategies are implemented, each predicting the world’s best organic NLO materials. The first search method relies on the concept of ‘molecular lego’, taking particular types of molecular fragments that are known to be important constituents of an NLO active material (the ‘lego’), and searching for these through chemical space, with the assistance of graph theory algorithms and systematic enumeration and classification. The second search method uses quantum-mechanical calculations to evaluate the molecular hyperpolarizability, beta, of every organic molecule in the aforementioned database. Since beta affords the intrinsic measure of NLO output, all organic molecules listed in descending order of beta values reflects a ranked list of their NLO potential.

The NLO properties of selected materials that are highly-ranked in these two lists were then tested experimentally, using Hyper-Rayleigh Scattering (HRS) and Teng-Men ellipsometry. The predictions are shown to be borne out by such experiments: HRS results show beta(0) (static hyperpolarizability) values that are up to 10 x greater than those for the standard industrial reference samples, para-nitroaniline (pNA), Disperse Red 1 (DR1) and N-(4-nitrophenyl)-L-prolinol (NPP). Meanwhile, Teng-Men ellipometry results are very favourable: one sample, in particular, shows a staggering electro-optical response of 15 x DR1. Due to the commercial potential of these results, four new classes of NLO materials identified by this study have recently been patented.

This paper will present the findings of the patent disclosure that reveals the chemical identity of these designer NLO materials, together with a fuller discussion of the prediction methodologies and experimental results. The experiments were conducted in collaboration with Prof Clays and Dr Moreno at the Katholieke Universiteit Leuven, Belgium (HRS) and Drs Cross and Szablewski at the University of Durham, UK (electro-optical) who will be co-authors on the relevant full publications.

A-0260

STRUCTURE-PROPERTY RELATIONSHIP STUDY OF TWO-DIMENSIONAL CHARGE-TRANSFER NONLINEAR OPTICAL MOLECULE: 9-DIAZO-2,4,5,7-TETRANITRO-9H-FLUORENE

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Nonlinear optics occupies a significant role in scientific research, as it can enable a variety of highly desirable effects, such as wavelength/frequency conversion and electro-optic effects. Nevertheless, for the majority of cases, the performance of nonlinear optical (NLO) devices and the range of their applications are limited primarily by the availability of suitable NLO materials. New materials that exhibit advanced NLO effects are therefore highly sought after. Above all, organic NLO materials are of high interest due to their several advantages over their inorganic counterparts, such as $LiNbO_3$. For example, there are certain organic NLO compounds which have been demonstrated to show superior second-harmonic generation (SHG) performance, faster optical response times and significantly higher optical thresholds when compared with their inorganic counterparts. These advantages originate from the different principles that give rise to the NLO phenomena in organic and inorganic compounds: the former is induced by the electronic charge-transfer (CT) process, whereas for the latter, ionic displacement functionalises the nonlinearity. Consequently, there is much impetus to investigate the CT process related to the observed NLO properties in organic compounds.

The electronic CT processes inherently result from the molecular structure. Planar molecules, with a conjugated donor-pi-acceptor structure are known as the best basic structural form to facilitate intramolecular CT processes. Recently multi-dimensional CT molecules have been proposed as a new class of highly promising candidates for NLO applications due to their improved transparency in the visible region and enhanced phase-matched SHG performance by the off-diagonal hyperpolarizability components.

In this work, we are going to present the experimental and theoretical studies of a two-dimensional CT molecule, 9-diazo-2,4,5,7-tetranitro-9H-fluorene (DATNF, $C_{13}H_4N_6O_8$). The CT process has been investigated by means of the topological charge-density analysis: an extensive X-ray diffraction data-set was collected using the state-of-the-art single-crystal diffractometer (Cavendish Lab., Uni. of Cambridge, UK) to obtain the charge-density distribution of the molecule. Furthermore, a comparable study was made by a synchrotron diffractometer (BM01A, ESRF, France) using the same crystal. In order to acquire the accurate hydrogen positions with the associated hydrogen-bond network, which is crucial for intermolecular CT and molecular packing arrangement, a neutron diffraction experiment will take place in May, 2010 (ANSTO, Australia). Further experimental validation of the DATNF NLO properties including hyperpolarizability and electro-optic coefficient measurements using Hyper-Raleigh Scattering and Teng-Men ellipsometry respectively will be discussed in the presentation, in relation to its structure and charge-density distribution.

These experimental results, combined with the density functional theory calculations may reveal previously unknown structure-property relationships, and this could provide a complete assessment of the relevance of this two-dimensional CT molecule to further applications.

A-0261

THE CRYSTALLIZATION EFFECTS IN OPTICAL TELLURIDE GLASSES DOPED WITH RARE EARTH IONS

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The goal of this work was to investigate the influence of rare earth ions such as Tm^{3+}, Yb^{3+} on physico-chemical properies of tellurite glass from the TeO_2-WO_3-PbO-PbF_2-Na_2O system. The thermal characteristic of telluride glass Tm^{3+}, Yb^{3+} doped have been presented.. The effect of the glass crystallization on thermal stability of the glass and crystallizing phases formed upon heat treatment were investigated by DTA/DSC and XRD methods. It has been found that the effect of nanocrystallization of LaF3 and incorporation of RE elements in formed upon heat treatment nanocrystalites depends on kind of rare earth elements and is determine by factors of crystallochemical nature and require adequate proportions between components forming glass structure. The optical investigation comprise: the ellipsometric investigations by the means M2000 spectroscopic ellipsometer, reflection and transmission measurement by the use Perkin Elmer 419 integrating sphere and small angle light scatter study (SALS). These measurements allowed to determine dispersion of refractive glass indices in the range [190 -1700 nm] and depolarization coefficients.

The obtained results have been elaborated by means of the Debye and scalar theories of light scattering. These theories describe light scattering from bulk in diffuse media and from surface irregularities. The optical method of separation of bulk from surface scattering is discussed. The theoretical results (i.e. angular dependence of

reflectance, optical spectra for total and specular reflectance, and transmittance from diffuse films) vs. the size of scattering centres and their correlation lengths are also shown.
Influence of nanocrystallization process on refractive index and loss function have been discussed.

A-0262

OPTICAL AND THERMO-OPTICAL PROPERTIES OF SILICA ANTIREFLECTIVE FILMS FORMED IN SOL-GEL PROCESSES

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Sol-gel technology offers huge potential capabilities involving the fabrication of low refractive index layers which the refractive index can change within the range n=1.1 - 2.3, depending on the composition and the applied technological process. Therefore, basing on the silica films we can fabricate multilayer structures with a preset refractive index which can offer high optoelectronics application. The silica films have been obtained by sol - gel method. They showed porous structure with pore size ranged from couple to tenth nanometers. Also SiO_2 films exhibited porosity causing optical inhomogeneity of layers. Their optical properties have been described by Brugemann effective medium approximation (EMA) . The obtained values of refractive index from ellipsometric measurements simulate homogenous film with effective optical coefficient ne. The investigated porous SiO_2 revealed very low refractive films and might be used for production of antireflective coatings (ARC).
The work presented results of nondestructive contactless methods whose comprise: the optical reflectance and transmittance measurements and spectroscopic elipsometric studies performed in wavelength range 190-1700 nm. Also temperature dependence of ellipsometric parameters by the use M2000 ellipsometer have been done. Using the extended Cauchy model of reflectance versus wavelength the thermal refraction coefficients from combined ellipsometric and reflectometric measurements in temperature ranges from 293 K to 533 K have been determined. The paper presents silica layers with the effective refractive index in the range 1.2 to1.3. Also this work provides examples for the application of the elaborated technology for the fabrication of waveguide films. Basic fabrication technology was presented as well as the applied measurement methods of refractive index and thickness.

A-0263

OPTICAL PROPERTIES OF MULTILAYER SILICON NITRIDE WITH SILICON QUANTUM DOTS

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Silicon quantum dots embedded in dielectric is a very promising material for very efficient third generation solar cells. One of the most interesting concepts is all-silicon tandem cell based on the quantum dot superlattices. The effective band gap of these structures can be optimized by adjusting the size of the quantum dots.
In our study we report the investigation of nanostructures embedded in silicon nitride films deposited by RF plasma enhanced chemical vapor deposition (PECVD).
The multilayer structures consisting of fifty near stoichiometric silicon nitride layers followed by silicon-rich silicon nitride layers has been deposited and heated in 1100^{o}C in order to realize the quantum dot superlattice as well.

The photoluminescence is observed in the range 1.9 - 3.5 eV depending on the gas flow ratio. The properties of the quantum dots are investigated using high resolution transmission electron microscopy (HRTEM) and spectroscopic ellipsometry.

A-0264

ON THE APPLICATION OF A DIMENSIONLESS JOINT DENSITY OF STATES FORMALISM FOR THE QUANTITATIVE CHARACTERIZATION OF THE OPTICAL RESPONSE OF HYDROGENATED AMORPHOUS SILICON

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Using a recently developed dimensionless formalism for the joint density of states function associated with hydrogenated amorphous silicon, we analyze a wide array of experimental optical absorption data corresponding to this material. By rescaling the experimental optical absorption spectra into a form that is compliant with this dimensionless formalism, fundamental differences, beyond the usual variations in the Urbach tail breadth and Tauc energy gap, are observed. From these fundamental differences, conclusions into the fundamental character of the optical response of hydrogenated amorphous silicon may be gleaned.

A-0265

STUDIES ON GE2SB2TE5 FILMS AT STRUCTURAL TRANSITIONS

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Thermally evaporated GST films of 500 nm are characterized for the transmittance and reflectance changes at various annealed temperatures (up to 360^{o}C). A clear distinction between two phases before and after switching is visible in the both studies. The band gap and other optical parameters like Urbach energy, B1/2 etc. are calculated from these spectra. The resistivity reading by four probe shows a semiconductor to semimetal transition and the electrical band gap before and after switching is 0.42 and 0.38eV. The Sheet resistance studies of the annealed films gave clear indication of phase change at 125^{o}C, signifying a fast switching possibility in this material. Intensive studies are carried out by XPS to understand the bonding transition while structural transitions. We confirmed that Te-Te, Sb-Sb bondings are not present where as Ge-Te, Ge-Ge ,Te-Sb, Te-Ge are present a-state and Ge-Te,Te-Sb, Te-Ge present in c-state. Raman studies are done to interepret the structural transitions and variations in vibrations modes before and after switching are observed. Atomic Force Microscope studies are done to understand the changes in roughness and grain size variations in all annealed films. A thorough analysis is done on the basis of all these characterizations to understand the signatures during structural transitions.

Keywords: (Phase change materials, XPS, GST, Thermal evaporation).

A-0266

RECENT ADVANCES IN X-RAY PHOTOCONDUCTORS: SELECTED EXAMPLES ON PBO AND A-SE

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The choice of photoconductor is crucial for the optimization of application-specific direct conversion x-ray imaging detectors. For the optimal choice of a photoconductive material, the following major factors must be considered: (1) x-ray detective quantum efficiency, (2) x-ray-to-charge conversion gain, (3) photoconductive properties; (4) technical feasibility to produce large area detectors with a photoconductive layer deposited directly on the imaging array. Amorphous Selenium (a-Se) and polycrystalline Lead Oxide (PbO) are two materials with a proven efficiency in detecting radiation while technologically compatible with advanced readout techniques. Here we describe the recent advances in their technology and discuss their photoconductive properties and the origin of the dark current. As well, we highlight some of the current challenges in the design of next generation detectors. We also discuss the origin of impact ionization and avalanche multiplication in a-Se - a-Se is the only amorphous photoconductor where charge, while drifting in high electric field, can avoid energy dissipation and hence can acquire sufficient energy from the field to initiate impact ionization process. We show that avalanche a-Se structures are capable of multiplication gain of up to 104 which promises their fruitful utilization in ultrasensitive imaging devices.

A-0267

REVERSING THE ARROW OF TIME VIA PHOTNICS USING POLYMER-DYE INTERATIONS

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The use of dye-doped polymers for nonlinear optics was originally motivated by their good optical quality due to the polymer host and the large nonlinear-optical response imparted by the guest chromophores.[1] In addition, the ease of processing dye-doped polymers in optical fibers[2] and thin films, as well as being able to use them as coatings on semiconductor substrates for making integrated devices has lead to an explosive growth in research aimed at making chromophores with a larger nonlinear-optical response. The development of devices based on polymers has paralleled fundamental research aimed at understanding the nonlinear-optical response.[3] Dye-doped polymers are attractive also because the material's optical and rheological properties can be controlled based on the choice of host polymer and dopant. Indeed, the development of photorefractive polymers, which required photosensitive materials with a large electro-optical effect and charge mobility, is an example of an intentionally designed material with specialize functionality.[4] Based on the versatility of dye-doped polymers, our group demonstrated the first all-optical circuit that actively stabilized the position of mirror using the photomechanical effect in a polymer-optical fiber.[5] This demonstration was significant because all functions of sensing, logic, transmission and actuation was optical, with no use of electronics aside from the power supplied to the laser. These 4 functions were later miniaturized into an element in an optical fiber, called a Photomechanical Optical Device (POD). The fact that many PODs can be integrated into a fiber forming Waveguide-Integrated Smart PODs (WISPs) leads to the real possibility of the development of ultra-smart morphing materials.[6]

Since a POD is the optical analogue of a multi-transistor logic element, sensor, and actuator, combining many of these into a network could lead to emergent properties. Thus, networks of PODs (podworks) made of WISPs could be intentionally designed for advanced applications or general architectures could be constructed and

subsequently “taught” to respond adaptively to external stimuli. My presentation will discuss recent research on the fabrication and characterization of PODs as well as studies aimed at underrating integration issues. A problem that any material faces when exposed to high-intensities is optical damage. Our laboratory discovered that molecules, which normally photodegrade irreversibly in liquid solution, self heal after optical damage in a dye-doped polymer.[7,8] Thus, the polymer acts in a way that turns what is normally a irreversible phenomena into a reversible one. Perhaps more importantly, when cycling this material through periods of degradation and self-healing, the dye-doped polymer is observed to become more robust. While the mechanisms of self-healing and laser-hardening are not well understood, it is clearly a useful property of optical materials that are prone to damage. In conclusion, dye-doped polymers are highly versatile and are being studied for their potential applications in the next generation of devices and applications, many of which have not yet been discovered. In parallel, many new phenomenal, such as self healing, are being discovered that are both of scientific interest and may have an impact in future applications.

A-0268

CORRELATION BETWEEN THE TYPE OF F-CENTER AND OXYGEN IMPURITY SITE IN THE STORAGE PHOSPHOR BAFBR:EU2+

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Commercial image plates for 2D detection of x-rays in medicine usually consist of the x-ray storage phosphor BaFBr:Eu^{2+}. It can be shown that the photostimulated luminescence (PSL) efficiency of BaFBr:Eu^{2+} is highly sensitive to the oxygen content, which is, together with the lattice sites of F-centers, controllable by the reagents NH4F and NH4Br. The oxygen content is qualitatively monitored by photoluminescence (PL) measurements. PL peaks at 470 nm and 520 nm, respectively, which are not present in the PSL spectrum, indicate oxygen on ,different anion lattice sites depending on the surplus of one of the ammonium halide reagents, while remission shows the coinstantaneous change of the F-center type. The correlation between oxygen content, F-center type, Eu^{2+} luminescence and their effect on the PSL sensitivity is analysed.

A-0269

LIGHT-INDUCED ELECTRICAL INSTABILITY IN NC-SI THIN FILM TRANSISTORS

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While the a-Si TFT is commonly used in most flat panel devices, the low charge carrier mobility and poor electrical stability limit its use in new application areas. One of the potential alternatives is nanocrystalline silicon (nc-Si), which is not only compatible with the existing a-Si technology, but also has higher carrier mobility and superior electrical stability. Most of the stability experiments on nc-Si TFTs to-date have been performed in the dark or in ambient light conditions. However, in applications such as touch-screen AMLCD or AMOLED displays, the nc-Si TFTs may be operated under high illumination for extended time periods. While the effect of light stress has been investigated in thin nc-Si films and solar cells, its effect on nc-Si TFTs has hardly been broached.

This work examines the stability of nc-Si TFTs under light and/or bias stress conditions, and the underlying mechanisms. Here, the devices were subject to both gate and drain bias stress, and the stress was interrupted periodically for short periods to sample the TFT characteristics. After stressing, the devices were kept at room temperature without light or bias stress for self-recovery. The threshold voltage (VT) and sub-threshold slope (S) were extracted from measured characteristics.

The mechanisms underlying shift in VT during bias stress only is concluded to be charge trapping, consistent with previous reports. However, the electrical instability in nc-Si TFTs under combined light and bias stress is found to be due to defect state creation, in which the gate bias induced increase in charge carrier concentration promotes bi-molecular recombination and, subsequently, defect state creation in the amorphous phase of the nc-Si.

These results provide new important insights on the instability of nc-Si TFTs, operating under light illumination, and should be taken into consideration when designing nc-Si devices and circuits for operation under high illumination applications.

A-0270

METAL SURFACE PLASMON ENHANCED ELECTROLUMINESCENCE OF ORGANIC LIGHT EMITTING DIODES

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The incorporation of silver nanoparticles (NPs) into organic light emitting diode (OLED) was investigated. The electroluminescence (EL) efficiency of OLED was improved by 6-fold in the presence of silver NPs. Noble metal NPs a play dual role in improving OLED device efficiency via amplified localized electric field: on the one hand, surface plamson induced electric field impels electron tunneling injection from cathode, which balances the hole/electron ratio of diode; on the other hand, surface plamson induced electric field also promotes the radiative decay of molecular excitons in emitting layers and therefore improves its photoluminescence (PL) efficiency*.

*'Metal Plasmon Enhanced Europium Complex Luminescence', F. Liu, G. Aldea, J.M. Nunzi, J. Lumin. 130, 56-59 (2010)

A-0271

ON THE PHOTO INDUCED VOLUME CHANGES OF OBLIQUELY DEPOSITED CHALCOGENIDE GLASSES

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Chalcogenide glasses show a variety of photo induced effects during band-gap illumination, like photo induced volume change (expansion or contraction), photo darkening, photo bleaching, photo densification, etc. Recently, Ykeda and Shimakawa [1] published their experimental results of photo induced volume change on flatly and obliquely deposited a-As_2Se_3. Flatly deposited sample shows photo induced volume expansion while the other shrinks during the illumination. In flatly deposited a-Se (the model material for the chalcogenides) films photo expansion has been found due to covalent bond breaking during the electron excitation process, and simultaneously photo contraction due to inter-chain bond formation in the case of hole creation [2,3]. This bond breaking model obtained using Molecular Dynamics (MD) simulations has been confirmed experimentally by Raman spectroscopy [4]. In order to understand the controversial result of the photo induced volume changes

[1] further MD simulations have been carried out [5] on the structures and on the photo induced volume changes of obliquely deposited amorphous selenium. The results obtained are presented in this talk.

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A-0272

PHOTO-INDUCED CHANGES IN THE OPTICAL PROPERTIES OF THERMALLY EVAPORATED AS$_{40}$SE$_{50}$SB$_{10}$ FILMS

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Knowledge of amorphous materials is one of the most active fields of research in the physics of condensed matter today. The great interest in these materials is largely due to their ever increasing applications in modern technology. Their possibilities in the immediate future are huge based on the characteristic properties such as electronic-excitation phenomena, photoinduced phenomena etc. Glassy alloys of chalcogen elements were the initial objects of study because of their interesting semiconducting properties and more importantly photoinduced optical changes. In this paper, we have presented the photoinduced optical changes in $As_{40}Se_{50}Sb_{10}$ thin films.

The thin films of $As_{40}Se_{50}Sb_{10}$ was prepared by thermal evaporation technique from the prepared bulk glass. The amorphous nature of the film was verified with XRD and composition was checked with EDAX. The sample was illuminated with above band gap light with DPSS laser of wavelength 532 nm with a power density of 3.5W/cm2 for 30 minute.It should be noted that the illumination also causes a decrease in thickness of the films, which may influence the changes in absorption coefficient. However, for the present calculations, we assume d (thickness of the film) to remain constant as the changes in d by illumination are small (less than 5%) compared to the changes in absorption coefficients. The optical transmission spectra of the as-prepared, illuminated films were taken by FTIR in the wavelength range 400-1200 nm at room temperature. The Raman spectra were measured by a double monochromator and detected by photomultiplier tube (CCD). The XPS core level and valence band spectra were obtained with monochromatic Al K□ X-rays (1486.6 eV).

The optical band gap of the as-prepared $As_{40}Se_{50}Sb_{10}$ film decreases with illumination. The optical band gaps of the as-prepared, illuminated films are 1.54, 1.48 eVs respectively. It can be suggested that the photo induced changes are caused by chemical bond redistribution, according to the equation 2(M-S)<=>M-M+S-S where M stands for As or Sb, S is for selenium and dash denotes a chemical bond. The equilibrium can be moved in both directions, depending on the initial state of the film and the conditions of light exposure. Photodarkening of the illuminated film is due to the increase in homo polar bond density causing more disorder which can be seen from the B1/2 values. The B1/2 values for as-prepared, illuminated films are 673 and 665 cm-1/2 eV-1/2 respectively. This changes were supported by the corresponding changes in the XPS core level spectra of As3d, Se3d, Sb4d as well as the Raman spectra.

A-0273

TIME-RESOLVED INVESTIGATIONS OF ERBIUM IONS IN ZBLAN GLASSES AND GLASS CERAMICS

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Fluorozirconate-based glasses such as ZBLAN have shown their potential as hosts for rare-earth (RE) ions such as erbium; in these glasses the RE ion shows emissions that would be quenched in other glasses due to their phonon energies. Such material systems are of practical interest for photon up-conversion. Up-conversion is the sequential absorption of two or more low-energy infrared photons by a RE ion followed by subsequent emission of a visible photon. This process is dependent on the intermediate level lifetime of the RE ion, which is mainly influenced by the phonon energies of the host material. Low phonon energy glasses like ZBLAN are thus desirable hosts.

Additional doping of these materials with chlorine ions leads to the formation of barium chloride nanocrystals within the glass matrix upon heating. The nanocrystals have even lower phonon energies than the ZBLAN host glass itself, which could be favorable for the up-conversion efficiency of these systems if the RE dopant is incorporated into the nanocrystals upon heating.

In this work, the spectroscopic properties of erbium-doped ZBLAN glasses with and without barium chloride nanocrystals are investigated. The radiative lifetimes of the energy levels of erbium emitting in the visible range are analyzed by time-resolved spectroscopy. The excitation is carried out with a Ti:Sapphire fs-laser in conjunction with a nonlinear optical parametric amplifier (NOPA). The erbium radiative lifetime of the various emission lines in the visible spectral range were measured via time-correlated photon counting for different excitation energies. For up-conversion measurements, a pulsed laser as well as a laser diode was used. Significant differences between the lifetimes of the states populated by either single photon or subsequent multi-photon absorption are observed due to the presence of intermediate levels in the latter case.

The concentration dependence of the lifetimes will be presented with respect to possible excitation and quenching processes. Comparison of the lifetimes of erbium ions in ZBLAN glasses and glass ceramics will also be discussed.

A-0274

SELF-ORGANIZATION OF SILICA NANOPARTICLES INDUCED BY THE ION BEAM

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We studied the (spontaneous) self-organization of ion beam-irradiated colloidal silica nanoparticles in Langmuir-Blodgett layers as function of the particle diameter and of the ion beam fluence. By using Ga+ ion beam of E = 30 keV, the small size silica nanoparticles of D = 90 nm have been irradiated by the fluence ranging from 1.1x10^16/cm2 up to 4.4x10^16/cm2, while the medium size ones of D = 200 nm were irradiated by the fluence ranging from 7.8x10^16/cm2 up to 3.9x10^17/cm2. The new result emerging from these studies indicates a great difference in the self organization of the small and medium-size particles indicating a great difference in the underlaying dynamics. The small size particles become organized into chains connected over the whole spot, and may be assumed infinitely interconnected chains. The graph theory analysis of the chain segments reveals the graph trees with significant branching and relatively large loops comprising up to 9 particles. The

chain configuration does not comprise any remnants of initial fch cellular structure, indicating the formation of chains by the Brownian motion. The topological complexity of the self-organization of small particles (D = 90 nm) increases with increasing fluence at the constant ion energy.

In contrast to the small-size nanoparticles, the self-organization of medium-size ones forms short, unconnected, separated chains. The chain analysis reveals simple graph trees ranging from the „minimal spanning tree" (comprising no loops), to the trees with minimized loops of 3-4 particles only. The chain configuration comprises remnants of initial fch cells indicating their decomposition associated with angular motion and unfolding of the ark segments of the cell. The analysis reveals that short chains have been formed by decomposition of only one cell without further recombination, as well as by decomposition of two cells followed by recombination of decomposed ark segments. In contrast to the small particle chains, these have not been formed by the Brownian motion. The topological complexity of the chains of medium-size (D = 200 nm) particles decreases with increasing fluence, at the constant ion energy.

A-0275

METHODS AND PROCESS FLOWS FOR CMOS COMPATIBLE PHOTONIC INTEGRATION: WAVEGUIDES, COUPLERS, RX AND TX

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We are entering the era of multi-core computing: Multi-core processors are highly parallel computing systems on a single die (chip). Efficient use of this parallelism requires very high bandwidth interconnects between processors, e.g., multi-Tb/s. At these speeds, off-processor electrical signaling exhibits power and latency problems, which an optical interconnect strategy can potentially remedy. At the same time, fully CMOS compatible integration of optical interconnect would allow for inter-core, intra-die optical communication. It is also widely seen as the commercial enabler for its wide adoption in consumer products. Cost is an issue, and we present strategies/solutions using standard equipments and process flows.

Applied Materials is the leading developer of wafer processing equipment and is providing the next generation and next technology integration tools. We have developed process methods for routing of optical clock signals during the last decade and developed low confinement single crystal SiGe waveguides made by epitaxy and novel, embedded in-line deep-level impurity based, high speed, detectors within them. Waveguides and detectors were buried below the surface of prime epi silicon substrates targeting the optics integration to be implemented early in the flow of the CMOS integration. Our waveguides and detectors survive a thermal budget of several hours at 1050 C as would be encountered, in normal CMOS processing e.g., as part of the shallow-trench isolation of CMOS transistors, or for SD anneals. For wavelengths of 1300 nm and above, we consistently achieve attenuations below 1.0 dB/cm and bending radii on the order of 100 um became practical for these low confinement waveguides. The detector data, uncorrected for coupling losses, show responsivities of 1 mA/Watt at 1300 nm and were only slightly lower at 1400 nm. At the same time, using plasma silicon etch we developed a 45 degree mirror and in conjunction with a dry-etched back-side lens and surface mount optical coupler created an efficient input/output system with well-relaxed optical alignment tolerances that enable the use of commercially available passive pick-and-place systems. Since these early days of silicon photonics, great strides have been taken in a number of processing fields and we will review a number of the following aspects: CD and line-edge roughness control are paramount for the manufacture of well-tuned and efficient ring resonators and couplers to waveguides. Deep etch technologies for photonics crystals and furnishing of smooth sidewalls on waveguides are of great interest. Novel annealing and the rapid thermal re-growth transforming amorphous or poly-crystalline material into near-perfect single crystals result in superior photo-detectors, and show promise for emitters and will be discussed as a future enabling technology. The heterogeneous growth of optical active materials for light sources as well as plasma immersion doping for reduced defects and/or a reduced thermal budget are major areas of interest as well.

A-0277

PHOTOINDUCED SURFACE PATTERNING OF POLYMER-DYE THIN FILMS

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Macroscopic mass transport can be induced to polymeric materials by light through nano-scale photoisomerization of azobenzene derivatives. When an azobenzene-containing polymer sample is irradiated with an interference pattern of light, the initially flat sample surface can reproduce the intensity and/or polarization modulation of the incident light field as a surface-relief grating (SRG). Such gratings are temporally stable, and their surface-modulation depth can be hundreds of nanometers, showing potential for applications ranging from holographic storage to fabrication of diffractive optical elements and photonic components.

In the present study we show that hydrogen-bonded polymer-azobenzene complexes will give rise to efficient SRG formation, characterized by in-situ light diffraction measurements and ex-situ atomic-force microscopy (AFM) scans [1]. The main results show that the SRG formation takes place for all complexes with the degree of complexation ranging from 0.06 to 1.0 chromophores per one repeat unit of the polymer. When every second polymer repeat unit is occupied, the grating formation is the most efficient, yielding a surface-modulation depth of 625 nm, and first-order diffraction efficiency of 44 %.

All the inscribed gratings are thermally erasable and they can be subsequently rewritten after the erasure. Together with our previous results on phenol-pyridine hydrogen-bonded complexes [2], the present findings introduce a facile supramolecular route towards efficient light-induced surface patterning.

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A-0279

PLASMONIC LIGHT-TRAPPING FOR PHOTOVOLTAICS

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Nanostructured metallic layers and metal nanoparticles could play an important role in photovoltaic devices. By tuning plasmonic resonances for enhanced absorption or enhanced scattering there are opportunities for increased solar cell efficiencies or reduced material usage in photovoltaics.

Application of plasmonics to photovoltaics has been considered for a number of years, however, greatly enhanced (or much thinner) inorganic devices exploiting plasmonics have yet to be demonstrated. We can gather that it is not easy, the key challenges are: (1) establishing efficient processes that work across broad spectral ranges, (2) minimising losses , (3) suitable modification of device design to allow appropriate use of plasmonics and (4) reliable and inexpensive large-area fabrication of nanostructured metals.

In this presentation we will review the most important photovoltaic device structures and explore how plasmonics can make a difference. We will start by looking at simple, single particles and random arrays required for enhanced light-scattering in thin films. We will finish with consideration of how ordered arrays of particles and holes might exploit diffraction and extraordinary transmission, respectively.

A-0280

NANO-CAVITIES IN DIAMOND FOR QUANTUM ELECTRODYNAMIC EXPERIMENTS

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A novel solid state platform for Quantum Information Technology (QIT) is a negative nitrogen-vacancy color center (NV-) in single crystal diamond. The NV- triplet spin state can be read-out and manipulated at room temperature, presenting a long decoherence time which makes it an ideal candidate for a quantum bit (qubit). The realization of scalable quantum operations requires interaction between distant qubits which cannot relay on the dipole-dipole mechanism. Therefore, multi-qubit operation shall be carried out by photons, where each NV- is registered and coupled to the cavity and the cavities are interconnected by the waveguides. In this talk we will discuss various approaches towards realization of this photonic architecture in diamond and review the progress in the design, fabrication and optical characterization of these devices.

Photonic cavity design, a key element for the QIT, is described with focus on the photonic crystal 2D-slab geometry that present the most flexible way in the realization of the multi-qubit “environment”. We dwell on the design of the photonic crystal ultra-high-Q diamond nanocavities, the coupling between several cavities and its implication on the qubit architecture, the interweavement of the fabrication limitations and the cavity geometry. Finally we describe novel a non-PC cavity geometry that has the potential for substantial improvement in the fabrication processing relieving the need for the membrane formation. Then, we present several approaches and dilemmas to diamond photonic fabrication: nano-diamond vs. single-crystal, focused-ion-beam (FIB) patterning vs. electron-beam lithography, diamond membrane formation processing and its implication on the photonic and spectroscopic characteristics. Finally, we show the manufacturing process of a 2D-slab PC high-Q nanocavity realized on a single-crystalline diamond membrane and optically characterized by micro-photoluminescence measurements.

A-0281

CARRIER TRANSPORT IN MOLECULAR BEAM EPITAXIALLY GROWN GAAS/ INAS CORE-SHELL NANOWIRES

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Semiconductor nanowires produced by metal-catalyzed vapour liquid solid (VLS) growth continue to attract strong interest for applications in optoelectronics and biological sensing. Charge transport in nanowires has been shown to be strongly influenced by ionized impurities, surface roughness scattering, and charged surface states. Recently we discovered that dynamic capture of electrons producing repulsively charged traps can strongly modulate the conductance of backgated InAs nanowires, and shift threshold voltage by more than 100 mV, and that the modulation in conductance depends sensitively on nanowire diameter. To obtain high performance field effect transistors and sensors, scattering from charged centers and surface roughness should be reduced as much as possible. With the goal of improving surface properties in mind, we recently we began investigation of growth of InAs/GaAs core/shell heterostructure nanowires. We discuss preliminary results from this study along with some device-oriented applications.

A-0282

PHOTON SWITCHING IN NANOPHOTONICS COUPLERS FABRICATED FORM PHOTONIC CRYSTALS

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Recently there is a considerable interest to study a new class of materials called photonic nano-fibers and nano-couplers fabricated from photonic crystals. This field is known as nanophotonics and it is a new emerging research area which has applications in sensing and advanced information technology. Photonic nanowires made by embedding a high index material into a low index material have been widely studied. However not much work is done on photonic wires made from photonic crystals [1,2]. Photonic crystals are materials which have band gaps in their photonic spectra [1]. In this paper we have considered that the nano-couplers are fabricated by doping two photonic crystals A and B into another crystal C. Photonic crystal C is fabricated from nonlinear dielectric materials such as silica. On the other hand crystals A and B are made from polaritonic materials such as GaP. Electromagnetic signals are carried out by polaritons rather than electrons or photons in polaritonic materials [2]. Frequencies of polaritons lie between gigahertz to THz. This means that polaritonic frequencies lie in an intermediate regime between photonics and electronics. Therefore, polaritonics bridges the gap between electronics and photonics and has a wide range of applications, including high bandwidth signal processing, THz imaging and THz spectroscopy. It is considered that conduction band edges of crystals A and B lie within the band gap of crystal C. Due to this band structure engineering, crystals A and B act as two photonic nanowires. Numerical simulations have been performed on photon absorption and bound photons states of the photonic coupler. It has been found that when both wires are far away from each other the energies of bound photons are degenerate. However, when wires are brought close to each other the degeneracy of the bound state is removed due to the coupling between nano-wires. The energies of the couplers split into the symmetric and asymmetric states. This means that the coupler can be switched on and off by changing the interaction between nanowires. We have also investigated the nonlinearity of the photonic crystal C. It is found that the absorption in couplers can be switched on and off by applying the pump laser. This reveals interesting results and can be applied to develop new types of nanophotonic devices such as nano-switches, nano-transistors, nano-limiters and nano-gates.

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A-0283

PHOTOLUMINESCENCE STUDIES OF GAAS QUANTUM DOTS AND QUANTUM RINGS

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Recently, the growth of self-assembled quantum structures has been intensively investigated for basics physics and device application. Our work, self-assembled strain-free GaAs quantum dots and quantum rings were investigated by the photoluminescence technique. The GaAs nanostructures are fabricated on AlGaAs (001) surface by droplet epitaxy method. Temperature dependent photoluminescence spectra were measured in the range of room temperature and 4 K. We give an explanation on the broadening of the photoluminescence peaks for different quantum structures. The calculated electronic structure are compared with the photoluminescence data.

A-0284

SELF-ASSEMBLED MONOLAYERS (SAMS) OF PORPHYRIN DEPOSITED INSIDE HOLLOW-CORE PHOTONIC BANDGAP FIBER (HCPBGF) AND POLARIZATION MAINTAINING FIBER (PMF)

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Free-base porphyrin is an attractive candidate as a sensory molecule due to its high fluorescence efficiency [1]. In these studies, the self-assembled monolayer (SAM) method has been applied as the deposition technique of porphyrin molecules [2]. To the best of our knowledge, this is the first paper reporting on the SAM deposition of free-base porphyrins inside hollow-core photonic bandgap fiber (HCPBGF) and polarization maintaining fiber (PMF). HCPBGF (HC19-1550-01 from Blazephotonics) has 20 µm main hollow core and 4 µm small hollow cores. PMF (from Fiber Optics Research Center, RAS) has two cores with 50 µm diameter and the central partition 10 µm.
Fluorescence lifetime microscope studies of the facet of HCPBGF with deposited SAMs of free-base porphyrin were carried out. The fluorescence lifetime of the deposited porphyrin films was found to be around 2 ns, which is 1.2 times higher than that measured previously for glass plate samples [3].
Fluorescence lifetime microscope studies of the PMF with deposited porphyrins were carried out along fibers optical axis. The obtained fluorescence lifetime was found to be roughly 0.6 ns. This difference in the fluorescence lifetimes can be due to different aggregation of porphyrins when comparing large and small holes of the two fibers in question.
In order to study emission spectra of the free-base porphyrins deposited inside PMF, the single-mode fiber was spliced to the PMF. The emission spectra were obtained with the help of diode laser emitting at 405 nm, two objectives, dichroic mirror and spectrometer connected to a computer. The results are in a good agreement with those obtained for glass samples previously [3].
One of possible applications of the HCPBGF and PMF with deposited SAMs of free-base porphyrin, is the detection of various gases, e.g. ammonia which was demonstrated for glass samples in [4].

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A-0285

INDUCED VOLUMECHANGE AND INTERDIFFUSION ANTICORRELATION IN SE/AS2S3 NANOLAYERED SAMPLES

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Unique photoinduced behaviors of amorphous chalcogenides and nanolayered structures among others had been widely investigated by many authors [1]. In the case of nanolayered structures, composed of two or more different chalcogenide sub-layers with different modulation period was a subject for observation of induced intermixing and diffusion processes [2,3]. A new approach was offered by in situ measurement of the induced giant photoexpansion and bleaching kinetics. Measurement was provided by continuous sample illumination during AFM surface scanning. Thus bleaching kinetic vs. volume change kinetics has been investigated. Investigations show that saturation of the bleaching and the volumechange has different behaviors and time resolution even if the driving force of the diffusion and volume change is assumed as the same [4]. Two parts of the volumechange are separated. Before the photobleaching saturates photoexpansion kinetics is noticeable but not prominent while after saturation begins enhance essentially and keeps increasing with constant velocity during significant time. In other words while bleaching has saturated surface bump is still growing, even faster. Thus it is assumed that the induced volume change is observable before and after entire intermixing of the constituent sub-layers as well. Difference between saturation time of bleaching kinetics and photoexpansion time reaches one order of magnitude. The dependence of these effects on the thickness of sub-layers was also investigated. Results can be applied for the development of materials for direct, one-step surface phase relief recording.

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A-0286

OPTICALLY INDUCED ANISOTROPY OF LOCAL PLASMON IN ISOTROPIC NANOCOMPOSITE

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Study of surface plasmon in nanostructures and its interaction with intense electromagnetic field is important topic in spectroscopy of solids because of its significance both for pure and applied surface science. This interest is caused by a number of specific phenomena observed at the surface of metal in pico- and femtosecond time domain and also by promising applications in the emerging fields of nanophotonics and plasmonics.

Samples containing spherical copper nanoparticles with narrow size distribution in pure silica matrix have been prepared by modified sol-gel method [1]. Pump-probe measurements have been performed with a Coherent femtosecond laser system consisting of a Mira-900F oscillator operating at 800 nm and a Legend HE amplifier, which provided 2 mJ 130 fs pulses at 1 kHz repetition rate. Probe “white light” was generated in a sapphire plate. Measurements were performed at room temperature.

Characteristic feature of absorption spectrum of copper nanoparticles is absorption peak of surface plasmon at 2.17 eV. Under intense pump it decreases in amplitude and broadens. At first, red shift of plasmon is observed for very short time equal to pump pulse duration. After the end of pump pulse plasmon peak shifts to blue side and then gradually relaxes to original position with time constant 1.1 ps. These phenomena have been reported in [2] and explained in [3] taking into account changes of the dielectric constant of silica matrix, heating of electron gas in copper, and plasma formation in silica.

Here we report splitting of surface plasmon peak,which is clearly observed at high intensity of pump beam of the order of 10 TW/cm^2. For its explanation we can recall that interaction of light with metal nanoparticle has mainly dipole character. As a result area with enhanced electric field induced in the vicinity of nanoparticle has uniaxial symmetry. It causes induced anisotropy of silica matrix surrounding nanoparticle and leads to splitting of surface plasmon resonance. We have checked this supposition by measurements with different polarization of probe beam. Significant difference of plasmon peak shift in different polarization is observed during pump pulse. This difference in shift value leads to splitting observed in nonpolarized light.

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A-0287

SURFACE RELIEF MODULATION PHENOMENA BY LIGHT INDUCED INTERFERENCE

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This work is devoted to the topical issue - photoinduced formation of relief in thin layers of chalcogenide vitreous semiconductors (ChVS) without following complicated chemical processing. Direct holographic recording technique is on of the advanced methods for surface relief structuring in light sensitive materials. Because of the high light gradient it is possible to obtain surface structures like no one else method can. In this report the study of direct holographic recording of the surface-relief gratings on ChVS like As-S, As-S-Se and organic films has been presented. Holographic recording was performed by 532nm wavelength and by using multibeam recording setup. Also the mechanism of the direct recording of surface-relief on amorphous chalcogenide films based on the photoinduced plasticity has been discussed.

A-0288

PSEUDO-SELF-ADAPTIVE TOPOLOGICAL PHASES IN GLASSY SELENIDES FOR IR PHOTONICS

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Chalcogenide glasses have been in a sphere of tight interests because they exhibit a variety of useful applications especially in IR photonics. These solids possess many glass-forming compositions dependent on their connectivity. Within mean-field rigidity theory [1,2], the covalent-bonded networks proper to such glasses reveal three distinct phases: the networks having less than 3 Lagrangian constrains per atom are under-constrained ones (floppy), while those having more than 3 constrains per atom are over-constrained and enthalpically-stressed-rigid ones. Onset from floppy to stressed-rigid networks predicted to be solitary [1,2], but it can split into two points owing to self-adaptation tendency so that second-order transition occurs from floppy to unstressed-rigid phase and first-order transition occurs from unstressed-rigid to stressed-rigid phase [3]. The stressed-free intermediate phase appears to avoid stress, forming a so-called reversibility window. In device application, these self-adaptive intermediate-phases are most attractive since they reveal unique non-aging ability.

Search for self-adaptive phases in different glass systems yields numerous methods, the most popular being temperature-modulated DSC. It was assumed that marginality of non-reversible heat flow in these experiments serves as quite reliable criterion for such identification [4]. However, as it was shown [5,6], this argumentation could not be used as appropriate criterion for self-organization in terms of non-ageing ability. More precise measurements performed with XRD, EXAFS and XPS techniques supported by molecular dynamics simulation did not yield any evidence for structural signature of this phase in some glasses [5-7]. Only calorimetric

experiments in real time-scale chronology from earliest stages of as-prepared to long-term aged state can be used as reliable criterion for compositional boundaries of self-organized phase in covalent-bonded network glass-formers.

In the present report, we stretch this conclusion on binary As/Ge-Se systems using computational cluster-modeling approach based on ab-initio calculations (with RHF/6-311G* basis set). The calculations showed that corner-shared $AsSe_{3/2}$ blocks within As-Se network are more energetically favorable than edge-shared ones, while optimally-constrained quasi-tetrahedral $Se{=}AsSe_3$ units are impossible in this system. So the self-adaptive phase can be formed only by corner-shared $AsSe_{3/2}$ pyramids in obvious contrast to [4]. The obtained results testify also lack of optimally-constrained phase in Ge-Se system. It is shown, that character “outrigger raft” structural carcass built of two edge- and four corner-shared $GeSe_{4/2}$ tetrahedra is conserved for glasses within pseudo-self-adaptive domain, which is concluded to be composed of over-constrained “outrigger raft” clusters interconnected via bridges with extra Se atoms in ring-like≡Ge-Se-Se-Ge≡optimally-constrained configurations instead of Se-Se dimmers.

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A-0289

ECOLOGICAL CRYSTAL GLASS FABRICATED FROM THAILAND RESOURCES DOPED WITH ZIRCONIA

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Ecological crystal glass with no toxic compounds, especially lead, was located in soda-lime-silica based glass that fabricated mainly from 50 wt% local dressing quartz sands and doped with various concentration of zirconia. The density, refractive index, thermal expansion and hardness were measured. It was found that the values of density, refractive index and hardness were increased linearly as the increasing of zirconium dioxide concents, whiles the thermal expansion was decreased. This glass was environmentally friendly materials.

A-0290

COLOR CONVERSION LEDS USING NANOPHOSPHORS OF COLLOIDAL SEMICONDUCTOR QUANTUM DOTS

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Semiconductor nanophosphors of colloidal quantum dots allow for color conversion with high photometric quality using both radiative and nonradiative energy transfer. In this talk, we will present our recent research results on color conversion light-emitting diodes (LEDs) integrated with such quantum dot nanophosphors and those enhanced with nonradiative energy transfer for energy efficiency. Here we will discuss nanocrystal integrated LEDs to achieve high-quality solid-state lighting with high color rendering, high luminous efficacy of radiation, and warm color temperature. We will present the design, fabrication, integration and characterization of these nanophosphors based LEDs. Such colloidal quantum dots hold great promise for future solid state lighting.

(This work is supported by NRF RF, EU FP7 Nanophotonics4Energy NoE, ESF EURYI, and TUBITAK109E002-1009E004.)

A-0291

LUMINESCENCE OF COLLOIDAL NAYF4 DOPED WITH DY3+ SYNTHESIZED VIA THERMAL DECOMPOSITION OF FLUORACETATES PRECURSORS

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There was a growing demand for highly emitting and efficient nano luminescence materials during the last decades. A significant role was found for the wide band gap materials, mainly the fluorides, which have become an important field of study. These wide band gap materials offer excellent transparency in the range from infrared (IR) to far ultraviolet (UV) and low-energy phonons. These materials play a significant role as upconverting nanoparticles, which are extremely attractive for a large variety of applications, in the field of emissive displays, solar cells, bio imaging and for disease detection and diagnostics. Here, we report on the synthesis and luminescence properties of colloidal sodium yttrium fluoride $NaYF_4$ nanocrystals doped with Dy^{3+}. The luminescent host has been obtained via thermal decomposition of the sodium trifluoroacetate and lanthanide trifluoroacetate precursors. The noncoordinating, high-boiling solvent octadecene was selected as the growth medium for the nanoparticles. Oleic acid was employed as the surfactant, which attached to the particle surface during the crystal growth and kept the nanoparticles well-separated from each other. Nanocrystals of Dy^{3+} doped NaYF4 in the range of 8-30 nm were obtained. High Resolution Transmission Electron Microscopy (HRTEM) was used to evaluate the morphology and particle size distribution (PSD) of the prepared NaYF4: Dy^{3+} nanoparticles. The structural (XRD) and of spectroscopic properties of Dy^{3+} doped NaYF4 samples have been determined based on the excitation spectra, emission spectra and luminescence decay curves recorded at temperatures between 4.2 K and 300 K in the UV-Vis spectral regions.

A-0292

FABRICATION, CHARACTERIZATION AND TESTING OF THE THERMALSTABILITY OF ZNO-BASED SCHOTTKY ULTRAVIOLET PHOTODETECTORS

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The article reports fabrication, characterization and testing of the thermal stability of ZnO-based Schottky ultraviolet photodetectors. The ZnO thin film was grown on p-type Si ‹100 › substrate by sol-gel technique. The surface morphological and the structural properties of the thin film were studied by atomic force microscope (AFM) and scanning electron microscopy (SEM). For the investigation of the surface chemical bonding, X-ray photoelectron spectroscopy (XPS) measurements were also performed. The I-V characteristics of the Schottky barrier photodetector were studied and the parameters such as ideality-factor, leakage-current, turn on voltage and barrier-height were extracted from the measured data at room temperature were found to be 6.7, 2.26 $\times 10^{-8}$ A, 0.5V and 0.7354 eV respectively. With applied bias voltages in the range from -3V to 3V the contrast-ratio, responsivity, detectivity and quantum-efficiency of the photodetector were found to be 8, 0.21 A/W, 1.45×10^{9} mHz^{½}W^-1 and 72% respectively. The optical performance were measured for an incident optical power of 0.1mW at 365nm wavelength. The electrical and optical study revealed that the performance of the device improves with increasing post metal deposition annealing temperature up to 100 degree C. The device exhibited excellent thermally stability in the annealing temperature range of 100 degree C to 200 degree C. For annealing temperature beyond 200 degree C the performance of the device degrades drastically. It was also found that under 200 degree C there is a harmonious relation between the optical and electrical characteristics of the device. Above this annealing temperature there is no correlation between the variations of optical and electrical characteristics with increasing annealing temperature. The variation of the electrical and photoresponse properties of Schottky photodetector subjected to different post fabrication annealing can be attributed to combined effects of interfacial reaction and phase transition during the annealing process.

A-0293

MICROSCOPIC SIMULATION OF SEMICONDUCTOR LASER DEVICES

Stephan W. Koch

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This talk presents an overview of the microscopic theory used to quantitatively model and design a wide range of semiconductor laser gain materials. Detailed theory-experiment comparisons are shown and it is analyzed how the theory can be used as a quantum design tool for modern laser systems. It is demonstrated how the systematic design, growth and experimental realization of VECSELs (vertical external cavity surface emitting lasers) led to world record performance of the realized devices.

This work presents the results of an ongoing collaboration with the groups of J. Moloney (Tucson/AZ) and W. Stolz (WZMW Marburg)

A-0294

NOVEL III-V SEMICONDUCTORS FOR NEXT GENERATION PHOTONIC DEVICES

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In spite of their importance in optical communications systems, InP-based semiconductor lasers operating in the 1.3-1.6um range suffer from high threshold currents and a large sensitivity to temperature, requiring the use of energy-demanding temperature stabilisation electronics. The cause of this behaviour has been the subject of considerable debate. Previous works have shown that Auger recombination processes (e.g. CHSH) and inter-valence band absorption involving transitions to the spin split-off (SO) band dominate the threshold current of InP-based lasers around room temperature. Further work has shown that antimonide-based lasers operating between 2 and 3um have lower threshold currents and a reduced sensitivity to temperature. This is due to the large spin-orbit splitting in antimonide-alloys (such that the SO splitting is larger than the band gap) which suppresses such losses. While conventional GaAs and InP-based alloys provide band gaps suitable for laser emission in the near-IR, the valence band structure enables losses to persist. The SO-splitting is strongly dependent on the group V element atomic number and Bismuth is the largest stable group V element. Hence, novel Bismuth containing alloys (e.g. GaAsBi/GaAs) can offer a large SO-splitting. Also, due to valence band anti-crossing, as observed in GaAsBi, the incorporation of Bismuth offers the potential of narrow gap materials with large spin-orbit splitting. For Bi fractions ~10% we show that a preferential band structure may be formed offering lasing in the telecoms band (and beyond) whilst suppressing the losses which dominate conventional InP and GaAs based lasers, offering the potential for efficient, uncooled sources. Further advantages of this new material system and related alloys will be outlined in more detail at the conference.

A-0295

SUB-MICRON SILICON PHOTONIC DEVICE STRUCTURES

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As the device density and communication bandwidth of CMOS devices steadily increases, optical interconnects have emerged as a possible solution to the heating and energy loss obstacles being encountered by copper interconnects. Silicon photonics using waveguides which are sub-micron in size offers the possibility of realizing optical interconnects that can be fabricated using existing infrastructure and standard CMOS processes. However, silicon has the disadvantage of being an indirect bandgap material and therefore is not well-suited to the optical detection functionality needed to incorporate receivers into an optical link, particularly at the standard telecommunication wavelengths for which this is most desirable. This problem can be circumvented, however, by introducing damage into the silicon crystal lattice in order to enable defect-enhanced sub-band detection. In this talk we describe some of the results we have achieved with this approach for integrating detectors with variable optical attenuators for channel leveling and with ring resonators for enhanced sensitvity.

A-0296

A SIMPLE PATHWAY TO ACHIEVE EFFICIENT ORGANIC LIGHT EMITTING DIODES

Zhibin Wang, M. G. Helander, M. T. Greiner, J. Qiu, Z. H. Lu
University of Toronto

It is found that the device performance of organic light emitting diodes (OLEDs) can be significantly improved by eliminating the hole accumulation at organic/organic interfaces. By using a hole transport material with a very deep highest occupied molecular orbital (HOMO) as a single layer hole transport layer (HTL) a dramatically improved device efficiency even at high luminance was achieved. The direct hole injection into HTL's with deep HOMO was accomplished using high work anodes. This simple design strategy is also applicable to other OLED structures, such as phosphorescent devices. It is envisioned a simple pathway to achieve high performance OLEDs, particularly for applications at high luminance such as solid state lighting.

A-0297

ULTRAFAST ALL-OPTICAL SWITCHING AND DISPERSION OF THE PROTEIN BACTERIORHODOSIN

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It is generally believed that all-optical data processing is the most promising direction to achieve serious improvement both in capacity and speed of internet data traffic. One of the bottlenecks of the state-of-the-art photonic integration technology is to find the proper nonlinear optical (NLO) materials that are supposed to be a cladding medium in waveguide-based integrated optical circuits performing light-controlled active functions. Recently the unique chromoprotein, bacteriorhodopsin (bR) was proposed to use as an active, programmable NLO material in all-optical integrated circuits. Upon illumination it transports protons across the membrane, while undergoing a cycle of reactions with quasi-stable intermediate states. All the intermediates are also light sensitive, that is, upon a second excitation they rapidly return to the ground state (BR). For almost all of the applications of bR it is crucial to have precise knowledge of its absolute refractive index as well as the light induced refractive index change. In this paper we explore the refractive index changes accompanying the excitation of BR to the first transition states I and K, which makes possible even sub-ps switching, leading beyond Tbit/s communication rate. The dispersion and refractive index of bR is also measured at high accuracy with the use of spectrally and spatially resolved interferometry. In the experiments the direct pulses of a femtosecond laser system at 800 nm were used along with the additionally generated ultrafast laser pulses at 530 nm. We believe that the results may be the basis for the future realization of a protein-based integrated optical device, and represent the first steps to a conceptual paradigm change in optical communication technologies.

A-0298

PHOTOLUMINESCENCE OF EUROPIUM DOPED LIINO2 POWDER

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Double oxides of indium might comprise a new family of high density (≥ 6 g/cm^3) scintillators and phosphors. They have short distances from cation to surrounding oxygen ions which favors high light output. Indium background β- (495 keV maximum) decay rate per mol is ca. 316 times lower than in natural lutetium containing radioactive 176Lu, and therefore can be used in nuclear applications requiring large volume of scintillator, as well as for detection of low energy solar neutrinos.

In this report we show simple solid-state procedure for preparation of LiInO2:Eu^{3+} powders. X-ray diffraction confirmed product in tetragonal structural form (space group: I41/amd) and no impurity phases were detected. Then, high resolution photoluminescence emission measurements were performed at room and low temperatures to find 5D0 →7FJ and 5D0 →7FJ transitions and to evaluate energy levels. Emission kinetics from 5D0 level exhibited pure single exponential behavior with lifetime of about 1.2 ms. M

A-0299

SB2S3-SENSITIZED INORGANIC-ORGANIC HETEROJUNCTION SOLAR CELLS

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Dye-sensitized solar cells (DSSCs) are considered to represent low-cost alternatives to conventional inorganic devices. The use of inorganic semiconductors as sensitizer in place of a dye in DSSCs offers several advantages: excellent optical properties, which can be tuned by controlling the semiconductor dimensions, a high extinction coefficient, and a large intrinsic dipole moment. Thus, inorganic semiconductor-sensitized solar cells bring new hopes to make a breakthrough for the next-generation solar devices. In this letter we report solid-state inorganic-organic heterojunction solar cells by depositing Sb_2S_3 onto mesoporous-TiO_2 as a sensitizer and poly(3-hexylthiophene) (P3HT) as a hole conducting dye. These inorganic-organic light harvesters perform remarkably well with maximum incident photon-to-current efficiency (IPCE) of 80%, and power conversion efficiency of 5.13% under air-mass 1.5 global (AM 1.5G) illumination of 100 mW cm-2 intensity. To the best of our knowledge, this is the highest value reported so far for inorganic semiconductor-sensitized solar cells.

A-0301

ENHANCED LIGHT-MATTER INTERACTION WITH PHOTONIC NANOSTRUCTURES

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Many areas of Photonics are concerned with enhancing optical fields and the interaction between light and matter. The challenge is to overcome the typically weak interaction, which is often addressed by employing strong laser fields. A far more elegant solution is to use photonic nanostructures that enhance fields locally, thus providing strong light-matter interaction for low pump powers. Slow light photonic crystal waveguides offer this opportunity [1].

The key to exploiting this opportunity is dispersion engineering. The uniform lattice of a photonic crystal is fully described by the lattice constant and the radius of the holes, so it seems rather limited in scope; the design of a waveguide structure, however, offers far more degrees of freedom than appears at first sight, because its properties can be tailored widely by shifting holes and adjusting their size locally. Using this method, we have demonstrated group indices up to ng=100 while maintaining an operating bandwidth of several nanometres in wavelength [2]; being able to provide such large enhancements with considerable bandwidth is a major advantage of the slow light approach and it has allowed us to observe third harmonic generation (THG) in silicon [3] as well as using the same process for optical signal monitoring at bandwidths up to 640 Gbit/s [4]. Another promising aspect of slow light waveguides is the fact that they enable efficient adiabatic frequency conversion, and we have recently observed efficient blue-shifting over ≈3nm with >80% conversion efficiency [5]. Similar techniques apply to cavities, and by locally adjusting the size and position of the holes, we have been able to demonstrate cavities in the slotted waveguide geometry that allows us to concentrate most of the optical field in air [6], or to adjust the far-field radiation of a cavity such that it can easily be fibre-coupled. In conclusion, it is clear that many routes of exploration are still available with photonic crystals based on the rich variety of possible lattice modifications.

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A-0302

ORDERED AND DISORDERED BIOLOGICAL AND BIOMIMETIC PHOTONIC NANOARCHITECTURES

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Photonic nanostructures, i.e. materials with optical properties changing on the submicron scale, exhibit a broad range of optical phenomena: coloration, iridescence, photonic band gap, polarization, diffraction, total reflection, etc. These materials have many existing and potential applications in technology, e.g. in communication, signal processing, computing, and as ecological freindly colorants. In order to construct a macroscopic device from photonic nanostructures, it is necessary to build a nanoarchitecture from the individual nanostructures. One simple and theoretically much studied example is the photonic crystal, a photonic nanoarchitecture with long range order. Biological evolution created photonic nanoarchitectures in living organisms more than 500 Million years ago, these give the so called structural (not pigmentary) colors of living organisms. Most spectacular examples are in butterflies and beetles, but structural colors are also present on birds, mammals, and even in plants. Because of their very biological origin these photonic nanoarchitectures are never perfect, they always contain more or less randomness. As it was shown by our extensive experimental and theoretical examination of such structures, biological nanoarchitectures are structured over several orders of magnitude and show a huge variety of optical phenomena. Multilayer structures, i.e. one dimensional photonic nanostructures with photonic band gap in the visible are widely used in science and technology, but the manufacturing of large size two- and three dimensional photonic nanostructures remains a technological challenge. Therefore the natural design principles may help in finding new, bioinspired ways, different from the design principles of man-made nanoarchitectures most frequently composed of building blocks of regular shape arranged in a perfect crystalline order. Hence the study of biological nanoarchitectures is an important source of ideas for technological applications, leading to the development of biomimetical and bioinspired materials.

A-0303

TEMPERATURE SENSITIVE VISIBLE AND NEAR-INFRARED LUMINESCENCE OF ERBIUM IONS IN LIYF4 CRYSTAL

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The erbium ion is used as dopant in several laser host materials showing a wide range of luminescent transitions from 500 to 3000 nm. Lasing has been obtained for 550, 850, 1230, 1540, and 2740 nm emissions. Broad photoluminescence (PL) bands are observed at about 370, 400, 440, 485, 520, 650, 850, 1000, 1220, and 1500 nm. We studied the temperature dependence of these PL bands in LiYF4 crystal doped with 1.0% erbium ions at 296-12 K. Each of these bands consists of several sharp lines. The intensity of lines at high energy side in each band decrease with decreasing temperature from 296 K to 12 K, while several emission lines at high energy side are almost constant. This is observed for all the emission bands. The observed temperature dependence is explained by the thermal population in the excited states that consist of many crystal-field-split sublevels. The population is sensitive to not only the radiative and non-rediative multi-phonon relaxations from the upper states but also the radiative and non-rediative multi-phonon relaxations to the lower states. Besides the temperature dependence of the PL bands, we investigated the PL quantum efficiency for the visible emission bands under the various excitations at room temperature. The efficiency of an emission band was found to depend on excitation wavelength. For example, the 550 nm emission band has efficiency of 0.067, 0.086, 0.175, and 0.019 by excitation at 253, 354, 376, and 448 nm, respectively. The 484 and 518 nm excitations give the same efficiency as the case of the 448 nm excitation. The efficiency measurement clarifies the selective relaxation processes after excitation into an excited state.

A-0304

A GENERALIZED RULE OF AVERAGE FOR THERMOLUMINISCENCE OF TERNARY IONIC CRYSTALS

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The anion composition dependence of the characteristic glow peak temperature of europium doped $KC_{l0.50}KBr_{0.25}RbX_{0.25}$:$Eu^{2+}$ (X=Cl, Br) mixed crystals are studied. Each material shows a thermoluminescence glow curve consisting of two main glow peaks whose temperature is between that of KCl:Eu^{2+} and KBr:Eu^{2+}. The most intense is related to the F center destruction as occur in the case of KCl:Eu^{2+} crystals and its characteristic temperature depends strongly on the halogen composition. This behavior confirms that the temperature of the F-H center recombination in this type of materials depends more on the proportion of anions. From these results, a generalized rule to obtain the temperature from averaging the characteristic temperature as function of the composition is discussed.

A-0305

THERE IS LIGHT AT THE BOTTOM

Norbert Kroó
Hungarian Academy of Sciences

One of the beauties of plasmonics is that some of the properties of surface plasmons (SPO-s) are completely different from those of ordinary light. This is the basis of the avalanche-like increase of interest in phenomena, characteristic of plasmonics. SPO-s are offering a gold mine for research. The absence of the diffraction limit, the strongly bending energy-momentum dispersive curve, the huge electric fields near the surface, the potentially existing forbidden energy gap, the localization of SPO-s around nanometer sized particles or irregularities, the specific nonlinear phenomena or even non-classical behavior of SPO-s are expected to open a wide range of potential applications in information technologies, biology, medicine, nanotechnology, etc.

Nonlinear plasmonics is one of the fields of broad interest, since due to the strong enhancement of electric fields by surface plasmons, nonlinear phenomena can be studied and applied at significantly lower exciting laser powers than those applied to realize nonlinear response in ordinary optics.

In order to illustrate the above listed properties of SPO-s some of our experimental and theoretical findings are described having linear or nonlinear, classical or quantum character. In order to complete the picture some findings of other authors are also described.

In addition to quasi-stationary phenomena short, femtosecond laser pulse excited SPO-s are also analyzed including SPO mediated electron emission.

A-0306

SYNTHESIS OF EU^{2+} DOPED A-SITE AND OXYGEN DEFICIENT PEROVSKITE HOST FOR PHOTO LUMINESCENT MATERIALS

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Perovskite related compounds have been investigated in wide area of fields like ferroelectrics, magnetics, optics, phosphors, superconductors, catalysts, etc., because they have various but unique properties due to their compositions and structures which are characterized by the various combinations of A and B cations. In addition, defect perovskite-type compounds have been also investigated in wide area, especially ion conductor. In this study, we apply the A-site and oxygen deficient Perovskite, Sr3Al2O6, for photo luminescent host material. It means the defect sites were able to substitute several ions.

We investigate (Mg, Ca, Sr, Ba)$_3$Al$_2$O$_6$:Eu^{2+} phosphor material by solid state reaction in several kinds of atmosphere. In our result, the phosphor shows wide excitation and emission band 300-400nm and 450-600nm, respectively. The emission colors could control depends on A-site substitution ratio. It is very useful phosphor for white LEDs.

A-0307

NEW WORK PROGRAMME FOR PHOTONICS IN EU

Markus Korn
EC, Brussels, Belgium

The new ICT Work Programme (WP) 2011-2012 in the context of the EU Framework Programme 7 has been adopted and published recently. The presentation will give detailed insight in the structure and timing of the WP for the area Photonics and Organic Electronics. The talk will also explain, which topics will be called for and which specific requirements are to be addressed to have a realistic chance to submit a successful proposal.

A-0308

OPTICAL ABSORBTION AND POTOLUMINESCENCE OF LUMONOPHORE NANOCOMPOSITES

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Nanocomposites (NC) based on polymers and coordinate complex organic compounds of rare earth metals are excellent materials for a new generation of light emitting devices with high efficiency due to strong luminescence, easy color tunable, temperature insensitivity, and high stability.

The Europium complex tris(dibenzoylmethane)(monophenanthroline)europium(III) ($Eu(DBM)_3Phen$) was successfully incorporated with different molar ratios into organic copolymer matrix of styrene:butylmethacrilate (1:1) (SBMA) via sol–gel process. Spin-coated thin films were obtained. The layers turn out to be transparent in optical range of investigation. Absorption and luminescence properties of a Europium complex on each step of technology nanocomposites of the pure $Eu(DBM)_3Phen$ complex powder, its solution with SBMA and the resultant thin films nanocomposites (NC) phosphors (SBMA-$Eu(DBM)_3Phen$) were investigated. The microscopic investigations of the morphology of the NC surface show that the dimensions of $Eu(DBM)_3Phen$ particles, incorporated in the polymer matrix are less than 100 nm. The forbidden bands of NC were obtained. Photoluminescence (PL) spectra have been measured exciting with N_2-laser ($\lambda = 0.334$ μm) and they were revealed the radiative bands between the energy levels of the Europium ions centered at 578, 590, 615, 652, and 705 nm and can be attributed to the spin forbidden f-f transitions $^5D_0 \rightarrow {}^7F_i$ (i = 0,1,2,3 and 4), respectively [1]. The comparison of NC and organic coordinated compounds PL at equal ultraviolet exciting are showing the increasing of the external efficiency of NC luminescence. In nanocomposites, the effect of energy transfer from polymer matrix to coordinated molecule with subsequent transfer of them to ion Eu^{+3} have been identified. The detail analysis of the energy transfer has been given. We concluded from the shape of the PL spectrum of NC photoluminescence that non-radiative transition of the energy transfer to Eu^{+3} ion has place. We proposed some applications of given nanocomposites in optoelectronics and medicine.

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A-0309

TECHNOLOGY OF MIXED AMORPHOUS $AS_2(S_XSE_{1-X})_3$ FROM CHEMICAL SOLUTIONS AND OPTICAL CHARACTERIZATIONS

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Photosensitive materials of amorphous chalcogenide semiconductors of mixed structure $As_2(S_xSe_{1-x})_3$ are widely applied in optoelectronics as media for registration of optical and holographic information in various areas of a science and technique, e.g., in microlithography.

Usually, the maximal sensibility of the recording of holographic information in $As_2(S_xSe_{1-x})_3$ is attained at various lengths of waves in dependence of x. It is hence necessary to determine x for given wavelengths to have such material. To obtain such composition, high costly vacuum technologies and high temperatures are used, e. g., vacuum thermal deposition or chemical deposition from mixed composition of amorphous $As_2(S_xSe_{1-x})_3$.

In our case, the mixed compound $As_2(S_xSe_{1-x})_3$ was obtained on the base of dissolution of amorphous binary compounds As_2S_3 and As_2Se_3 each taken separately in organic solvents: diethylamine or monoethanolamine. Then solutions were mixed in necessary ratio to obtain the given compound $As_2(S_xSe_{1-x})_3$. Deposition on plate of silica glass was carried out by spin-coating or drop-coating methods. The homogeneous and transparent layers with periodically reflection of a layer were obtained by drying. The thickness of the films after drying has been from 0.5 to 10 μm.

The optical absorption of thin films $As_2(S_xSe_{1-x})_3$ was investigated in the range of spectrum 0.3 – 3 μm for different quantity of x and doses of ultraviolet (UV) irradiation. The dependence of optical absorption from energy in coordinates $\alpha(h\nu)^{1/2}$ - hv by extrapolation $\alpha^{1/2} \rightarrow 0$ for all researched concentration gives the magnitude of the edge of optical absorption (Eg) which correspond to E_g of $As_2(S_xSe_{1-x})_3$ films obtained by thermal deposition in vacuum.

The UV irradiation of samples during 20 min has revealed the following. At the initial moment some enlightenment (shift of absorbance to UV part of spectrum) takes place but later during irradiation it is replaced by more significant photodarkening (are inverse shift). In range of energy less than Eg, the darkening (increasing of absorption) takes place always. For the constant wavelength, the increasing of As_2S_3 concentration in $As_2(S_xSe_{1-x})_3$ lead to the increasing of darkening. In the Table, characteristic dates are shown obtained experimentally from absorbance of $As_2(S_xSe_{1-x})_3$ both as grown layers and layers after irradiation with ultraviolet light with equal dose. The maximal photosensitivity (α/α_o) are atained on $x = 0.43$, where α_o is the absorbance of as-deposition layers and α is the absorbance one after UV irradiation.

[2] A.M. Andrieş, S.A. Buzurniuc, M.S. Iovu, V.I. Verlan. Invention nr. 5539. Deposited on AGPI Moldova, 2007-0147, deposit on 2007.05.23, The positive decision on 2008.04.29.

Notes

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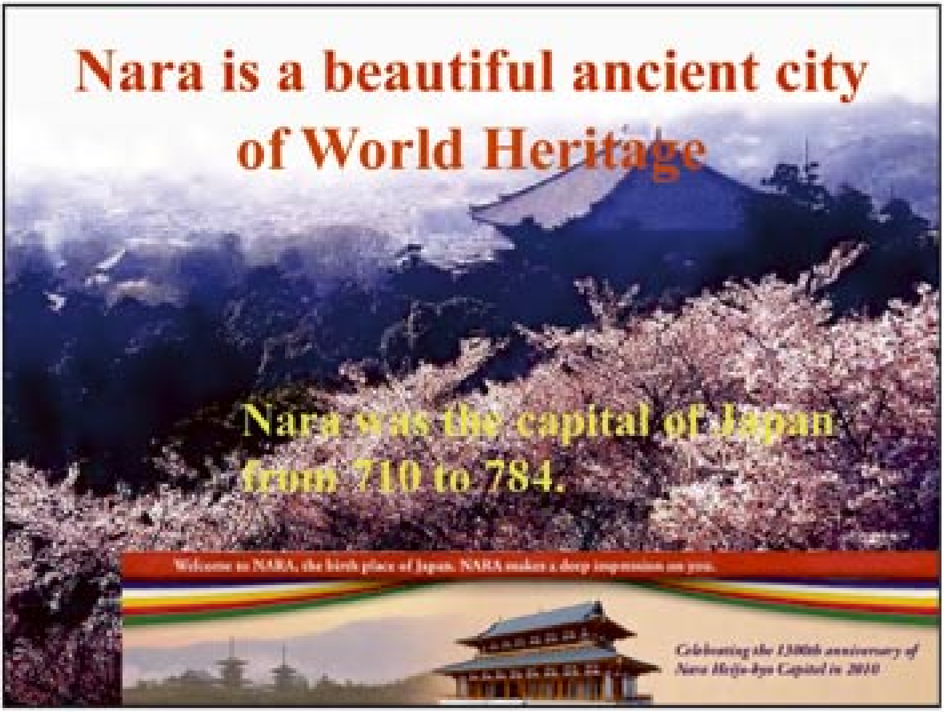

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