International Student Workshop on Laser Applications 2010

ISWLA'10

CONFERENCE PROGRAM

Bran, Romania
May 25-28, 2010

ORGANIZED BY:

Institute for Atomic Physics SPIE Student Chapter &

INFLPR OSA Student Chapter

NILPRP – National Institute for Laser, Plasma and Radiation Physics

CO-ORGANIZING CENTERS:

CSET – Center for Science and Education

SPIE – International society for optics and photonics

INOE- National Institute of Research & Development for Optoelectronics

University of Bucharest - Faculty of Physics

SRF – Romanian Society of Physics

ARFO – Romanian Association for Photonics

Yerevan State Univ. Chapter – Armenia

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Welcome to "ISWLA'10"

We are pleased to host the first edition of the workshop ISWLA '10 – International Student Workshop for Laser Applications 2010 (http://iswla10.inflpr.ro) organized by students, mainly for young researchers (MS and PhD students) but for undergraduate students, as well. The organizing body consists of members of SPIE Romanian Student Chapter (http://spie.inflpr.ro) recognized by the SPIE board in 2001. Since 2004 the participation of the elected president of the chapter every year at the SPIE Annual Meeting represented a good opportunity to be in contact with representatives from other chapters, to change information and experience and establish collaborations with researchers from other countries. In this conference we welcome the participation of students from Armenia, Poland, Russia and Ukraine. The close contacts with the representatives from SPIE board, the visit of SPIE president James Bilbro and the executive director Eugene Arthurs in 2004 in Bucharest and the meeting with Romanian students was important to enhance the professional consciousness and encouraged students to approach new challenges as participation in conferences sponsored by SPIE and the organization of a conference.

Undergraduate students from University Bucharest and "Politehnica" University joint the SPIE Chapter, as well, and this was a benefit, because of the closer contacts between young scientists and undergraduate students. We consider this useful for the future career decisions, as thinking at the opportunity to participate in projects funded by the international bodies. In the last years, since 2004 the investment in research allowed to improve the endowment in the laboratories and use mobilities to improve the professional level of young scientists. The organization of the conference was possible due to the moral and material support offered by SPIE Chapter Directorate for developing Chapter activities, to the support of the main research institutes from the Physics Platform Magurele: the National Institute for Laser, Plasma and Radiation Physics, National Institute for Optoelectronics, Faculty of Physics - University Bucharest, and the National Authority for Scientific Research of the Ministry of Education and Research. We are grateful as well for support to Prof. Sabina Stefan from Faculty of Physics, University of Bucharest, to ARFO – Romanian Association for Photonics, SRF Romanian Society for Physics, CSET – Center for Science Education and Training and "Radiatia Trade Union". We would like to mention the support offered by the laboratories heads, which encouraged students to present the results of their research and surveyed the preparation of the manuscripts and presentations.

We hope that the large topics are favoring the large participation of students, the information exchange and establish new contacts and collaborations. We are thinking at the new project supported by EU the development of the pan European ELI project- Extreme Light Intensities in which Romania is one of the partners.

This is a pleasant duty to mention the hard work of Laura Mihai, the leader of the organizing committee and ex elected SPIE Romanian Chapter president, who coordinated with authority but in a friendly manner the distribution of responsibilities among the members of the team: Silviu Popescu and Daniel Rizea who organized the web site, Viorel Nastase, Mihai Boni, Radu Stancu, Flavia Frumosu and Ruxandra Cojocaru involved in all the steps of the organization.

For me, as advisor of the student chapter is a high satisfaction to notice their initiative spirit, the ability to manage and control unexpected situations, the large openness to cooperate. This means that this new experience of my young colleagues show that they really have qualities as researchers and make me positive to believe that they will manage well in all the future projects.

Finally I hope that the attendees will enjoy this conference both for the opportunity to present their results and also for the social program and surprises of the organizers.

Be welcome and enjoy this participation!

Dr. Clementina Timus
Conference Advisor

Scientific Committee

Prof. **Michael ALLEY**	Penn. State University/SPIE Instructor
Dr. **Dan APOSTOL**	NILPRP
Dr. **Razvan DABU**	NILPRP / 3EU ELI - Project Coordinator
Dr. **Traian DASCALU**	NILPRP Deputy Director
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Md. Dr.**Katarina SVANBERG**	Lund University / Department of Oncology / SPIE trainer
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Advisor: Clementina Timus

Coordinator: Laura Mihai

Local Organizing Committee

Viorel Nastasa

Mihai Boni

Radu Stancu

Flavia Frumosu

Catalin Constantinescu

Ruxandra Cojocaru

Web design:

Silviu Popescu

Daniel Rizea

Conference Schedule

MONDAY 24 MAY, 2010		
	16:00	Registration Desk Open
	19:30	Welcome Party

TUESDAY 25 MAY, 2010		
	08:00	Registration Desk Open
		Breakfast
	09:00	Conference Opening
Course 1	09:30	**„The Craft of Scientific Presentations" – Part 1 –** Prof. Michael Alley, Penn State University
	11:00	Coffee Break
	11:20	**„The Craft of Scientific Presentations" – Part 2 –** Prof. Michael Alley, Penn State University
	13:00	Lunch
Course 2	14:00	**„The Craft of Scientific Writing" – Part 1 –** Prof. Michael Alley, Penn State University
	15:45	Coffee Break
	16:15	**„The Craft of Scientific Writing" – Part 2 –** Prof. Michael Alley, Penn State University
	18:00	Free time
	19:30	Dinner

WEDNESDAY 26 MAY, 2010		
	08:00	Breakfast
Plenary Session	09:00	**Plenary Session: Laser Review** – Acad. Voicu Lupei – Romanian Academy, NILPRP
Session 1 –Medical Applications	09:40	**Invited Lecture – Diagnostics and Treatment of Tumours using Laser Techniques** – Prof. Katarina Svanberg, Department of Oncology, Lund University Hospital/ Lund University Medical Laser Centre- Lund, Sweden
	10:20	**Physico-chemical properties of sucrose thin films for biomedical applications -** S.L. Iconaru[1], D. Predoi[1], A. Costescu[1], A.M. Prodan[2]- [1]National Institute of Materials Physics, P.O.Box MG-7, Magurele, Bucharest, Romania, [2]Department of General Surgery, Emergency Hospital, Bagdasar-Arseni, Bucharest
	10:40	**Application of silver-doped nanomaterials for enhancing the efficiency of photodynamic diagnosis** - Pucińska Joanna[1], Kopaczyńska Marta[1], Ulatowska-Jarża Agnieszka[1], Wysocka-Król Katarzyna[1], Podbielska Halina[1]- [1]Bio-Optics Group, Institute of Biomedical Engineering and Instrumentation, Wrocław University of Technology – Wrocław, Poland
	11:00	Coffee Break

Session 2 –Lasers in life sciences	11:20	**1060 nm central wavelength swept source laser for OCT imaging –** Daniel Rumiński, Karol Karnowski, Michalina Góra, Maciej Wojtkowski, Andrzej Kowalczyk – Institute of Physics, Nicolaus Copernicus University – Torun, Poland
	11:40	Invited Lecture **– IN VITRO studies of cerebral tissues by laser induced autofluorescence –** Mihail – Lucian Pascu[1*], Alexandru Pascu1, Mihaela Oana Romanitan[2], Leon Danaila[3] - [1]National Institute for Laser, Plasma and Radiation Physics, Laser Department, Bucharest, [2]Neurology Clinics, Emergency University Hospital, Bucharest, [3]Neurosurgery Clinics, National Institute of Neurology and Neurovascular Diseases, Bucharest
	12:20	**Measurement of the modifications of polidocanol absorption spectra after exposure to NIR laser radiation** - Adriana Smarandache[1*], M. Trelles[2] and M.L.Pascu[1]- [1*] National Institute for Laser, Plasma and Radiation Physics, Laser Department, Bucharest, Romania, [2] Instituto Médico Vilafortuny/Fundacion Antoni De Gimbernat, Cambrils, Spain
	12:40	**Towards obtaining qualitative and quantitative spectroscopic information of scattering media with the use of Spectral OCT-** Szymon Tamborski, Danuta Bukowska, Ireneusz Grulkowski, Maciej Szkulmowski, Andrzej Kowalczyk and Maciej Wojtkowski - Institute of Physics, Nicolaus Copernicus University - Torun, Poland
	13:00	**Investigations about the production of micro and nano-droplets starting from immiscible solutions-** V. Nastasa[1*], Andra Militaru[1], T. Karapantsios[2], M. Ferrari[3], K. Samaras[2], E. Dafnopatidou[2] , I. R. Andrei[1], L.Ligieri[3], V. Pradines[4], R. Miller[4], M. L. Pascu[1]- [1]National Institute for Laser, Plasma and Radiation Physics Bucharest, Romania, [2]Department of Chemistry, Aristotle University of Thessaloniki, Greece, [3]CNR- Institute for Energetics and Interphases, Via De Marini 6, I-16149 Genova, Italy, [4]Max Planck Institute for Colloids and Interfaces, Potsdam, Germany
	13:20	Lunch
	14:30	Medieval Trip
	19:30	Dinner

THURSDAY 27 MAY, 2010		
Session 3 – Micro- and nano - Technologies	08:00	Breakfast
	09:00	**Invited Lecture - Progress in high power ultrashort pulsed laser systems –** Dr. Razvan Dabu - 3EU ELI - Project Coordinator, NILPRP- Bucharest, Romania
	09:40	**Invited Lecture - Micro- and nano-processing with ultrashort laser pulses –** Zamfirescu, Marian[1]; Ulmeanu, Magdalena[1]; Jipa, Florin[1]; Rusen, Laurentiu[1]; Neagu, Liviu[1]; Anghel, Iulia[1]; Radu Catalina[2]; Ionita, Iulian[2]; Luculescu, Catalin[1]; Moldovan, Antoniu[1] and Dabu, Razvan[1] – [1]National Institute for Laser Plasma and Radiation Physics, Magurele, Romania, [2]University of Bucharest, Faculty of Physics, Măgurele, Romania
	10:20	**Soliton waveguides arrays in lithium niobate-** S. T. Popescu[1*], A Petris[1], V. I. Vlad[1], E. Fazio[2]- [1]Natl. Institute for Laser, Plasma and Radiation Physics, Dept. of Lasers, Bucharest-Magurele, Romania, [2]University "La Sapienza" of Rome, Dept. of Energetics, Italy
	10:40	**Interdigital capacitors fabricated by femtosecond laser ablation**, Radu,Catalina[1], Rusen, Laurentiu[2], Neagu, Liviu[2], Ion, Valentin[2], Amarandei, Luminita[3], Banciu, George[3], Zamfirescu, Marian[2]
	11:00	Coffee Break
Session 4 – Lasers in Environment Research	11:15	**Invited Lecture – Laser remote sensing in atmosphere science –** Doina Nicolae*, Emil Carstea*, Anca Nemuc*- *National Institute of Research and Development for Optoelectronics, Măgurele,Romania
	11:55	**Cloud height comparisons from SEVIRI and LIDAR-** Luminita Marmureanu*, Camelia Talianu*, Razvan Radulescu*, Jeni Vasilescu* - *National Institute of Research and Development for Optoelectronics, Magurele, Romania
	12:15	**Validity of LIDAR time series measurements-** Rădulescu, Răzvan-Cosmin[1] and Belegante, Livio[2], [1]Laser Remote Sensing Department - National Institute of R&D for Electronics and Optoelectronics, Măgurele, Romania, [2]Laser Remote Sensing Department / National Institute of R&D for Electronics and Optoelectronics, Măgurele, Romania
	12:35	**Aerosol imaging using a holographic method -** Ruxandra Cojocaru, M. B. Tanasescu, M. Mihailescu - "Politehnica" University from Bucharest , Bucharest, Romania
	13:55	Lunch
Session 5 – Laser Engineering	14:00	**Invited Lecture – Chaotic behaviour and control of a semiconductor laser –** Prof. Mircea Bulinsky, Faculty of Physics, University of Bucharest- Bucharest, Romania
	14:40	**Fast digital phase lock for external cavity diode lasers –** Mateusz Bawaj – Faculty of Physics, Astronomy and Informatics Nicolaus Copernicus University – Torun, Poland
	15:00	**Photonic crystal optoelectronic devices and circuits-** Radu-Florin Stancu – Applied Sciences Faculty, Politehnica Bucharest University, Bucharest, Romania

	15:20	**Analysis of in-plane rotational dynamics for photoisomerisable (DCM) and non-photoisomerisable (NR) molecules in PMA matrix –** Kordas Wojciech[1], Dutier Gabriel[2], Pawlik Grzegorz[1] and Mitus Antoni[1], [1]Institute of Physics, Wroclaw University of Technology, Wroclaw, Poland, [2]Laboratoire de Physique des Lasers, Centre National de la Recherche Scientifique, Universite´ Paris, Villetaneuse, France
	15:40	**Characterization of chaotic emission of a laser diode for selective and unselective optical feedback produced by external reflectors-** Andrei, Ionut-Relu[1], Ticos, Catalin-Mihai[1], Bulinski, Mircea[2] and Pascu, Mihail-Lucian[1,2] – [1]National Institute for Laser, Plasma and Radiation Physics, Department of Lasers, Magurele, Romania, [2]University of Bucharest, Faculty of Physics, Bucharest, Romania
	16:00	Coffee Break
Session 6 – Laser in Education	16:15	**Invited Lecture** – **Outreach activities in optics and photonics –** Sporea, Adelina and Sporea, Dan - Center for Science Education and Training, National Institute for Laser, Plasma and Radiation Physics – Bucharest, Romania
	16:55	**Using laser physics in high school** - Cătălin Chițu[1-2], Alexandra Vintilă[1], Cătălin Măciucă[1], Laura Mihai[2,3], [1]Energetic High School, Câmpina, Romania, [2]University of Bucharest - Faculty of Physics, Bucharest, Măgurele , Romania, [3]Center for Science Education and Training, INFLPR, Bucharest, Romania
	17:15	**Laser audio transceiver/receiver on Mars community** - Garabet Mihaela[1,2], Neacsu Ion[2] and Munteanu Dragos[2,3] - [1]Faculty of Physics, University of Bucharest, Romania, [2]"Grigore Moisil" Theoretical High School, Bucharest, Romania, [3]Faculty of Automatic Control and Computer, University "Politehnica"of Bucharest, Romania
	17:35	**Albert Abraham Michelson – the master of light** - Kolenderska, Sylwia - Department of Physics Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University, 87-100, Toruń, Poland
Round Table	17:50	**Quo vadis scientific research? - Bridging expectations and economy needs –** Dr. Clementina Timus – RO SPIE Student Chapter Advisor, Dr. Dan Sporea – Director of Center for Science Education and Training, Prof. Sabina Stefan – Faculty of Bucharest, University of Bucharest
	18:30	**Discussions / Poster Session**
	19:30	Traditional Party

FRIDAY 28 MAY, 2010		
Session 7 – Advanced Materials	08:00	Breakfast
	09:00	Invited Lecture – **Advanced laser processing of soft materials -** Dinescu M.[1], Palla-Papavlu A.[1], Dinca V.[1], Shaw-Stewart J.[2], Mattle T.[3], T. Lippert[3], [1]National Institute for Lasers, Plasma and Radiation Physics, Magurele, Romania, [2]EMPA, Swiss Federal Laboratories for Materials Testing and Research, Laboratory for Functional Polymers, Dübendorf, Switzerland, [3]Paul Scherrer Institute, General Energy Research Department, Switzerland
	09:40	**Different microscopic characterization techniques on hydroxyapatite powder-** Aurora Anca Poinescu[1], Rodica Mariana Ion[2,3] Otilia Vasile[4], Raluca-Ioana van Staden[4], Jacobus Frederick van Staden[4], Marius Ghiurea[3], [1]Valahia University of Targoviste, [2]Valahia University of Targoviste, [3]ICECHIM, Bucharest, Analytical Department, Bucharest, Romania; [4]National Institute of R&D for Electrochemistry and Condensed Matter, Electrochemistry Laboratory, Bucharest, Romania
	10:00	Coffee Break
Session 8 – Laser Measurements and Control	10:20	Invited Lecture - **Romanian contribution to the EUROMET 156 project –** Sporea, Dan, and Sporea, Adelina – Laser Metrology Laboratory, National Institute for Laser, Plasma and Radiation Physics (NIPNE), Magurele, Romania
	11:00	**Evaluation of Optical Spectrum Analyser Best Measurements Capabilities –** Mihai, Laura and Sporea, Dan – Laser Metrology and Standardization Laboratory, National Institute for Laser, Plasma and Radiation Physics, Magurele, Romania
	11:20	**Investigation of the vibration damping using laser vibrometry-** Sporea, Dan[1], Dragomirescu, Cristian[2] and Frumosu, Flavia-Dalia[2], [1]National Institute for Laser, Plasma and Radiation Physics, Magurele, Romania, [2]University "Politehnica" of Bucharest, Bucharest, Romania
	11:40	Poster and Oral Presentation Awards
	12:00	Lunch
	13:00	Conference Closing

Session 1 – Medical Applications

INVITED LECTURE

Diagnostics and Treatment of Tumours using Laser Techniques

Katarina Svanberg

Department of Oncology, Lund University Hospital, Lund University
SE-221 85 Lund, Sweden
and
Lund University Medical Laser Centre, Lund University, S-221 85 Lund, Sweden
Katarina.Svanberg@med.lu.se

Applications of optical and laser spectroscopy to the medical field, including photodynamic therapy (PDT) and laser-induced fluorescence diagnostics (LIF) for cancer treatment and diagnostics, respectively, will be presented. Photodynamic therapy, when delivered as a superficial illumination to the target area, has a limitation due to restricted light penetration through tissue. One way of overcoming this is interstitial illumination (IPDT) in which the light is transmitted to the tumour via optical fibres. Interactive feed-back dosimetry is of importance for optimising the modality and such a concept has been developed and will be presented.
The most important prognostic factor for cancer patients is early tumour discovery. If malignant tumours are detected during the non-invasive stage, most tumours show a high cure rate of more than 90 %. There is a variety of conventional diagnostic procedures, such as X-ray imaging. More advanced results are given in computerised investigations, such as CT-, MRI- or PET-scanning. Laser-induced fluorescence (LIF) for tissue characterisation is a technique that can be used for monitoring the biomolecular changes in tissue under transformation from normal to dysplastic and cancer tissue before structural tissue changes are seen at a later stage. The technique is based on UV or near-UV illumination for fluorescence excitation. The fluorescence from endogenous chromophores in the tissue alone, or enhanced by exogenously administered tumour seeking substances can be utilised. The technique is non-invasive and gives the results in real-time. LIF can be applied for point monitoring or in an imaging mode for larger areas, such as the vocal cords or the portio of the cervical area. The possibility to combine LIF and PDT will be discussed and illustrated with clinical examples from many specialities, such as dermatology, gynaecology and laryngology.
A new method where free gas (oxygen or water vapour) in the human sinus cavities is detected will be described. The technique is based on gas absorption spectroscopy in scattering media. The method can also be used to study the gas exchange in between the nasal cavity and the different sinuses in the facial region.

Affiliation:
Katarina Svanberg, MD, PhD
Chief Consultant; Professor of Oncology
Lund University Hospital
Department of Oncology
SE-22185 Lund
Sweden

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PO1: Physico-chemical properties and cell proliferation on sucrose thin films for biomedical applications

S.L. Iconaru[1], D. Predoi[1], A. Costescu[1], A.M. Prodan[2]

[1]National Institute of Materials Physics, P.O.Box MG-7, Magurele, Bucharest, Romania,

[2]Department of General Surgery, Emergency Hospital, Bagdasar-Arseni, Bucharest

Tel: (+40) 0723093666, E-mail: simona.iconaru@infim.ro

***Keywords*:** sucrose thin films, vacuum deposition, osteoblast cells, biocompatibility

In this paper we present a part of the characteristics of sucrose thin films deposited on glass in medium vacuum conditions, as a part of a culture medium for fibroblast cells.

Sucrose is a natural osmolyte accumulated in cells of organisms as they adapt to environmental stress. The obtaining of uniform adherent thin films, deposited on different substrates, and having a good biological activity is representing now an important purpose in the field of biochemical research. The difference between biomaterials and passive materials (dielectrics) is mainly consisting in their specific biochemical function. The biomaterial transfer requires the preserve of molecular function. In vitro sucrose increases protein stability and forces partially unfolded structures to refold. Thin films of sucrose ($C_{12}H_{22}O_{11}$) were deposited on thin cut glass substrates by thermal evaporation technique (p~ 10^{-5}torr). Characteristics of thin films were putted into evidence by FT-IR (FTIR), X-ray Photoelectron Spectroscopy (XPS), scanning electron microscopy (SEM) and differential thermal analysis and thermal gravimetric analysis (TG/DTA). The experimental results confirm a uniform deposition of an adherent layer. The biological tests confirm the characteristics of sucrose thin films as bioactive material. Osteoblasts cells were used to determine cell proliferation and viability after interaction with sucrose thin films.

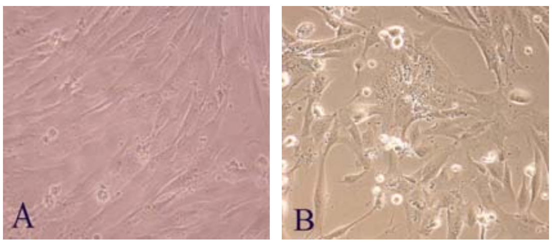

Figure 1: Micrographs in phase contrasts for hFOB 1.19 osteoblasts (objective 10x): A – control; B – S1.

On the powder, Differential thermal Analysis and Thermal Gravimetric Analysis were performed using the Shimatzu DTG-TA-50 and DTA 50 analyzer in the 25-800^{0}C temperature range, air environment.

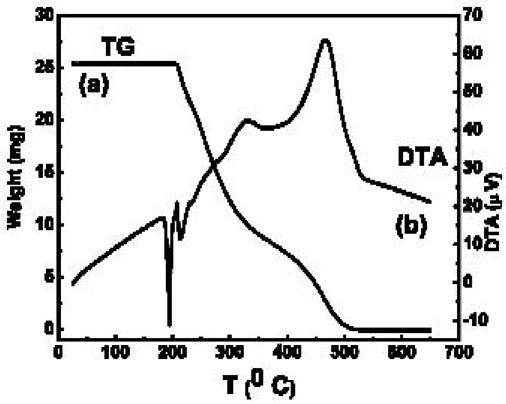

Figure 2.The DTA/TGA evolution curves for sucrose powder

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References :

M.*del C Luzardo, F. Amalfa, A.M., Nunez, S. Diaz, , A.C. Biondi de Lopez, E.A. Disalvo, "Effect of Trehalose and Sucrose on the Hydration and Dipole Potential of Lipid Bilayers" , Biophysical Journal, 78 (2000) 2452.*

Cioni, P., Bramanti, E., Strambini, B. G. ,"Effects of Sucrose on the Internal Dynamics of Azurin", Biophysical Journal, 88, 2005, p. 4213.

Ungureanu, F., Predoi, D., Ghita, R.V., Vatasescu-Balcan,R.A.,Costache, M.,"Characteristics of vacuum deposited sucrose thin films", Interface Controlled Organic Thin Films, Springer- Verlag Berlin Heilderberg, 2009, p 67.

Vatasescu-Balcan, R.A., Predoi, D., Ungureanu, F., Costache, M.,"Study of iron oxide nanoparticles coated with dextrin obtained by coprecipitation", JOAM, 10, No. 3, 2008, p. 693.

P. Aranda, M. Darder, R. Ferna´ndez-Saavedra, M. Lo´pez-Blanco, E. Ruiz-Hitzky,, "Relevance of polymer– and biopolymer–clay nanocomposites in electrochemical and electroanalytical applications", Thin Solid Films 495 (2006) 104 – 112

PO2: Application of silver-doped nanomaterials for enhancing the efficiency of photodynamic diagnosis

Pucińska Joanna[1], Kopaczyńska Marta[1], Ulatowska-Jarża Agnieszka[1], Wysocka-Król Katarzyna[1], Podbielska Halina[1]
[1] Bio-Optics Group, Institute of Biomedical Engineering and Instrumentation, Wrocław University of Technology, Wybrzeże Wyspiańskiego 27, 50-370 Wrocław, Poland

Keywords: nanomaterials, photodynamic diagnosis, fluorescence enhancement

Photodynamic diagnosis (PDD) is a method of tumor localization and determination of its stage. Administrated dye called photosensitizer accumulates prefentially in diseased tissue. Subsequently, areas of suspicion are irradiated with a light of certain wavelength. Fluorescence of irradiated dye accumulated in diseased tissue enables determination of pathological changes (Podbielska *et al.*, 2004). Photodynamic diagnosis enables to localize microlesions as well as solid tumors (Ladner *et al.*, 2001). An enormous advantage of photodynamic medicine is the possibility of diagnosis of superficial changes without breaking the skin continuity. Due to endoscopes and fiber optic catheters PDD also enables diagnosis of internal organs changes (Podbielska, *et al.*, 2004). Photosensitizers are usually derivatives of porphyrin, chlorin or phtalocyanine. One of them is Photolon, chlorin derivative, which is an example of photosensitizer that can be used to treat various oncological and non-oncological diseases. Photolon is also a hydrophilic compound which facilitates its intravenous application. In addition, absorption spectra of Photolon allow to use it for both photodynamic diagnosis and for photodynamic treatement (Ulatowska-Jarża *et al.*, 2005). However all photosensitizers currently used in PDT and PDD suffer from certain shortcomings, in example dark toxicity, prolonged photosensitization (Allison *et al.*, 2004). Reducing the amount of administrated dye and maintaining or even increasing treating efficiency at the same time would be crucial. It has been already shown that certain undesired pharmacokinetic properties of photosensitizer can be changed using nanotechnology. Our researcher goal was to synthesize nanoparticles that increase fluorescence intensity of Photolon. Providing those would allow us to decrease the concentration of administrated photosensitizer while maintaining the same diagnostic efficacy. Nanomaterial - silver-doped silica nanospheres - prepared by our group (Wysocka *et al.*, 2007) was examined of its influence on fluorescence intensity of Photolon.

A set of spectrophotometric measurements was conducted to determine the influence of prepared nanomaterials on fluorescence spectra of Photolon. The dye was excited by a laser light source of wavelength 415 ± 5 nm and maximal output power 200mW. The measurements were conducted for three solvents: distilled water, phosphate buffered saline (pH 7,4) and ethanol 96%. Experiment revealed that nanomaterials synthesized in our laboratory successfully increase fluorescence intensity of Photolon of a well-defined concentrations. Experiments conducted for a broad range of Photolon concentrations indicate that the inappropriate selection of photosensitizer's concentration and nanomaterial concentration can lead to decrease of fluorescence intensity. It has also been shown that fluorescence intensity of Photolon strongly depends on solvent type. In conclusion the addition of prepared nanomaterial in dye solution can successfully increase Photolon fluorescence. However the Photolon concentration as well as used solvent has a great impact on the result. In case of possible future clinical applications a well-defined dosimetry has to be obtained.

References:

Allison, R., Downie G., Cuenca, R., Hu, X., Childs, C., Sibata, C., Photosensitizers in clinical PDT, Photodiagnosis and Photodynamic Therapy, 2004, 27-42

Ladner, D., Steiner, R., Allemann, J., Haller, U., Walt, H., Photodynamic diagnosis of breast tumours after oral application of amino-levulinic acid, British Journal of Cancer, 2001, 33-37

Podbielska, H., Sieroń, A., Stręk W., Diagnostyka i terapia fotodynamiczna, Wydawnictwo Medyczne Urban & Partner, 2004

Ulatowska-Jarża, A., Binging, U., Podbielska, H., et al., Spectroscopic properties of a chlorophyll-based photosensitive dye entrapped in sol-gel fibreoptic applicator, Materials Science –Poland, 2005, 111-122

Wysocka, K., Leszkiewicz, A., Stręk, W., Doroszkiewicz, W., Podbielska, H., Silica based silver doped nanomaterials and their possible biomedical applications, Acta Bio-Optica et Informatica Medica, 2007, 180-183

PO3: 1060 nm central wavelength swept source laser for OCT imaging

Daniel Rumiński, Karol Karnowski, Michalina Góra, Maciej Wojtkowski, Andrzej Kowalczyk
Institute of Physics, Nicolaus Copernicus University, ul. Grudziądzka 5/7 PL-87-100 Toruń, Poland

Keywords: swept source, OCT, medical imaging, eye imaging.

Optical Coherence Tomography is non-invasive and non-contact examination technique which provides cross-sectional images of weakly scattering objects with micrometer resolution. This method finds application in diagnosis of ocular diseases. There are two main kind of OCT systems: TdOCT (Time domain) and FdOCT (Fourier domain). The latter divides on two types: SdOCT (Spectral domain) and SSOCT (Swept source). The commercial available swept laser works up to 100 kHz, while laboratory ones can achieve higher level.

The operating parameters of AXSUN laser working at 1060 nm central wavelength will be presented. This central wavelength overcomes some limitations of 800 and 1300 nm. 1060 nm light penetrates tissue deeper than 800 nm and enables higher axial resolution than 1300 nm. It is not absorbed by vitreous humour so can be used for retina as well as anterior segment of the human eye imaging.

The performance of the OCT system (system sensitivity for specified light power illuminating the sample, axial and transversal resolution, imaging depth) using AXSUN 1060 nm swept laser will be presented.

There are still some technical problems to overcome i.e. dispersion to compensated to accomplish eye measurements. Finally some preliminary results of biological samples *in vivo* will be demonstrated.

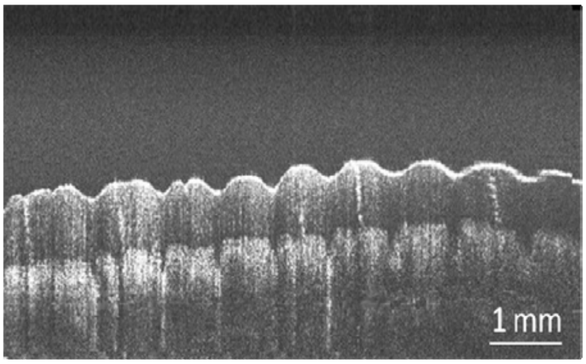


Figure 1. Image o human finger with distinguish skin surfaces and sweat glands in epidermis.

References:

Góra M., Karnowski K., Szkulmowski M., Kałużny B.J., Huber R., Kowalczyk A., Wojtkowski M., Ultra high-speed swept source OCT imaging of the anterior segment of human eye at 200 kHz with adjustable imaging range, Optics Express, ***17****, Issue 17, 14880-14894 (2009)*

Huber R., Adler D. C., Srinivasan V. J., Fujimoto J. G., Fourier domain mode locking at 1050 nm for ultra-high-speed optical coherence tomography of the human retina at 236,000 axial scans per second, Optics Letters, ***32****, 2049-2051 (2007)*

11:40 –INVITED LECTURE – IN VITRO studies of cerebral tissues by laser induced autofluorescence

Mihail – Lucian Pascu[1*], Alexandru Pascu[1], Mihaela Oana Romanitan[2], Leon Danaila[3]

[1] National Institute for Laser, Plasma and Radiation Physics, Laser Department, Bucharest
[2] Neurology Clinics, Emergency University Hospital, Bucharest
[3] Neurosurgery Clinics, National Institute of Neurology and Neurovascular Diseases, Bucharest

* Corresponding author; E-mail: mihai.pascu@inflpr.ro; Phone: +40 21 4574524;
FAX: +40 21 457 5739

In this paper it is shown that the comparison of the autofluorescence spectra induced by exposure to laser radiation in ultraviolet and visible allows the identification of brain tumor tissues and normal tissues as well as evidencing the difference between them. The experiments started from the study of the main fluorescent components present ion the structure of the cerebral tissues. Further, the measurements were performed on homogenates prepared from the available cerebral tissues, to ensure an optimal reproducibility of the results. The conclusion is that the autofluorescence spectra of the tumor samples are close to those measured for normal tissues, but there are differences between them that allow distinguishing the tumor from the normal tissue. One difference is that for each pair of tumor/normal tissue samples, the peak autofluorescence for the normal tissue is shifted with respect to that for the tumor — typically between 10 nm and 20 nm; overall autofluorescence intensity is also different for the components of the same pair, the difference being in the range 15–30%. The variation of the ratio of some fluorescence intensity peaks between normal and tumor tissue samples may also be utilized to differentiate between normal and tumor tissues. Measurements of this parameter yielded variations ranging around 10%. Another conclusion of the study is that *in vitro* experiments show that it is mandatory to use pairs of samples (normal/tumor tissue) taken from the same patient. The results show that, after further experimental *in vitro* tests, the method may be adapted to real-time intra-operative conditions by measuring the autofluorescence of the tumor and of the adjacent normal tissue.

PO4: Measurement of the modifications of polidocanol absorption spectra after exposure to NIR laser radiation

Adriana Smarandache[1*], M. Trelles[2] and M.L.Pascu[1]

[1*] National Institute for Laser, Plasma and Radiation Physics, Laser Department, P.O.Box, MG-36, 077125, Bucharest, Romania

[2] Instituto Médico Vilafortuny/FUNDACION ANTONI DE GIMBERNAT, Cambrils, Spain

Keywords: sclerotherapy, polidocanol, laser

Sclerotherapy is the targeted elimination of varicose veins by injection of a sclerosing substance into the vein lumen. Sclerosing agents cause a chemical irritation inside the vein, that produces an inflammation of the endothelial lining of the vessel. Subsequently, a secondary, wall-attached local thrombus is generated and, in long term, the veins will be transformed into a fibrous cord (sclerosis) (Trelles M.A. & al., 2004).

According to their potency, sclerosing agents can be classified as major, intermediate or minor. Polidocanol (Aetoxisclerol 2%) is an intermediate sclerosing agent, that contains a hydrophilic and a hydrophobic pole and acts by altering the surface tension at the interface between the endothelial cells and their environment.

The understanding of the interaction between the Polidocanol and the target veins (tissues) becomes an important factor in utilizing it in varicose veins disease. More, it seems that the exposure of the tissues impregnated with the Polidocanol to laser radiation emitted at 1.06µm improves the efficiency of the treatment.

This is the reason for which we started an extensive study about the optical properties of Aetoxisclerol 2% and about the possible modifications induced at molecular level in this medicine as supplied by the manufacturer. In fact Aetoxisclerol 2% (Kreussler Pharma) is a mixture of the following substances: polidocanol, sodium hydrogen phosphate, potassium dihydrogen phosphate, ethyl alcohol and water. For this reason, when the Aetoxisclerol 2% solution is exposed to laser radiation, one should consider actually the interaction of all the above mentioned compounds present in the commercial grade substance.

We performed absorption spectra measurements of Aetoxisclerol 2% in UV-VIS-NIR. These spectra indicate no significant absorption in the UV-VIS spectral range, and very weak peaks in NIR at 900nm, 1.18 µm, 1.69µm and 1.72µm; they are the result of the superposed absorption of all the compounds included in the commercially available Aetoxisclerol 2%. The ethyl alcohol has relatively significant absorption peaks at 900nm, 1µm and 1.2µm.

We exposed Aetoxisclerol 2% commercially available at laser beam emitted by a pulsed Nd:YAG laser at 1.06µm, the laser radiation having the following characteristics: rep. rate 10pps, FTW 5ns, beam energy on the sample 1.359mJ. The exposure time was made on samples in bulk, between 2 min and 30 min; the sample was introduced in spectrophotometer cells and the corresponding exposure dose varied from $1x10^9 J/cm^2$ to respectively $1.63x10^{10} J/cm^2$.

Following the irradiation, the absorption spectra of Aetoxisclerol 2% at λ>500nm remain within the measuring error limits. Modifications above the error limits are obtained in the spectral range (250-270)nm and they may be due to the changes in the molecular structure of polidocanol.

Comparing these data with the clinical experimental results obtained at Instituto Médico Vilafortuny (Trelles M.A. & al., 2004), we might conclude that the improvement of the action of Aetoxisclerol 2% on the varicose vein by exposure of the impregnated tissues with 1.06µm laser beam is possible due to the following mechanisms:

- at λ=1.06µm the absorption may be produced by the Ethyl alcohol and Haemoglobin; this may contribute to the sclerosis of the veins in the exposed area but it remains to clarify the possible mechanisms which lead to this effect;
- at λ around 250nm, the laser radiation may be absorbed by the Polidocanol proper, but in this case it also remains to clarify the mechanisms of interaction between the veins tissues and the medicine under the influence of laser radiation. It is possible that nonlinear absorption effects take places in the tissue such as absorption of 4 photons at 1.06 µm (which would correspond to a transition at 265nm), which may be responsible for further effects on the tissue.

References:

Trelles MA, Allones I, Martín Vázquez MJ, Trelles O, Vélez M, Mordon S. Long Pulse Nd:YAG laser for treatment of leg veins in 40 patients with Assessments at 6 and 12 Months. Lasers in Surgery and Medicine 2004; nr. 35: p. 68-76

Acknowledgements: This research work was supported by the ANCS (RO), projects LAPLAS 3-PN 09 33, PALIRT 41-018/2007 and COST P21-Physics of Droplets

International Student Workshop on Laser Applications 2010 - ISWLA'10 -

PO5: Towards obtaining qualitative and quantitative spectroscopic information of scattering media with the use of Spectral OCT

Szymon Tamborski, Danuta Bukowska, Ireneusz Grulkowski,
Maciej Szkulmowski, Andrzej Kowalczyk and Maciej Wojtkowski
Institute of Physics, Nicolaus Copernicus University, ul. Grudziadzka 5/7, PL-87-100, Torun, Poland

Keywords: spectral optical coherence tomography (SOCT), spectroscopic OCT, indocyanine green (ICG)

In Spectral Optical Coherence Tomography (SOCT) in-depth information about the object structure is encoded in a spectral fringe signal produced at the output of an interferometer system and collected by a spectrometer with a multipixel photodetector. From this signal different parts can be distilled in order to obtain various information of the object. Whereas the frequency spectrum of the fringes carries information of object's structure, the reconstruction of signal spectral envelope can enable analysis of depth-dependent changes of spectrum of light scattered back on consecutive interfaces. By these means the absorbance map can be calculated which one can use either to image contrast enhancement, as well as to characterize chemical composition of individual layers within the object.

The spectroscopic information can be relatively easily derived when the OCT signal is constructed with light reflected from the surfaces within the sample. Far more complex case is when light is just scattered by the object, as it is usual when the latter is turbid biological tissue, especially if one aims at obtaining qualitative information, as the intensity of light coming back from the object is very low. Information about selective (wavelength dependent) attenuation of the probing light in Spectral OCT is coded in depth dependent changes of amplitude of these fringes (called here *spectral envelope*) corresponding to different depth regions of the sample. The spectral envelopes are being obtained by means of mathematical combination of Fourier transformation of obtained OCT signal to *z-space* and appropriate spatial filtering enabling indication of the region from which the spectroscopic information is being derived. Inverse Fourier transform enables reconstruction of the contribution to the registered signal from indicated depth. At this point the use is made from Lambert-Beer law which predicts exponential attenuation of the probing light intensity due to both scattering and absorption. Analytic analysis results in conclusion that information of attenuation is contained in ratio of spectral envelopes obtained for layers from within different depths.

The set of experiments on phantom consisting of capillary filled with water solution of intralipid (non-wavelength-dependent scatterer) and a green dye - indocyanine green (ICG, absorber of known absorbance spectrum). The measurement was performed with the custom-made OCT system with broad-band Ti:Sa femtosecond laser as the light source. As the spectrum of the laser fit well the absorption spectrum of ICG, the spectroscopic analysis were possible. The signal from different depths within the capillary diameter was analysed to obtain absorbance spectra. The results were compared to the independently measured (with the use of commercial spectrophotometer) ICG absorption spectra showing good accordance, both qualitative (spectra shapes) as well as quantitative (linear decrease of absorbance spectra with depth within the sample and dyer concentration).

In the contribution will be presented the methodology, mathematical background, as well as the results of spectroscopic analysis.

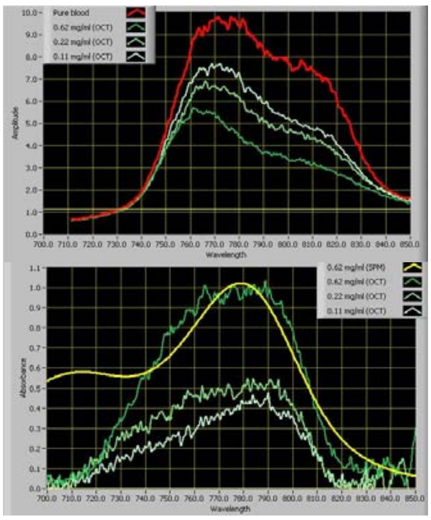


Figure 1. Spectral envelopes of signal from fixed depth obtained for different ICG concentration (above) and absorbance spectra (bottom, OCT) compared to reference spectrum obtained with the use of commercial spectrophotometer (bottom, SFM).

PO6: Investigations about the production of micro and nano-droplets starting from immiscible solutions

V. Nastasa[1*], Andra Militaru[1], T. Karapantsios[2], M. Ferrari[3], K. Samaras[2], E. Dafnopatidou[2], I. R. Andrei[1], L.Ligieri[3], V. Pradines[4], R. Miller[4], M. L. Pascu[1]
[1] *National Institute for Laser, Plasma and Radiation Physics Bucharest, Romania*
[2] *Department of Chemistry, Aristotle University of Thessaloniki, Greece*
[3] *CNR- Institute for Energetics and Interphases, Via De Marini 6, I-16149 Genova, Italy.*
[4] *Max Planck Institute for Colloids and Interfaces, Potsdam, Germany*

Keywords: micro-droplets, nano-droplets, LIF, surface tension, contact angle, hydrophobic surfaces, superhydrophobic surfaces

The multiple resistance to treatment, developed by bacteria and malignant tumors require to find alternatives to the existing medicines and treatment procedures. One of them is strengthening the effects of cytostatics as a consequence of the modification of their molecular structures through exposure to laser radiation[1]. The effects of medicines in malignant tumor treatment can also be increased by improving their delivery methods and means to targets. One of them is the use of micro/nano-droplets which contain solutions of medicines[2]. For this purpose we have measured the wetting properties of the solutions of medicines in ultra-pure water. We report the results concerning the generation and study of micro/nano-droplets; the generation and measuring of micro-droplets with an inner core (medicine) and a thin layer covering it, using a double capillary system is also reported. The surface tension (ST) at Vancomycin-in-water/air interface and Vancomycin-in-water/oil interface was measured; structured droplets containing medicine solution as a core and a covering thin layer of Vitamin A were measured. The micro/nano-droplets may be produced by mixing two immiscible solutions at high rotating speed and/or high pressure difference. We have studied the generation of emulsions of vitamin A diluted in sunflower oil and a solution of a surfactant Tween 80 in distilled water. The concentration of surfactant in water was typically $4*10^{-5}$M. We have also studied in a batch stirred tank system, the dependence of droplets dimensions in emulsion, function of the mixing rotation speed, agitation time and components ratio. At 600 rpm rotation speed we generated droplets with diameters between 20-500µm noticing that 90% were in the 20-100µm range. In order to obtain droplets in nm range we have used an homogenizer providing up to 25000 rpm and a high pressure homogenizer with a ΔP = 800 bar. The surfactant concentration in water was $2.5*10^{-3}$M. The droplet diameters were measured using a microscope and a light scattering instrument. We have obtained droplets with diameters smaller than 100 nm and a distribution peak at 65 nm (Fig.1).

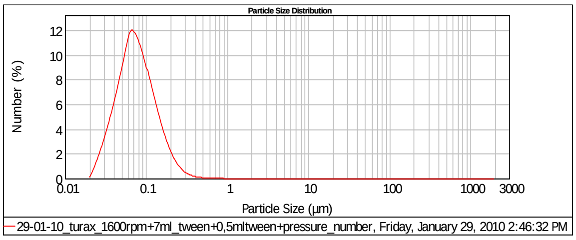


Figure 1. Droplet dimensions distribution

We report results on measurements of the ST and contact angles of the micro-droplets containing solutions of BG1120 and Doxorubicin, in ultra-pure water in the 10^{-3}M-10^{-5}M. The measurements of ST and contact angles on hydrophobic/superhydrophobic surfaces show that the BG1120 and Doxorubicin molecules distribution in the droplets is and remains homogeneous in time. They also show that the ST and the contact angles of ultra-pure water droplets and of droplets containing the medicines are practically the same, within the limits of the experimental errors. The resonant interaction between the micro-droplets of solutions of BG1120 and Doxorubicin in ultra-pure water on one hand, and the laser radiation on the other, was also studied. The molecules are modified after exposure to laser radiation, which was evidenced by measuring the uv-vis absorption and LIF spectra. The modifications are obtained several times faster in micro-droplets than in the same solutions irradiated in bulk.

Acknowledgements:
This paper was made in the ANCS project 41-018 and COST Action P21, "Physics of Droplets (COST-STSM-P21-4703), (COST-STSM-P21-5390)

References:

In vivo studies of the effects of alkyl substituted Benzo[b]pyridinium compounds exposed to optical radiation. AIP Conf. Proc., Vol. 1142, pp. 8-14, June 19, 2009 M.L. Pascu, I.R. Andrei, V. Nastasa

Wetting properties of droplets containing cytostatics drugs. I.R. Andrei, M. Ferrari, Silvia Rao, L. Liggieri, M. L. Pascu, 17th International Symposium on Surfactants in Solution, Berlin, www.SIS2010.org.au, August 17-22, 2008

INVITED LECTURE - Progress in high power ultrashort pulsed laser systems

Razvan Dabu
National Institute for Laser, Plasma, and Radiation Physics, Bucharest
razvan.dabu@inflpr.ro

Principles of high power ultrashort pulse generation by chirped pulse amplification (CPA) in laser media and by optical parametric chirped pulse amplification (OPCPA) in nonlinear crystals are presented.

Multi-TW and PW-level laser pulses make it possible to experimentally investigate highly nonlinear processes in atomic, molecular, plasma, and solid-state physics and to access previously unexplored states of matter. The petawatt laser power was achieved as early as 1997, based on CPA in Nd:glass. Until now, other laboratories have reported PW-level laser systems. All devices and projects now available may be classified into three types, according to the gain medium they employ: (1) neodymium glass, (2) titanium-sapphire, and (3) optical parametric amplifiers with KDP and DKDP crystals. In all three types, energy (in the form of population inversion) is stored in neodymium ions in glass. In the first case, this energy is directly converted into the energy of a chirped pulse that is then compressed. In the second and third cases, the stored energy is converted into the energy of a narrowband nanosecond pulse, which, upon second-harmonic conversion, serves as the pump for chirped-pulse amplifiers. This pump either provides population inversion in a Ti:sapphire crystal or is parametrically converted into chirped pulses in the nonlinear crystal. Peak power is determined by the duration and energy of the compressed pulses. Maximum energy is achieved in glass-based lasers, because energy that has been stored as population inversion is directly converted into a chirped pulse. However, the narrow bandwidth of Nd glasses typically restricts the compressed-pulse duration to about 500 fs. Recently a 1.1 PW laser based on hybrid optical parametric chirped pulse pulse amplification (OPCPA) and mixed Nd:glass amplifiers (silicate Nd:glass rod and phosphate Nd:glass disks) has been demonstrated, which produces 186 J and 167 fs pulses.

Ti:sapphire lasers have a large-gain bandwidth, allowing pulse compression up to 10–20 fs. Due to gain narrowing, up to now, the reported pulse duration of high power Ti:sapphire laser amplifiers was at least 30 fs. Current crystal growth technologies can produce commercially available Ti:sapphire crystals with an aperture of no more than 10 cm.

Parametric amplifiers are free of the above disadvantages. Current nonlinear KDP and DKDP crystals have an aperture of 40 cm or more and the gain bandwidth of the DKDP corresponds to a 10–20-fs duration of the amplified pulse. At the same time, in parametric amplifiers, the energy conversion efficiency of a Nd laser mono-pulse at fundamental frequency into a chirped pulse is typically only at the level of 10%. Also, parametric amplifiers require very-short (about 1 ns) pump pulse.

Thus, in existing approaches to PW and multi-PW lasers, the peak power is mainly limited either by the bandwidth (neodymium ion lasers), the crystal aperture (Ti:sapphire lasers), or the efficiency of the energy conversion from a pump wave into a signal wave and difficulties related to the development of high energy short pulse duration pump lasers (lasers with optical parametric amplifiers).

Different high power (hundreds of TW up to GW) femtosecond laser systems in operation and research projects under development are described: OPCPA in DKDP crystals (Rutherford Appletown Laboratory - UK, Garching –Germany, Nijnii Novgorod – Russia), CPA in Ti:sapphire (Apollon 10-France, APRI - Korea, Shanghai – China), CPA in mixed Nd:glass (Dallas – USA). 20-TW femtosecond laser system in operation and prospects of PW-class lasers development in the National Institute for Laser, Plasma and Radiation Physics, Bucharest, are presented.

References:

D. M. Pennington et al., in *Proceedings of the Solid State Lasers for Application to Inertial Confinement Fusion: Second Annual International Conference, London, 1997,* Proc. SPIE **3047**, 490–500 (1997).

Y. Kitagawa, H. Fujita, R. Kodama, et al., IEEE J. Quantum Electron. **40**, 281 (2004).

M. Aoyama, K. Yamakawa, Y. Akahane, et al., Opt. Lett. **28**, 1594 (2003).

V. V. Lozhkarev, G. I. Freidman, V. N. Ginzburg, et al., Laser Phys. Lett. **4**, 421 (2007).

E. W. Gaul et al., Appl. Opt. 49, 1676-1681 (2010).

I. N. Ross, P. Matousek, G. H. C. New, and K. Osvay, J. Opt. Soc. Am. B **19**, 2945 (2002).

V. Yanovsky et al., Opt. Express, 16, 2109-2114 (2008).

S. K. Lee et al., *0.1-Hz 1-PW Ti:Sapphire Laser facility*, LEI Conference, Brasov, Romania, Oct. 16-21, 2009.

Z. Wang et al., *Enhance XL III facility to Petawatt power with improved front-stage amplifier and optimized output energy*, LEI Conference, Brasov, Romania, October 16-21, 2009

Zs Major, "The Petawatt Field Synthesizer – Current status and recent progress," presented at the International Conference LEI 2009, Brasov, Romania, Oct. 16-21, 2009.

J. P. Chambaret, *The Extreme Light Infrastructure Project ELI and its prototype APOLLON/ ILE. "The associated laser bottlenecks"*, LEI Conference, Brasov, Romania, Oct. 16-21, 2009

Session 3 – Micro- and Nano- Technologies

INVITED LECTURE

Micro- and nano-processing with ultrashort laser pulses

Zamfirescu, Marian[1]; Ulmeanu, Magdalena[1]; Jipa, Florin[1]; Rusen, Laurentiu[1]; Neagu, Liviu[1]; Anghel, Iulia[1]; Radu Catalina[2]; Ionita, Iulian[2]; Luculescu, Catalin[1]; Moldovan, Antoniu[1] and Dabu, Razvan[1]

[1]National Institute for Laser Plasma and Radiation Physics, Atomistilor 409, 077125 Magurele, Romania
[2]University of Bucharest, Faculty of Physics, Atomiştilor 405,077125 Măgurele, Romania

Keywords: direct laser writing, two-photon photopolymerization, optical near-field enhancement

Direct laser writing (DLW) technique has been developed almost simultaneous with the domain of femtosecond lasers. The DLW consist in the fabrication of micro and nanostructures with controlled geometry by mean of the interaction of the ultrashort laser pulses with the processed material.

The laser induced modification of the material is based mainly on nonlinear multiphoton absorption of focalized femtosecond laser beam. Depending on the nature of target material and the laser intensity, different effects could take place. The laser ablation or melting is responsible for the structuring of metallic, dielectric or semiconductors surfaces, while multiphoton induced photopolymerization of photoresists, or modification of the refractive index by laser induced densification of glasses is the way to create 3D structures in the volume of a transparent media. When the laser beam is tightly focalized on or inside the material, the size of the modified area can be controlled by the laser intensity, the exposure time or number of laser pulses. If the laser fluence is properly set, the nonlinear absorption take place only in the centre of the focalised spot where the laser intensity exceed the threshold value. Then, structures with dimension much below the size of the focalised spot are created, even below the diffraction limit. When the sample is precisely translated in 2D or 3D, practically any computed design can be obtained.

Here, we present a series of laser processing techniques using ultrashort laser pulses, such as laser micromachining, laser induced forward transfer (LIFT), laser induced periodical surface structures (LIPSS), laser ablation by optical near-filed enhancement, two-photon photopolymerization (TPP). For implementation of these techniques we developed a microscope for laser processing which can be coupled with different type of laser sources. In our case an amplified femtosecond laser Clark-CPA2101 at 2 KHz repetition rate, and a Femtosource Synergy Pro oscillator at 79 MHz repetition rate were used. Structures on gold film or copper were created for applications in microelectronics. In photopolymers 3D microstructures were realised for applications in photonics or biology. Features of tens to hundreds of nanometres in size are also produced by special effects such as optical near-field enhancement or by surface self-organising of the material under laser irradiation.

References:

M. Zamfirescu, et al, "Femtosecond Laser Induced Periodic Surface Structures on ZnO Thin Films", J. Laser Micro/NanoEng. 4, pp.7-10 (2009).

M. Ulmeanu, et al, "Structuring by field enhancement of glass, Ag, Au, and Co thin films using short pulse laser ablation", J. Appl. Phys. 106 (11), p.114908 (2009);

M. Zamfirescu, et al., "Femtosecond Laser Fabrication of Metamaterials for High Frequency Microwave Devices", J. Laser Micro/NanoEng., 3 (1), pp.5-8 (2008).

A. Popescu, et al. "Direct laser writing of two-dimensional photonic structures in amorphous As2S3 thin films", J. Optoel. Adv. Mat., vol.11, p. 1874 – 1880 (2009).

F. Jipa, et al. "High-aspect-ratio structures produced by two-photon photopolymerization", J. Optoel. Adv. Materials, vol. 12, p. 124 - 128 (2010).

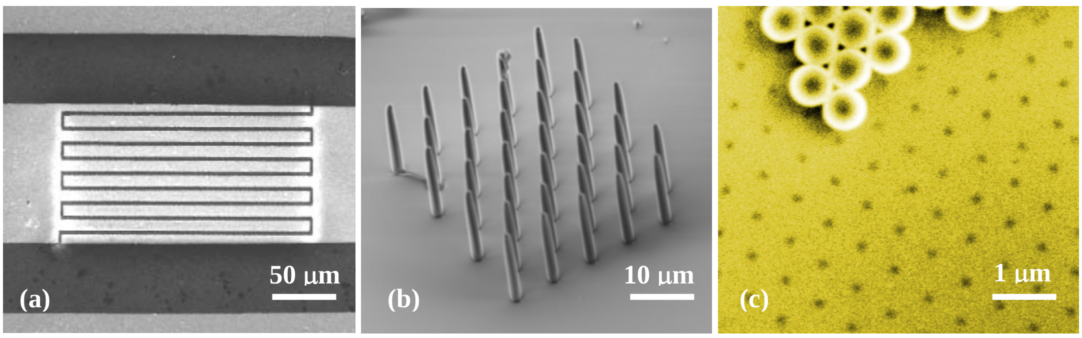


Figure 1. Micro and nanostructures produced by laser: a) laser micromachining of interdigital capacitors on gold film; b) high-aspect-ratio pillars in SU-8 photoresist obtained by TPP; c) nanoholes on glass surface produced by ablation in optical near-field enhancement regime.

PO7: Soliton waveguides arrays in lithium niobate

S. T. Popescu[1*], A Petris[1], V. I. Vlad[1], E. Fazio[2]
[1]Natl. Institute for Laser, Plasma and Radiation Physics, Dept. of Lasers, Bucharest-Magurele, ROMANIA
[2]University "La Sapienza" of Rome, Dept. of Energetics, ITALY

Keywords: spatial solitons, waveguides, lithium niobate, waveguide array, femtosecond pulse guiding

In the last two decades spatial optical solitons have attracted much attention. After the first experimental demonstration of photorefractive solitons (Duree *et al.*, 1993), many types of photorefractive solitons have been investigated. A particular type is the bright screening soliton which can be obtained by applying an external electrical field (Segev, *et al.*, 1994). This particular type of spatial soliton is stable in 2 dimensions and can be created with low intensity beams.

Lithium niobate (LN) crystal is a very good material for optoelectronic applications due to its electro-optic, photovoltaic, piezoelectric and pyroelectric properties. Its large production makes LN cheap, with reproducible parameters and a good platform for integrated photonics.

By writing soliton waveguides (SWG) in the volume of the material, many applications (Denz, *et al.*, 2003) in integrated photonics can arise.

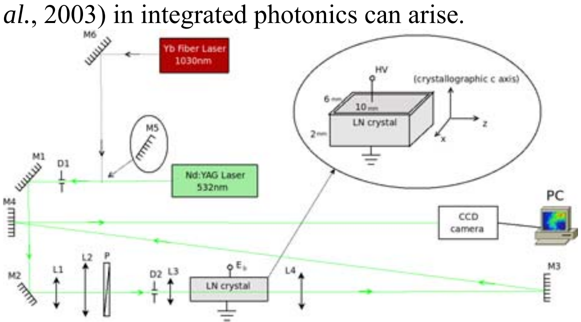


Figure 1. Experimental setup.

Using a setup (Fig. 1) similar to that used by Fazio *et al.*(2004), we determined the best writing conditions for our sample of LN crystal

An experimental characterization of the SWG writing process at λ=532 nm is done by writing several SWGs with different input parameters (input beam intensity, external electrical field or beam polarization). Experimental curves with the writing time dependence on the input intensity and on the external electrical field are shown.

The guiding properties of the SWGs recorded with 532nm radiation are investigated at various c.w. wavelengths (532nm, 808nm, 1030nm, 1557nm) and ultra-short pulses (1030nm).

We discuss methods for recording arrays of SWGs in LN crystals and present a large array of SWG (Fig. 2) that was recorded using a serial writing procedure.

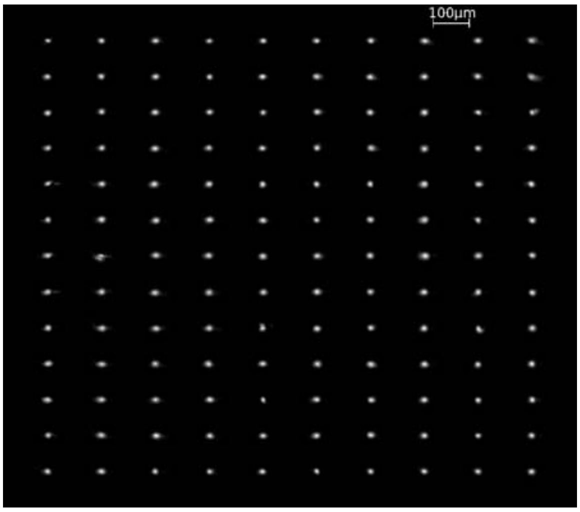


Figure 2. 13x10 SWG array.

These large SWGs arrays can have important applications in ultra-fast parallel coupling and integrated photonics.

References:

G. C. Duree, Jr., J. L. Shultz, G. J. Salamo, M. Segev, A. Yariv, B. Crosignani, E. J. Sharp, R. R. Neurgaonkar, P. Di Porto: Observation of self-trapping of an optical beam due to the photorefractive effect, Phys. Rev. Lett., vol 7. pp. 533-536, Jul. 1993.

M. Segev, G. C. Valley, B. Crosignani, P. Di Porto, A. Yariv, Steady-State Spatial Screening Solitons in Photorefractive Materials with External Applied Field, Phys. Rev. Lett., vol. 73. 3211-3214, Dec. 1994.

C. Denz, A. Desyatnikov, P. Jander, J. Schröder, D. Träger, M. Belic, M. Petrovic, A. Strinic, J. Petter: Photonic applications of spatial photorefractive solitons - soliton lattices, bidirectional waveguides and waveguide couplers, Photorefractive Effects, Materials, and Devices, P. Delaye, C. Denz, L. Mager, and G. Montemezzani, eds., Vol. 87. of OSA Trends in Optics and Photonics (Optical Society of America), Jun. 2003, paper 382.

E. Fazio, F. Renzi, R. Rinaldi, M. Bertolotti, M. Chauvet, W. Ramadan, A. Petris, V. I. Vlad: Screening-photovoltaic bright solitons in lithium niobate and associated single-mode waveguides, Appl. Phys. Lett., vol. 85. pp. 2193-2195, Sept. 2004.

PO8: Interdigital capacitors fabricated by femtosecond laser ablation

Radu,Catalina[1], Rusen, Laurentiu[2], Neagu, Liviu[2], Ion, Valentin[2], Amarandei, Luminita[3], Banciu, George[3], Zamfirescu, Marian[2]

[1] University of Bucharest, Faculty of Physics, Atomistilor 405,077125 Magurele, Romania
[2] INFLPR – Bucharest, Atomistilor 409, 077125 Magurele, Romania
[3] INFM – Bucharest, Atomistilor 405 bis, 077125 Magurele, Romania

Keyword: direct laser writing, interdigital capacitors, microstrip, CPW, microwave

Metallic or dielectric structures with resolution down to a few micrometers are traditionally done by photolithography which involves few protocol steps such as UV sensitive photoresist deposition, UV exposure, photoresist hardening, chemical layers corrosion. In contrast, the laser ablation technique is a direct writing method which allows the fabrication of a desired geometry in one step. The femtosecond lasers have been shown to be an attractive tool for the high quality micromachining of many materials, due to their ability of precise processing with minimal damage on the adjacent area. In the present study, interdigital capacitors are fabricated by laser ablation of copper films with different film thickness, 200 nm and 5 µm, deposited on Alumina substrate. The samples are processed by focused Ti:Sapphire laser beam (Clark CPA-2101) with lambda – 775 nm, rep. rate – 2 KHz, pulse duration – 200 fs. The focusing optics is a 20*X* microscope objective. The samples are precisely positioned in XY with accuracy of 1 µm. A CCD camera is used for visualization and focalization of the sample. All the process is computer controlled by dedicated software. Series of interdigital capacitors with different number and width of fingers were processed by direct laser writing method in order to establish the dependence of the capacity with the circuit geometry.

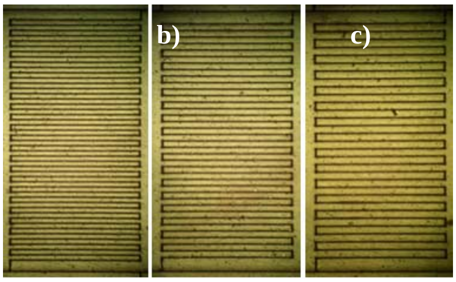


Figure 1. Laser processed interdigital capacitors for different digit width: a) 30 µm, b) 40 µm and c) 50 µm.

The width of the interdigital capacitors *w*, was varied between 10 to 50 µm, and the number of the fingers *N* was from 4 to 20. The focusing optics allow us to obtain by laser ablation, spacing between fingers *s* of 10µm. The length of fingers was 1000µm. The capacity of the fabricated capacitors was measured with Agilent 4294A Precision Impedance Analyzer. The experimental results were compared with the theoretical model presented in the Ref. 1 and 2. Figure 2 shows the comparison between the experimental values and the calculated one. Such structures realized by laser ablation can be integrated in more complex circuits for microwaves, transmission line, band filters, couplers, antenna, in microstrip or Coplanar Waveguide configuration.

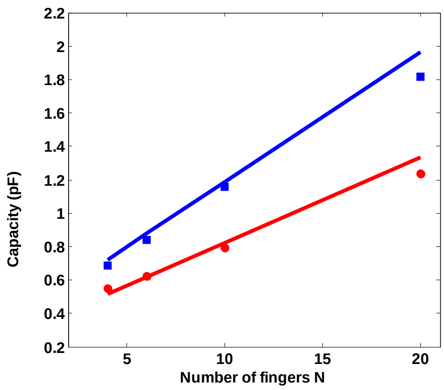


Figure 2. Theoretical dependence of the capacity on the number of fingers (solid lines) and the measured capacities for digit width *w* = 10 µm (solid circles) and *w* = 40 µm (solid squares).

References:

H.Yoon, et. Al "Design and development of micro machined bilateral interdigital coplanar waveguide RF phase shifter compatible with lateral double diffused metal oxide semiconductor voltage controller on silicon", Smart Mater. Struct. 12 (2003), 769–775.

K.C.Gupta et al., "Microstrip Lines and Slotlines", Artech House, Boston 1996, pp. 375-404.

11:15 – INVITED LECTURE – Laser remote sensing in atmosphere science

Doina Nicolae*, Emil Carstea*, Anca Nemuc*
*National Institute of Research and Development for Optoelectronics, Address: 409 Atomistilor Street, Măgurele, Ilfov, Romania, mluminita@inoe.inoe.ro

Keywords: LIDAR, atmosphere, long-range transport

The combination of lidar observations with in situ measurements and models provides a unique opportunity to conduct long-term inter-calibrations and complementary or simultaneous monitoring of different atmospheric parameters over various space-time scales at the Romanian Atmospheric 3D research Observatory - RADO.

One of the main issues at RADO refers to direct and indirect effect of aerosols on radiative budget. Vertically resolved profiles of optical properties of aerosols and ozone are measured each day by lidars. First information which can be immediately extracted is the vertical structure of the atmosphere. Aerosols measured by lidars can serve as valuable tracers of air motion in the planetary boundary layer [1]. The height of layers in the lower troposphere is calculated using the gradient method - minima of the first derivative – of the range corrected lidar signal (Fig. 1). Many scientists are still skeptical about the accuracy of retrieving layer altitude from lidar data, therefore at the observatory we also use the Richardson number method to estimate PBL height from radio-soundings and to check the consistency with lidar retrievals.

The multi-wavelength Raman lidar is used to observe significant variations in aerosol characteristics depending on the particle origins. First (backscatter and extinction coefficients) and second (lidar ratio, Angstrom exponents and color ratios) level optical properties of aerosols are derived in order to assess the aerosol class, which is then confirmed or not by air mass backward trajectory analysis. Numerous previous experimental studies [2] found that backscatter and extinction related Angstrom exponents and color ratios have specific values for various aerosol categories. This gives to lidar scientists a reliable tool for assessing the aerosol type – fresh or small aerosol, smoke or sea salt - based on multiwavelength instrument measurements. HYSPLIT4 back-trajectory model is used to estimate the origin of aerosols in conjunction with the associated meteogram (Fig. 2).

Conclusions

To quantify the impact of aerosols on climate and to assess, in turn, the feedback of climate change on aerosols requires a thorough understanding of the physico-chemical aerosol processes on the micro-scale and aerosol evolution in the context of regional and global scale circulation. Layers altitude provided by lidar can actually contribute to the calibration of satellite images. On the other hand, only lidar is able to separate the aerosol contributions of the free troposphere and stratosphere from boundary-layer aerosol, the latter one being the essential part contributing to local air pollution.

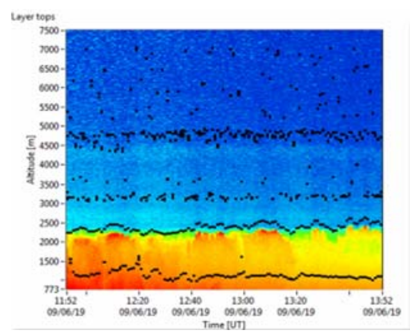


Figure 1 Layer heights from lidar data

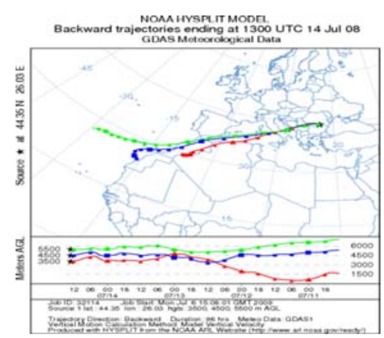


Figure 2 HYSPLIT back-trajectories

References

Stull, Roland B. An Introduction to Boundary Layer Meteorology, Kluwer Academic, 666pg., 1988.

Ina Mattis, Detlef Müller, Albert Ansmann, Patric Seifert, Matthias Tesche, Ulla Wandinger, CALIPSO and long-term ground-based multiwavelength Raman lidar observations, The EarthCARE Workshop, ESA/ESTEC, 2007

PO9: Cloud height comparisons from SEVIRI and LIDAR

Luminita Marmureanu*, Camelia Talianu*, Razvan Radulescu*, Jeni Vasilescu*
*National Institute of Research and Development for Optoelectronics, Address: 409 Atomistilor Street, Măgurele, Ilfov, Romania, mluminita@inoe.inoe.ro

Keywords: SEVIRI, LIDAR, cloud height

In recent decades, observations of climate and climate change have become increasingly important. Depending on their characteristics and height in the atmosphere, clouds can influence the energy balance. This paper presents two systems for estimate of clouds height and comparisons between them. The first system described is based on satellite imagery infrared reflectance on 3,9 µm and 10,8µm. This two channels are used because they have some advantages. Reflection at IR3.9 is sensitive to cloud phase and very sensitive to particle size having higher reflection from water droplets than from ice particles The 3,9µm chanel is used especialy for low clouds because cirrus clouds are more transparent at this wavelength and 10,8µm channel is more sensitive for the upper clouds. (J. Schmid). The model used to estimate the cloud height from Eumetcast-SEVIRI (Spinning Enhanced Visible and Infrared Imager) was the standard atmospheric model (Murry L. Salby, 1996). The second system is a Lidar (LIght Detection and Ranging) ground based that uses pulsed laser to sound high altitudes in the atmosphere that are characterized by high sensitivity and a long range penetration (S. Stefan, et al., 2008). This instrument is an elastic backscatter Lidar for aerosols with two detection channels 532nm and 1064 nm, performing measurements in the lower and upper troposphere (10 km maximum range at 15 m range resolution). The raw data offers information about clouds that are visible directly in the range corrected signal with 1 min resolution (S. Stefan, et al., 2008). During the measurements in Magurele located near Bucharest at 44.35 latitude and 26,03 longitude, results obtained using LIDAR on 532 nm wavelengths (Fig.1) and SEVRI (Fig.2) on 10.8 µm infrared channel have shown a good agreement of the cloud height. In this study case the cloud height using the Lidar was detected at 9 Km altitude, so we decided to compare this data with results from 10,8 µm infrared channel that have a better estimation of the upper clouds.

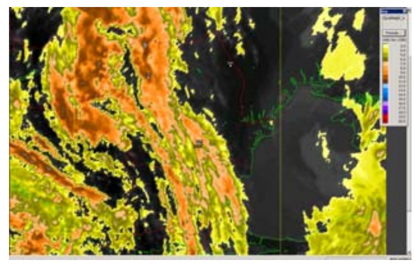


Figure 1Temporal evolution of the clouds for March 30 2010

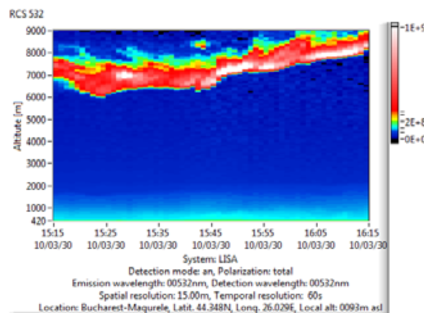


Figure 2 Satellite imagery of cloud height for March 30 2010 at 15:15 (GMT)

Differences of the cloud height between these two methods are less than 500 meters and this can be attributed to the thickness of the clouds.

Conclusion: The infrared satellite imagery can be used to estimate cloud height, but combined with ground measurements the estimation can be improved.

References
Sabina Stefan, Doina Nicolae, Mihaela Caian, Secretele aerosolului atmosferic in lumina laserilor, Ars Docendi, 2008, Bucuresti
J.Schmid, The SEVIRI Instrument, http://www.eumetsat.int/Home/Main/Documentation/Technical_and_Scientific_Documentation/Technical_Notes/SP_1124282611560?l=en
Murry L. Salby, Fundamentals of Atmospheric Physics, Academic Press, 1996,

PO10: Validity of LIDAR time series measurements

Rădulescu, Răzvan-Cosmin[1] and Belegante, Livio[2]

[1]Laser Remote Sensing Department, from The National Institute of R&D for Electronics and Optoelectronics, 077125, Măgurele, Romania
[2]Laser Remote Sensing Department from The National Institute of R&D for Electronics and Optoelectronics, 077125, Măgurele, Romania

Keywords: detrended, fluctuation, analysis, LIDAR, ranged, corrected, signal.

This paper will discuss an alternative general purpose algorithm for signal validation which, here, is applied to LIDAR (Light Detection and Ranging) profiles. Generally, the analysis' objective is to determine what part of the signal is actually of real interest (the other part can be considered to be just noise and thus cannot be further processed). This implies that for LIDAR profiles, the algorithm determines the height from which the signal is no longer reliable. This algorithm is based on the DFA (Detrended Fluctuation Analysis) method (Hu, K. et al. (2001) Effect of trends on detrended fluctuation analysis, Phys Rev E, **64** (1) 011114.) which is usually used to give information about the type of the noise from a signal.

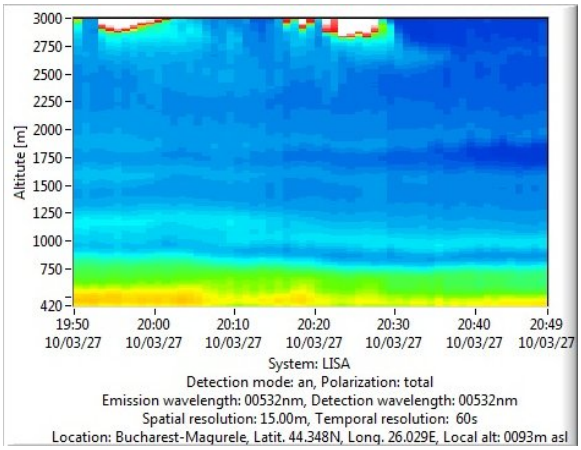


Fig. 1: Example of LIDAR RCS (Ranged Corrected Signal) time series (dust event over Romania). Station: Magurele, Ilfov

Fig. 1 is a typical LIDAR time series RCS from which a mean signal is taken and afterwards analyzed. But in order to actually get a mean signal from which you can further process information, you would have to know if the information stored in every RCS signal that comprises the selected (desired) area is of real interest. This is the problem that this algorithm would like to resolve.

Fig. 2 is a single RCS signal to be validated. By putting them together you get the image from Fig. 1 (in this case, only a part, because Fig. 1 is shown up to 3 km, whereas Fig. 2 shows a signal up to 10 km).

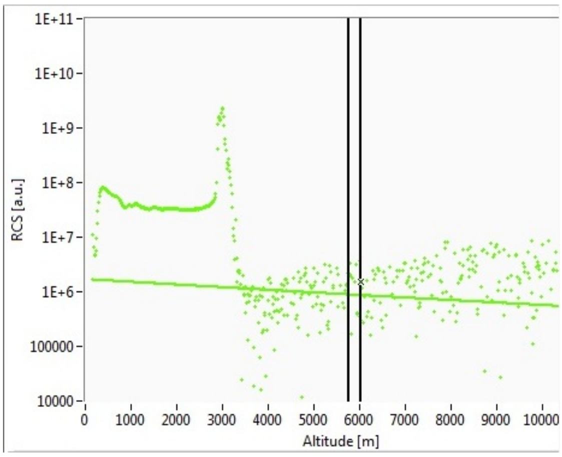


Fig. 2: Mean RCS of the above (Fig. 1) time series

PO11: Aerosol imaging using a holographic method

E. R. Cojocaru, M. B. Tanasescu, M. Mihailescu

"Politehnica" University from Bucharest, Bucharest – Romania

Aerosols are small particles in suspension in the atmosphere, which affect the global climate: directly – scattering or absorbing solar and terrestrial radiation, and indirectly – modifying cloud properties. Their physical and chemical properties are useful in calculating the backscatter cross section and optical depth profiles in LIDAR measurements. We study a sample containing mixed – transparent and opaque – aerosols, collected using 10 and 20 micron filters from a peripheral urban area, at a height of over 12 meters. In order to determine the refractive index of the transparent aerosols, we use digital holographic microscopy (DHM). The experimental setup is based on the Mach-Zehnder interferometer in which two additional objectives are positioned in the reference and object beams. We record the phase shift, introduced by the sample, using a high resolution CCD camera. Specialized software based on the Fraunhofer/Fresnel approximations is employed to reconstruct the three-dimensional microscopic image of the aerosol particle, from a single hologram, without scanning in the experimental setup. Our laboratory studies bring new information about the optical properties of the sample, useful in environmental studies.

14:00 – INVITED LECTURE – Chaotic behaviour and control of a semiconductor laser

Mircea Bulinski

University of Bucharest, Faculty of Physics, Department of Optics, PO Box MG11, 077125, Bucharest, Romania

Keywords: chaos, semiconductor lasers, low-frequency fluctuations, encoded communications.

The nonlinear and chaotic dynamics of semiconductor lasers represent a very interesting physical system and play an important role for a wide area of practical applications. When the light from a laser diode is redirected into the laser cavity as feedback from an external reflecting surface, mirror or diffracting grating, the configuration is known as external-cavity semiconductor laser, ECSL.

We analyze some numerical simulations and experimental data of the most significant behavior of these systems, the control of the chaotic dynamics in different experimental arrangements or synchronization between coupled systems. If the external cavity length is smaller than the output coherence length, the system will behave as a laser with a compound cavity, and when the length is increasing chaotic behavior appears. The value of the control parameters, length of the external cavity, optical feedback and intensity of injected current, greatly influence the chaotic system evolution.

Operated slightly above the lasing threshold with weak optical feedback the system runs into a temporally unstable regime, manifested as a cyclic dropout of the output light intensity, called low-frequency fluctuations (LFFs). These complex laser dynamics that has two time scales is described by a highdimensional chaos, and can be controlled by external electro-optical phase or intensity current modulation. It is shown that for specific values of the modulating frequency and amplitude, the phase difference between the laser power drop-out and the modulator remains constant in time leading to phase-synchronized states, steady LFFs, so called m:n phase synchronization.

The synchronization phenomena that appear in two coupled ECSL can be used in communications systems for transmitting encoded information. Methods for the information transmission using chaotic dynamics are based on chaos masking, chaos shift keying, or chaos modulation. In our simulations we use a masking scheme when we modulate the light intensity from the master system, and a chaos modulation scheme if we modulate the master injection current.

Refrences

Junji Ohtsubo, Semiconductor Lasers, Stability, Instability and Chaos, Springer Series in optical sciences, 2008.

J. S. Lawrence and D. B. Kane, "Nonlinear dynamics of a laser diode with optical feedback systems subject to modulation," IEEE J. Quantum Electron. 38, 2002, 185–192.

M. Bulinski, Catalin M. Ticos, I. R. Andrei, M:N phase synchronization of LFF in an chaotic ECSL system, SPIE, Volume 6603, 2007, pp. 660329 .

C. M. Ticos, M. Bulinski, R. Andrei, M. L. Pascu, Power drop-out control by optical phase modulation in a chaotic semiconductor laser, JOSA B, Vol. 23, Issue 12, 2006, pp. 2486-2493.

I.R. Andrei, C.M. Ticos, M. Bulinski, M.L. Pascu, Chaotic behaviour in the emission of semiconductor lasers optically coupled with an external cavity, J. Optoelec. and Adv. Mat. Vol. 12, No. 1, 2010, p63-67.

PO12: Fast digital phase lock for external cavity diode lasers

Mateusz Bawaj

Faculty of Physics, Astronomy and Informatics
Nicolaus Copernicus University, Grudziadzka 5, 87-100, Torun, Poland
Keywords: ECDL, phase lock loop, OPLL

Many experiments in atomic physics require two separate light beams whose frequency difference is well specified. If the difference is greater than a few megahertz two separate light sources are required. I describe one technique of producing this kind of beams, optical phase lock loop. In OPLL two laser beams interfere on a fast photodiode. The interference signal is called beat frequency. Stable beat frequency translates to fixed difference between interfered beams. Idea is to lock beat frequency to stable reference frequency from an external generator. Basic setup for OPLL is displayed in Figure 1.

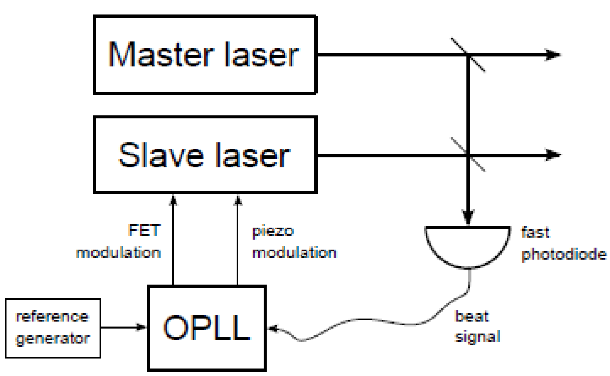


Figure 1: Optical phase lock loop diagram

The experimental setup contains two lasers, fast photodiode, stable reference frequency generator and electronic phase lock loop. Master laser has fixed frequency. Second laser frequency fluctuation causes beat frequency change. OPLL circuit uses beat and reference signal to drive second laser. The stability of outgoing beams highly depends on electronic circuit. In this paper I describe OPLL for use with external cavity diode lasers. Main advantages of ECDL are construction and tuning simplicity. ECDL optical frequency depends on three parameters: temperature, laser diode current and grating angle. I want to change only two of them: diode current and diffraction grating angle. In my laser grating is mounted on piezo stack. Speed of the piezo modulation is limited by mechanical resonances. Range of the current modulation is limited by mode hops. OPLL splits slave laser driving signal into slow and fast signal for piezo and current modulation respectively. OPLL electronic part is a fast and inexpensive, simple phase loop with digital phase detection and frequency pre-scaling. The device permits phase locking at frequency differences ranging from a few MHz to 7 GHz. A very wide locking range makes this system a universal tool for experiments in atomic physics. The electronic contains no microwave components. There should be no difficulties during construction with little experience in high frequency electronics. The performance of the device was measured in the second reference. The spectrum of the beat signal was measured around beat frequency 6:9 GHz. The phase variance is different for each reference generator. With an accurate device phase variance was found to be less than 80 mrad2. Long term stability is usually ob- served. Described device was used in a few experimental setups in optical and atomic physics.

References

Fundamentals of Phase Locked Loops (PLLs), *http://www.analog.com/static/imported-files/tutorials/MT-086.pdf*

J. Appel, A. MacRae, A. I. Lvovsky, Versatile Digital GHz Phase Lock for External Cavity Diode Lasers, Quantum Physics (2008)

Converting Oscillator Phase Noise to Time Jitter, *www.analog.com/static/imported-files/tutorials/MT-008.pdf* .

PO13: Photonic crystal optoelectronic devices and circuits

Radu-Florin Stancu
Applied Sciences Faculty, Politehnica Bucharest University, Romania

Keywords: photonic crystal, transmission

Nowadays, one of the main existing barriers in telecommunication are the processing nodes that connect the optical fiber nods, nods that are necessary for routing information. In present, there isn't a cheap and efficient method that makes this process totally optical. The optic transmission has to be first converted in electrical signals to be processed by the routing equipments, then reconverted again in optical signals to be sent forward. The extraordinary quality of the photonic crystals to forbid the electro-magnetic field on all directions in specific spectral spaces, offers the possibility of creating many viable optoelectronic devices, like filters, multiplexers, splitters, de-multiplexers, optical guides with 0 losses etc. The most common known photonic crystal is the one made from a basic environment having an εr_1 electric relative permitivity, in which a matrix of cylinders (εr_2 electric relative permitivity) is introduced. If guides constructed inside photonic crystals by removing an entire row of periodic elements are used, then the field's energy will not be radiated outside the propagation channel, no matter the path followed. The fields existence is impossible in the rest of the crystal, fact determined by the forbidden band gap.

Table 1. Comparison between theoretical predictions (A) and experimental measurements.(B)

	T_1	T_2	$T=T_1+T_2$
A	4/9	4/9	8/9
B	4/10	4/10	8/10

For the experimental applications, that included the devices construction and simulations, Optiwave FDTD software was used. For example, I used a 2D photonic crystal structure: basic environment: air ($\varepsilon r_1 = 1$), with a matrix of PBG cells: $\varepsilon r_2 = 11$. Two measuring points where placed strategically at the entrance and exit. The results returned by OptiFDTD Analyzer show that the wave goes from entrance to exit with minimal losses (less than 0.5%). Next, a guide ramification (beam-splitter) was constructed. I have used the following 2D photonic crystal structure: basic environment: air ($\varepsilon r_1 = 1$), matrix of PBG cells: $\varepsilon r_2 = 12{,}25$. The results and evaluations obtained after the computer simulations are comparable with the theoretically demonstrated results. The best results I got were for the following devices: turning zones, beam splitters, reflectors and coupled wave guides. In the case of the wave guide intersection, the results showed an unequal distribution of power, most like because of the device's geometry. Unfortunately, the value lost trough reflection is pretty high. As a global conclusion, we can say that photonic crystals are very useful in creating some reliable optoelectronic devices. Optoelectronic circuits can be realized by combining various photonic crystal devices. The photonic crystals have a lot of potential, and, if a good mass production technology will be developed, they can become a reliable material in communications, lasers and so on.

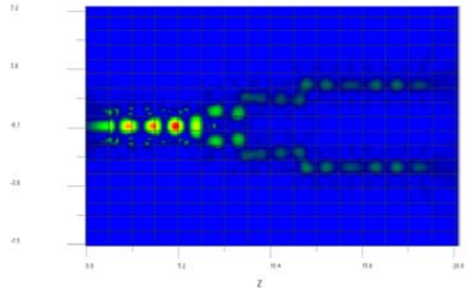


Figure 1. Map of wave transmission for a photonic crystal guide ramification

References:

Paul Sterian, „Fotonica" ("Photonics"), Editura Printech, Bucharest , 2000

Lazăr Bogdan, „Dispozitive optice bazate pe cristale fotonice" ("Optoelectronic devices based on photonic crystals"), Raport de cercetare (Research Report), Centrul de Fotonică (Center of Photonics), Bucharest, 2005

C.-G. Bostan, „Modelarea, simularea si proiectarea cristalelor fotonice 1D" ("Modeling, simulation and development of 1D photonic crystals"), Comunicari Stiintifice (Scientific Session), UPB, 2002

Eli Yablonovitch, „Inhibited Spontaneous Emission in Solid-State Physics and Electronics", Physical Review Letters vol. 58, No. 20, p. 2059-2062, May, 1987

Lazăr Bogdan, Paul Sterian, „Bandpass filter for photonic crystal microcircuits", Proceedings of SPIE, vol. 5 – 631, 2007

PO14: Analysis of in-plane rotational dynamics for photoisomerisable (DCM) and non-photoisomerisable (NR) molecules in PMA matrix

Kordas Wojciech[1], Dutier Gabriel[2], Pawlik Grzegorz[1] and Mitus Antoni[1]

[1]Institute of Physics, Wroclaw University of Technology, Wybrzeże Wyspiańskiego 27, 50-370 Wroclaw, Poland
[2] Laboratoire de Physique des Lasers, Unite´ Mixte de Recherche 7538 du Centre National de la Recherche Scientifique, Universite´ Paris 13, 99 Av J.-B. Cle´ment, 93430 Villetaneuse, France

Keywords: single molecule spectroscopy, photo-bleaching, anomalous diffusion.

We show the analysis of rotational dynamics for both photoisomerisable (DCM) and non-photoisomerisable (NR) molecules in polymer (PMA) matrix. Experiment was performed by Gabriel Dutier and Sophie Brasselet in ENS de Cachan (France). Firstly we present typical patterns of temporal evolution of angles for both types of molecules. Then photo-bleaching is shown. Histograms of photo-bleaching indicate totally different kind pdf (probability density function) of lifetimes between DCM and NR molecules. Main part of this analysis is the calculation of time correlation function of in-plane angles. Results show clear subdiffusive behavior of the system in both cases. However this analysis should be treated as preliminary because of limited experimental data, and more experiments should be performed to obtain better averaging.

PO15: Characterization of chaotic emission of a laser diode for selective and unselective optical feedback produced by external reflectors

Andrei, Ionut-Relu[1], Ticos, Catalin-Mihai[1], Bulinski, Mircea[2] and Pascu, Mihail-Lucian[1,2]
[1] National Institute for Laser, Plasma and Radiation Physics, Department of Lasers, str. Atomistilor 409, 077125, Magurele, Romania
[2] University of Bucharest, Faculty of Physics, str. Atomistilor 405, 077125, Magurele, Romania

Keywords: multimode laser diode, optical feedback, chaos, LFF

A laser diode (LD) shows a rich variety of dynamic phenomena named chaotic dynamics, when subjected to optical feedback from an external reflector, (Bulinski & Pascu, 2001). When the radiation emitted by LD is redirected into the laser cavity as feedback from an external reflecting surface, the configuration is known as external-cavity semiconductor laser (ECSL). Chaotic behaviour of LD with external feedback conditions is influenced by some of the intrinsic properties of the lasers. Broad gain spectrum (~5nm) which allows the excitation of different longitudinal modes of the laser diode cavity, small changes of driving parameters and strong dependence of the active medium refractive index on the excited carrier density or temperature are the most important factors. The amount of the intensity optical feedback greatly influences the system dynamics. One of the most intensely studied issue on the chaotic dynamics of ECSL is the regime of low-frequency fluctuations (LFF). This is an unstable regime, manifested as a cyclic dropout almost to zero of the output light intensity evidenced when a typical ECSL with weak optical feedback operate slightly above the lasing threshold (Liu & Davis, 1999). The time intervals between these dropouts are uncorrelated and depend on the control parameters of the ECSL, having a rate of gradually return to full power of about tens to hundreds of nanoseconds. The chaotic behaviour of an ECSL working in LFF regime can be controlled by different parameters such as injection current, temperature, external cavity length, external feedback, variations in the external cavity length (Andrei *et al*, 2010). In the present work we aimed to experimentally evaluate the chaotic dynamics of a laser diode emission (λ=633nm) with respect to the external optical reflector type of the ECSL system. In our case this reflector is, in order, a totally reflecting mirror, a holographic grating of 2400 lines/mm and a ruled grating of 1200 lines/mm. The measurements are made for an average to high optical feedback coefficient. Medium feedback levels, near the lasing threshold, generate line broadening and the coexistence of the LFF and the so called coherence collapse (including sub-harmonic bifurcation, intermittent behavior and self-pulsation). The laser was multimode operated and it was selectively adjusted on a few single longitudinal modes throughout the experiments by modifying the mirror position or angle of the gratings. The chaotic characteristics of the laser emission were analyzed with respect of the structure of the laser beam. The measurements show that there is a different evolution of the LFF dynamics between mirror and grating cases. Likewise, the deterministic fluctuations which are induced in the output intensity show a different temporal stability in ruled grating (1200 lines/mm) case, as well as mirror and grating (2400 lines/mm) cases. The experimental setup used is schematically shown in Figure 1.

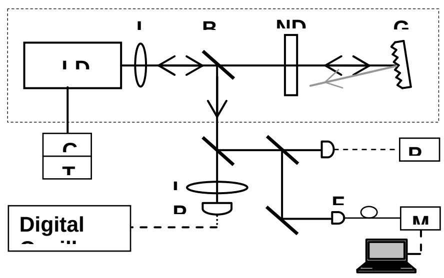


Figure 1. The ECSL experimental setup: LD, laser diode; PD, photo-detector; M, monochromator; PM, powermeter; CS, current source; TC, temperature controller; G, grating; NDF, neutral density filter; BS, beamsplitter; L, lens; FC, fiber coupler. The external cavity length is around of 30 cm.

Acknowledgments. The research work is supported by the National Authority for Scientific Research (RO) projects No. LAPLAS 3 – PN09 and No. PNCDI II 72-219/2008.

Reference:

M. Bulinski, M. L. Pascu, Chaos in laser diode light emission, Romanian Journal of Optoelectronics, 2001, ***19****(2), 34.*

Y. Liu, P. Davis, Recovery process of low-frequency fluctuations in laser diodes with external optical feedback, Phys. Rev. E, 1999, ***60****, 6595.*

I.R. Andrei, C.M. Ticos, M. Bulinski, M. L. Pascu, Chaotic behaviour in the emission of semiconductor laser optically coupled with an external cavity, JOAM, 2010, ***12****(1), 57.*

16:15 – INVITED LECTURE – Outreach activities in optics and photonics

Sporea, Adelina and Sporea, Dan
Center for Science Education and Training, National Institute for Laser, Plasma and Radiation Physics,
409 Atomistilor St, RO-077125, Magurele, Romania
dan.sporea@inflpr.ro

Keywords: science education, outreach, photonics

Starting from 2006 we established at the National Institute for Laser, Plasma and Radiation Physics the Center for Science Education and Training (http://education.inflpr.ro) aiming to support science education at all levels (from kindergarten to high school) in order to increase youngsters' interest into science and technology carriers. The Center runs national and international projects, organizes science related activities: science clubs, science fairs, contests, demo and training sessions for school teachers and students (Sporea, 2009). It is involved into the coordination at national level of the educational network "Hands-on Science – Romania". The Center is member of several international educational networks such as: Network for Youth Excellence; European Science Events Association – EUSCEA; l European Science Education Research Association – ESERA; Coalition for Science after School (SUA); MirandaNet, and has collaborations with various educational entities. Every year the Center organizes the international conference "Science Education in School – SES". The last year Conference was focused on the implementation of the inquiry-based science education at primary school level. In the field of optics and photonics teaching the Center is supported by SPIE and OSA, both institutions awarding educational grants to develop optics teaching in Romania. The grants helped the team to organize photonics demo sessions in several schools across the country and to start cooperation with the school for children with special hearing needs. The Center assisted several high school in Romania with advanced optical instruments for school experiments (microscope, small foot spectrometers etc.). Over the years the Romanian team had developed cooperation programs with National Optical Astronomy Observatory – NOAO (Arizona, USA) by promoting the "Hands-on Optics - HoO" project in Romania. During the 2007 international workshop "Science Education in School" the dr. Stephen Pompea, Manager of Science Education in the NOAO Office of Education, introduced to the Romanian educational community the project "HoO". In 2008, a tutor from NOAO delivered a 2 days course for Romanian primary and middle school teachers in Bucharest. The event was accompanied by an exhibition with optics related experiments developed by Romanian students. In the frame of a cooperation the Center has with the New England Board of Higher Education (Boston, SUA) three Romanian school teachers of physics graduated the course on photonics (PHOTON-2 project, supported by the NSF). The collaboration was reinforced by the participation of the PHOTON-2 Principal Investigator Fenna Hanes to the SES 2007 international workshop. Dr. Sporea along with one Romanian school teacher took part to the PHTON-2 training course in Boston (Sporea, 2007). In 2009, the Center, supported by SPIE and OSA, organized in cooperation with EASTCONN - the Regional Educational Service Center (CT, USA) and the Three rivers Community College (SUA) the international contest of photos and drawings "Light in our Life". Other activities organized by the Center refer to the evaluation of light pollution and the celebration of the Interracial Year of Astronomy. The Romanian team contribution in photonics educational activities was recognised by their citation in the Photonics21 Research Agenda of the EU. For the project on climate change developed together with "The Holy Cross School" (Surrey, UK) and the theoretical high school "G. Moisil" (Bucharest, Romania) the Center received the "Rolls-Royce Science Team Award" for outstanding contribution to science teaching.

The authors would like to acknowledge the financial support to carry out these educational activities of: the Romanian Ministry of Research and Technology (grant 58/ 2006, Project SET), the European Social Funds (grant 11015/2009, project Discover!) and the European Union (grant 244684/ 2010, project Fibonacci).

References:

Dan Sporea and Adelina Sporea, Outreach Activities for Pre-University School Students Coordinated by the Centre for Science Education and Training, J. Eng. Education, Vol 25, No. 3, 2009, pp. 426-435.

Dan Sporea, Nicholas Massa, Judith Donnelly, Fenna Hanes, "Web-based photonics training for a new, "flat world", Latinamerican meeting on Optics, Lasers and Applications (OPTILAS), October 21-26, 2007, Campinas, Brasil.

PO16: Using laser physics in high school

Cătălin Chițu[1-2], Alexandra Vintilă[1], Cătălin Măciucă[1], Laura Mihai[2,3]
[1]Energetic High School, Câmpina, Romania
[2]University of Bucharest - Faculty of Physics, Bucharest, Măgurele , 077125, Romania.
[3]Center for Science Education and Training, INFLPR, Bucharest, Măgurele , 077125, Romania.
E-mail : catalinchitumail@yahoo.com

Keywords: Laser beams, experiments, physical parameters, Alternative methods, differentiated instruction

The objective of this study is to diversify the methods of instruction within the framework of teaching laboratory experiment. Laser use is made both in geometrical optics and experiments in other areas of physics. The advantages of using laser beams, compared with using conventional light sources are used in teaching process to resume and systematization of certain physics experiments both in the classroom as well as across groups of students passionate about the study of physics.

Individualization of learning styles of students and the existence of a variety of educational profiles are strong arguments for promoting diverse methods of teaching - learning - assessment.

For a good efficiency of training, this study aims deduction features of physical parameters of materials studied by at least two alternative methods of learning. Depending on the method chosen student will be able to understand, retain and build skills related to preferences in the fields of cognitive and action. Following feedback achieved, the student will know which of the methods used in laboratory experiment and fit.

Differentiated instruction is predicted to grow by feeling the active involvement of students, allowing them to discover strengths and areas to use their best.

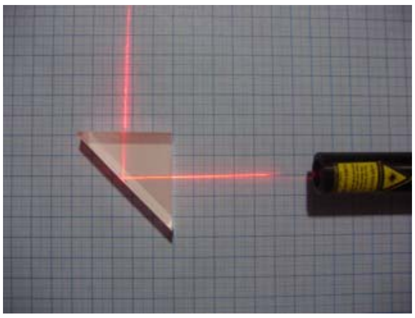


Figure 1. Total reflection study

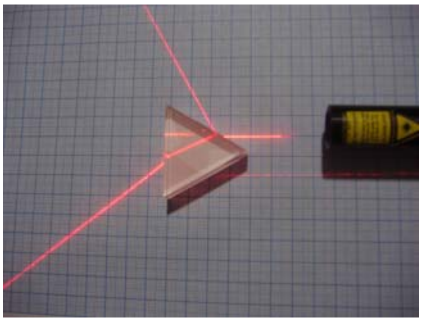


Figure 2. Study of minimum deviation

References:
Lidia Panaiotu, Iunian Chelu, Maria Petrescu Prahova, Elena Adriana Teodoru, Experimental work in physics for high school, Didactic and Pedagogic Publishing House, Bucharest, 1972, p. 245-247
Viorel Malinovschi, Methods for solving physics-Vol.V Optics, Publishing Parallel 45, Pitesti, 2004, p. 7-9
Cristina Miron, Teaching Physics, Bucharest University Publishing House, Bucharest, 2008, p. 152-156
Viorel Malinovschi, Teaching Physics, Didactic and Pedagogic Publishing House R.A., Bucharest, 2003, p. 248-245
Constantin Mantea, Mihaela Garabet, Physical-Manual 9th grade, Editura Bic All, Bucharest, 2004, pag.8-22
Emil I. Toader, Virgil Spulber, 555 tests Optics, Didactic and Pedagogic Publishing House, Bucharest, 1989, p. 57-58
George Vlăducă & Co., Problems of Physics for class XI-XII, Didactic and Pedagogic Publishing House, 1983, pag.28-30

PO17: Laser audio transceiver/receiver on Mars community

Garabet Mihaela[1,2], Neacsu Ion[2] and Munteanu Dragos[2,3]
[1]Faculty of Physics, University of Bucharest, Romania
[2] "Grigore Moisil" Theoretical High School, Bucharest, Romania
[3]Faculty of Automatic Control and Computer, University "Politehnica"of Bucharest, Romania

Keywords: green energy, photovoltaic cell, laser, radio transceiver/receiver, Martian community.

We will present and make a live demo with an application of the lasers in what concerns an audio transceiver/receiver, a device that will allow taking any sound source, and transmitting it over a laser beam. We will use a laser for the transceiver and a photovoltaic cell for the receiver. Why photovoltaic cell? Because all the energy we are using on Earth (and even on Mars) came from the Sun, no matter if it is oil, coal, gas, wood, etc. Today, the mankind is trying to use green energy which is environmentally friendly and non-polluting. Every consumer may purchase green energy (solar, wind, geothermal), in order to support further development, to help reduce the environmental impact of the conventional electricity generation and to increase their energy independence. And maybe the most important fact is that green energy provision doesn't compromise the ability of the future generation to meet their needs.

We have imagine and build a small community that uses only green technology for generate the energy they need. Maybe one day this small Moisil Town will be able to sustain itself on Mars! All the objects are real, hand-made by the participant students and the interaction is virtual, in order to develop virtual learning environment.

Figure 1. This is our little colony on Mars

Our project started from a pedagogical research on studying the green technologies (solar energy converters like photovoltaic cells and green leafs) in high school. The students helped by their teachers, made some simple applications like solar house, solar lift, solar power station for toy car chargers, solar gusher fountain. After all this, came the new challenges: robots on Mars and radio transmissions with lasers. Moreover, the whole little town will be a colony on planet Mars. The team learned how to interact with these green devices from distance, via Moisil Live.

See (username: vizitator password: vizitator): *http://portal.moisil.ro/tehnologiiverzi/Shared%20Documents/Forms/AllItems.aspx*

And now a short description of the laser audio transceiver/receiver we have built.

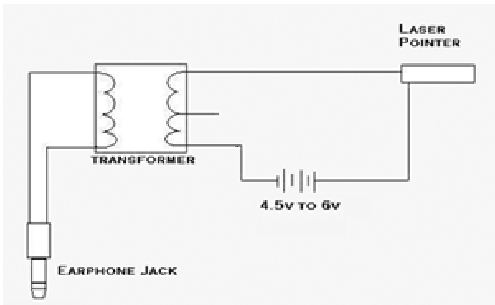


Figure 2. This is the block scheme of the transceiver (Ryan Woodford)

As you can see it contains a Laser Pointer supplied with 4.5 to 6 volts, a sound source with an output jack and an earphone jack to fit the sound source (a radio in our case). The sound source will turn the audio into an electrical current to be transmitted over the jack, wire, and the transformer. This will vary the amount of resistance on the other side between the batteries and laser pointer, making the intensity of the light directly affected by the intensity of the audio (amplitude modulation). The receiver, a photovoltaic cell, works the opposite way, varying the amount of current depending on the intensity of the light it receives. And so, we can make radio transmissions in our small community.

http://portal.moisil.ro
http://www.freeinfosociety.com/site.php?postnum=2310

PO18: Albert Abraham Michelson – the master of light

Kolenderska, Sylwia

Department of Physics Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University, 87-100, Toruń, Poland

Keywords: Albert Abraham Michelson, light, interferometer, OCT

Albert Abraham Michelson (Figure 1) was born in 1852 in a small Polish town, Strzelno. When he was two his parents, Samuel Michelson, a cotton merchant, and Rozalia Przyłubska, decided to emigrate to USA where Albert grew up, got married and, what is the most important, became renown and respected scientist.

Light was always his great passion. He constructed his interferometer which helped him measure nearly exact value of velocity of light and which nowadays is known by the name: Michelson interferometer and is used in many modern appliances like OCT. He built setups to be able to measure the famous ether in the experiments known today as Michelson – Morley experiments. In the end as the first scientist from United States of America he was awarded the Nobel Prize.

But apart from being great, intuitive scholar he remained a man with a lot of different interests. He played the violin and liked music, he painted and was very interested in zoology, did sports and was active almost until his last days of life.

His younger colleague, Albert Einstein, told that, if it was not Michelson, his theory of relativity "would be merely a speculation".

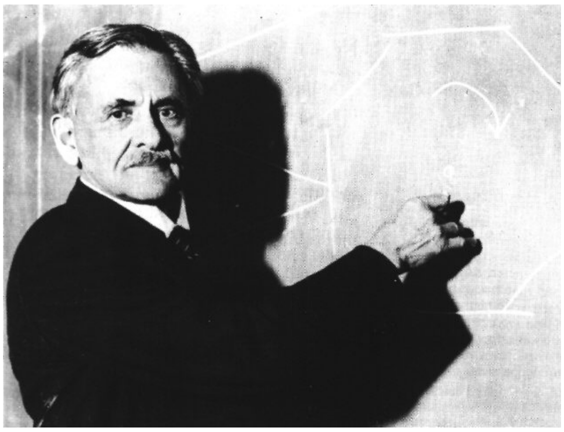


Figure 1. Albert Abraham Michelson

Bernard Jaffe, "Albert Michelson", Wiedza Powszechna 1964

Tomasz Kardaś, Szymon Kardaś, Albert Abraham Michelson – noblista ze Strzelna, Foton 84, pages 25-37, 2004

Robert A. Millikan, Biographical memoir of Albert Abraham Michelson, http://books.nap.edu/html/biomems/amichelson.pdf, 02/04/2010

ROUND TABLE - Quo vadis scientific research? - Bridging expectations and economy needs

Clementina Timus
National Institute for Laser, Plasma and Radiation Physics
Magurele, P.O. Box MG-36
077 125 Romania
E-mail: clementina.timus@inflpr.ro

The organization of this round table is an invitation for discussions, change of information and opinions between young scientists, professors, non graduated students before the option for a future job.
The long transition from an autocratic system to the market economy in the former socialist countries from Eastern and Central Europe determined a reconfiguration of the situation in many domains, the scientific one, as well.
The characteristics of the education nowadays in Romania and the possibility to compare it with the situation of other countries could be useful for every attendee to critically evaluate and adapt to the ever changing market economy. The tremendous changes produced in the economy determined professional re-orientation, the development of new activities, interdisciplinary ones. The investment in research was much influenced by the trends at European level and the access to EU imposed the approach of new strategy, adopting the system of funding research based on project competition since 2004.
As other economical activities the research was highly affected by the world crisis when the funds for such activity decreased dramatically in the last year.
The presence at the round table of professors and members of the Commercial Chamber and Industry in Romania to inform the students about the very specific features of the economy, to try to encourage people to adopt an entrepreneurial thinking is in our intention of high interest for the young researchers.
It would be of high interest to have the feedback from the students and young scientists to know their problems, to have their observations suggestions to better know their expectations.
The Eastern and Central Europe countries were confronted in the last two decades with the brain drain phenomenon and many of the most brilliant minds are enrolled in the big research centers all over the world. It is known that the Romanian math school is very appreciated in States and the winners of the International Olympiad contests in mathematics, informatics and physics are invited to graduate from the most famous universities. Statistics are presented regarding recent evaluations. The discussion is intending to stress the real situation nowadays, when the world crisis is affecting the domain as well, to know the opinion of young researchers as well, to confront the situation in different countries and offer for undergraduate students a clear image. The dialog between young scientists, their experience obtained in the field and the evaluation of the prospects could be useful.
In research and development more than in other domain the globalization is a reality; as evaluating the statistics regarding the bibliometric indicators the conclusion is that the share of world scientific publications declined in the developed countries over the last 20 years. It is to note an increased share of publications in collaboration of scientists from developing countries with those from developed countries.
According the data provided by the UIS – UNESCO Institute of Statistics in 2009 referring to the human resources in R&D it is to note that the highest representation is in Asia when in the other principal regions a decrease is to note in America and Europe from 2002 to 2007.
The evaluation of GERD in 2007 shows that the highest figure 4.7% is allocated in Israel 2.7% in North America, 1.6% Europe and Asia. It is easy to understand that in emerging countries the situation could be critical.

References:

UIS Bulletin on Sccience and Technology Statistics Issue No.2, September 2005 http://www.uis.unesco.org/template/pdf/S&T/BulletinNo2EN.pdf

UIS Fact Sheet, October 2009,No.2 A Global Perspective on Research and Development http://www.uis.unesco.org/template/pdf/S&T/BulletinNo2EN.pdf

09:00 – INVITED LECTURE – Advanced laser processing of soft materials

Dinescu M.[1], Palla-Papavlu A.[1], Dinca V.[1], Shaw-Stewart J.[2], Mattle T.[3], T. Lippert[3]

[1]National Institute for Lasers, Plasma and Radiation Physics, Atomistilor 409, Magurele, MG 16, Zip 077125, Romania
[2]EMPA, Swiss Federal Laboratories for Materials Testing and Research, Laboratory for Functional Polymers, Überlandstrasse 129, 8600 Dübendorf, Switzerland
[3] Paul Scherrer Institute, General Energy Research Department, 5232 Villigen PSI, Switzerland

Keywords: laser, printing, microstructures, shadowgraphy

Nowadays, a strong research effort is devoted to develop patterning methodologies for the spatially controlled deposition of a wide range of polymer, organic and inorganic materials. Patterning of biomolecules, in particular enabling precise positioning of biological active compounds with nano and micro scale resolution over large areas, is the main demand in the development of next generation research, analytical and diagnostic applications such as biosensors and microarray chip devices. In this study are presented two laser processing of polymer and biological compounds materials techniques, namely matrix assisted pulsed laser evaporation (MAPLE) and laser induced forward transfer (LIFT). Conventional pulsed laser deposition (PLD) using ultraviolet (UV) laser sources cannot be applied to most soft materials, since irradiation by UV light induces a substantial decomposition of the target molecules. Soft inorganic, organic, polymer and biomaterial films can be produced by an alternative technique, known as matrix assisted pulsed laser evaporation (MAPLE) which has the potential to create thin films of controlled thickness at the nanometer scale (10–500 nm) on surfaces of various substrates. Here, we show that thin polymeric (Polyethilenimine (PEI), Polyisobutylene (PIB) and Polyepichlorhydrine (PECH)) films can be obtained by the MAPLE process. The analysis of the films demonstrates that high quality films can be obtained and that a significant part of the polymer molecules are transferred to the substrate without decomposition. Laser induced forward transfer (LIFT) is widely used for the transfer of numerous materials such as metals, oxides, polymers, and biomolecules. In particular, biologically active molecules in liquid phase can be also transferred using an intermediate metallic or polymeric layer as sacrificial dynamic release layer (DRL), which protects the material to be transferred from direct laser irradiation (damaging). Triazene polymers (TP) are good candidates as sacrificial layer, because they decompose upon UV laser irradiation into gaseous fragments which transfer the soft material, with a minimum thermal load, to a receiver. This approach was used to enable a precise positioning of liposome containing solutions with micro scale resolution for possible applications such as biosensors and microarray chip devices. In order to understand and optimize the transfer process of biomolecules in liquid phase, shadowgraphy imaging was performed both on liposome containing solution as well as on a model solution consisting of double distilled water and glycerol. We will discuss the transfer mechanism, the effect of laser fluence on the deposited patterns, as well as advantages and limitations of the DRL assisted LIFT.

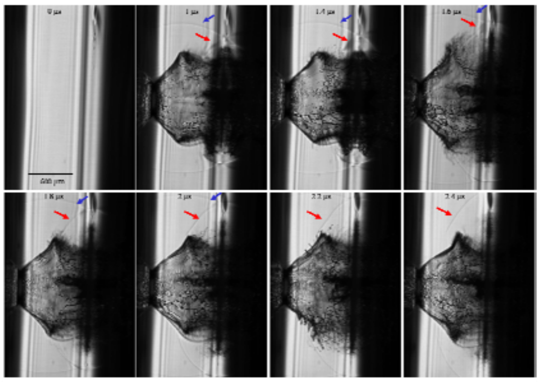


Figure 1. Shadowgraphy images of the laser transfer process of a model solution containing water and glycerol (50:50)

A. Palla-Papavlu, C. Constantinescu, V. Dinca, A. Matei, A. Moldovan, B. Mitu, M. Dinescu, Sensor Letters, Vol.8, 1–5, 2010

Fardel R., Nagel M., Nüesch F., Lippert T., Wokaun A., J. Phys. Chem. C 113, 11628 2009

A. Palla-Papavlu, I. Paraico, J. Shaw-Stewart, V. Dinca, T. Savopol, E. Kovacs, T. Lippert, A. Wokaun, M. Dinescu, "Liposome Micropatterning Based on Laser Induced Forward Transfer" submitted 2010

PO19: Different microscopic characterization techniques on hydroxyapatite powder

Aurora Anca Poinescu [1)], Rodica Mariana Ion [2,3)] Otilia Vasile[4)], Raluca-Ioana van Staden[4)], Jacobus Frederick van Staden[4)], Marius Ghiurea[3)]

1) Valahia University of Targoviste, 2 Regele Carol 1 Street, poinescua@yahoo.com,
2) Valahia University of Targoviste, 2 Regele Carol 1 Street, rodica_ion2000@yahoo.c.uk
3) ICECHIM, Bucharest, Analytical Department, 202 Splaiul Independentei, Bucharest-060021, Romania;
4)National Institute of R&D for Electrochemistry and Condensed Matter, Electrochemistry Laboratory, Timisoara, 202, Splaiul Independentei, Bucharest-060021, Romania; iustinavanstaden@yahoo.com

Keywords: hydroxyapatite, wet precipitation, AFM, SEM, FTIR.

The hydroxyapatite (HA) is one of the most used materials in medical applications, due to its similarity with human bones. A chemical synthesis method, and the characterization by atomic force microscopy (AFM) and scanning electron microscopy (SEM), has been chosen in this paper. The surface study on nm scale and the surface topography were evaluated by using AFM with tapping mode. The size distribution of the grown spherulite was carried out by AFM, operating in non-contact mode. The SEM pictures of the grown spherulite crystals shows many spherical agglomerations and few crystallites of 0.1 μm in size with pores.

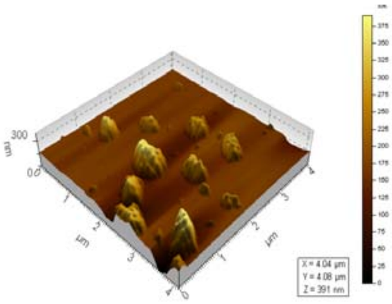


Figure 1. AFM analyse on hydroxyapatite

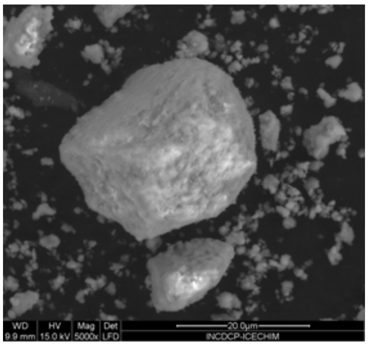


Figure 2. SEM Analyse of Hydroxyapatite with 1000X magnitude.

References:

A. Ruban Kumar and S. Kalainathan, Growth and characterization of nano-crystalline hydroxyapatite at physiological conditions, Cryst. Res. Technol. 43, No. 6, 640 – 644 (2008) / DOI 10.1002/crat.200711094;

Dong Seok Seo, Jong Kook Lee, AFM analysis of anisotropic dissolution in dense hydroxyapatite, Ultramicroscopy 108 (2008) 1157– 1162;

N. Monmaturapoj, Nano-size Hydroxyapatite Powder Preparation by Wet-Chemical Precipitation Route, J of Metals, Materials and Minerals. Vol.18, No.1, pp. 15-20, 2008;

Aurora Anca Poinescu, Rodica Mariana Ion, Inna Trandafir, Elena Bacalum, Constantin Radovici, Obtaining and characterization of a calcium hydroxyapatite, The XV-th International Scientific Conference "Tehnomus", May 8-9, 2009, Suceava Romania;

Maria Helena Santos, Marise de Oliveira, Luciana Palhares de Freitas Souza, Herman Sander Mansur, Wander Luiz Gerais, Synthesis Control and Characterization of Hydroxyapatite Prepared by Wet Precipitation Process, Materials Research, Vol. 7, No.4, 625-630, 2004.

T. Anee Kuriakose, S. Narayana Kalkura, M. Palanichamy, D. Arivuoli,Karsten Dierks, G. Bocelli, C. Betzel, Synthesis of stoichiometric nano crystalline hydroxyapatite by ethanol-basedsol–gel technique at low temperature, Journal of Crystal Growth 263 (2004) 517–523.

10:20 – INVITED LECTURE - Romanian contribution to the EUROMET 156 project

Sporea, Dan, and Sporea, Adelina
Laser Metrology Laboratory, National Institute for Laser, Plasma and Radiation Physics (NIPNE),
409 Atomistilor St., RO-077125, Magurele, Romania
dan.sporea@inflpr.ro

Keywords: intercomparison, laser power, metrology, proficiency testing.

The paper reports the contribution of the Laser Metrology and Standardization team to the international inter-laboratory comparison for the evaluation of laser power for several free space operating gas and solid-state lasers. The comparison corresponds to the supplementary comparison (SC) on radiant power of high power lasers (EUROMET project 156), as decided by EUROMET Photometry and Radiometry Contact persons during their Delft meeting, in April 12-13 1999. The comparison asks also as a global comparison carried out worldwide, being the first of this type over the 50 years period elapsed from the invention of the laser.

The participants were asked to evaluate the spectral responsivity of two laser power detectors, produced by Ophir (type 30A) and Molectron (type PM10), at the laser wavelengths and power levels stated in Table 1. The international participants to this project were: NMI (Australia); LNE (France); Physikalisch-Technische Bundesanstalt - PTB (Germany); NMIJ/AIST (Japan); NIPNE (Romania); NMISA (South Africa); SP (Sweden); NPL (United Kingdom); NIST (USA) (Kück, 2010). All the participants have to report the measurement conditions as well as the uncertainties budget.

Table 1. The wavelength and power level used for the comparison.

Laser type	Wavelength (nm)	Power level (W)
Ar^+	514.5	1
Nd:YAG	1064	1
Nd:YAG	1064	10
CO_2	10600	1
CO_2	10600	5

The Romanian team performed tests on the spectral responsivity of the two detectors at Ar^+ and Nd:YAG wavelengths, for the power level of 1 W. A schematic representation of the set-up used for the measurement of the Ar^+ laser power is illustrated in Figure 1. For the calibration of the two detectors at both the Ar^+ and the Nd:YAG lasers wavelengths the fluctuations of the laser power were monitored as the substitution methods was used. Corrections were made as it concerns the ambient temperature changes, the detectors' dark signal and the ambient lamination. The reproducibility of the laser beam incidence on the detector, the influence of the detectors' surface non-uniformity of the responsivity and the error induced by the changes in the incidence angle were taken into account.

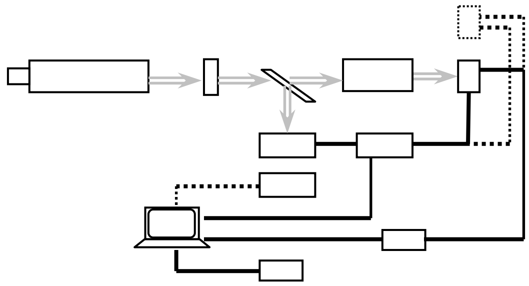


Figure 1. The set-up for the evaluation of the Ar^+ laser power.

The comparison results for the Supplementary Comparison Reference Value (SCRV) associated to the spectral responsivities of the two detectors are indicated in Table 2, while the Laboratory Degrees of Equivalence along with the corresponding uncertainties are listed in Table 3.

Table 2. The comparison SCRVs.

Laser type	SCRV (mV/W)
Ar^+ (30A)	1.4998
Ar^+ (PM10)	1.4617
Nd:YAG (30A)	1.6594
Nd:YAG (PM10)	1.6243

Table 3. The Romanian team results.

Laser type	SCRV (mV/W)	U (%)
Ar^+ (30A)	- 0.12	1.87
Ar^+ (PM10)	0.55	2.26
Nd:YAG (30A)	0.19	1.34
Nd:YAG (PM10)	0.26	2.29

The authors would like to acknowledge the financial support of the Romanian Ministry of Research and Technology through the grant 243/2004, in the frame of the "INFRAS" Program.

Stefan Kück, Final report on EUROMET comparison EUROMET.PR-S2 (Project No. 156): Responsivity of detectors for radiant power of lasers, Metrologia, 47, 2003, doi: 10.1088/0026-1394/47/1A/02003.

PO20: Evaluation of Optical Spectrum Analyser Best Measurements Capabilities

Mihai, Laura and Sporea, Dan
Laser Metrology and Standardization Laboratory, National Institute for Laser, Plasma and Radiation Physics, 077125, Magurele, Romania
Contact email: laura.mihai@inflpr.ro

Keywords: calibration procedure, optical spectrum analyzers, wavelength and optical power calibration

The Optical Spectrum Analyzer (OSA) is key equipment used for a wide range of applications in evaluating passive and active components for optical communications links, considering its accuracy, dynamic range and spectral resolution. Its most important applications are: the testing of light sources (LEDs, distributed – feedback laser diodes – DFB-LD, Fabry Perot laser diodes) spectral purity and the spectral power distribution in passive and active components. In order to improve the quality of the tests performed with an OSA, we have to evaluate the instrument's best measurements capabilities (BMC) for wavelength, optical power and spectral response. The assessment of the equipment BMC is done in our Laboratory during the OSA calibration. For this purpose, we developed several set-ups and the appropriate procedure was established. We used this procedure to calibrate two OSAs: a bench-top (ANDO) and a portable one (EXFO). For the wavelength calibration three different methods were employed:: a) reference materials in conjunction with a wide band light source (a Hydrogen Cyanide - $H^{13}C^{14}N$ filled cell for the spectral range 1526 – 1566 nm; a Carbon Monoxide $^{12}C^{16}O$ filled cell for the spectral range 1560 nm – 1600 nm; b) a tuneable laser source (for the interval 1530.33 nm to 1566,31 nm); c) two DFB lasers (operating at 1310 nm and 1550,12 nm). The calibration results indicated that the bench top optical spectrum analyzer has the best measurements capabilities for the characterization of optical communications systems (Fig.1), with a standard deviation equal to 0,20 nm, against 0,38 nm obtained for the bench-top instrument. The reference wavelength meter used in combination with the tuneable laser source is traceable to the Swiss National Institute of Metrology – METAS. For the optical power calibration we used a thermally stabilized reference power meter, traceable also to METAS. The calibration was made for the reference power level equal to 100 µW at λ=1550.12 nm. We kept the reference power fixed and we performed 10 acquisitions for each optical analyzer. Results are given in Table 1. A comparative study of the wavelength and power short term stability, the channel drift and the polarization dependence of the detected optical power was carried out for the both OSAs.

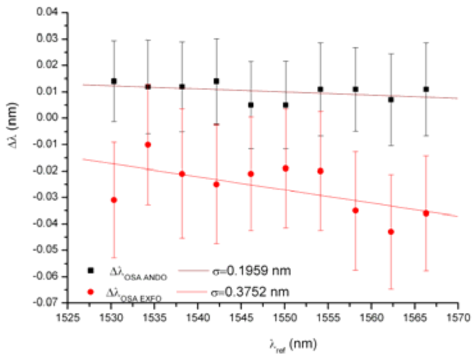


Figure 1. The calibration results corresponding to ten wavelength channels for the two OSAs.

The portable instrument has a very good stability: 0.5021 pm (wavelength stability) and 0.0261 dBm (signal level). We performed also the evaluation of the spectral responsivity and optical power stability for the primary standards used and the results show very good stability responses, with standard deviation values equal to 0,5 pm and respective 0,5 µW.

Table 1. Optical power calibration for the two OSAs.

Optical Spectrum Analyzer	ΔP (nm)	$U_{\Delta P}$ (nm)
1(the bench top one)	0.1137	0.4089
2(the portable one)	-0.3741	0.206

References:
Calibration of optical spectrum analyzers, IEC 62129 Ed. 1.0 b:2006.
Reference Guide to Fiber Optic Testing, Vol.1, 2007.
Certificate of Analysis – Standard Reference Material 2519a, NIST, 2005.
White Paper: In-service Measurement of the OSNR in ROADM-based Networks, JDSU, 2005.
EXFO Electro-Optical Engineering Inc.: "Optimizing the selection of your optical 129 spectrum analyzer", 2005.
EXFO Electro-Optical Engineering Inc.: "CWDM and dwdm testing in the field using broadband sources and an OSA", 2005

PO21: Investigation of the vibration damping using laser vibrometry

Sporea, Dan[1], Dragomirescu, Cristian[2] and Frumosu, Flavia-Dalia[2]
[1]National Institute for Laser, Plasma and Radiation Physics, 409 Atomistilor St., Ro-077125, Magurele, Romania
[2]University "POLITEHNICA" of Bucharest, 313 Splaiul Independentei St., Ro-060042, Bucharest, Romania

Keywords: Laser vibrometry, damping, vibration.

In the present paper we present the effects of a free oscillating pendulum on the damping vibrations of a panel embedded at one of its ends (Deciu 2001). The results of the study are of interest as they can provide useful data to implement counter-measurers in order to reduce the earth-quakes impact on old buildings. According to our paper, a building wall is assimilated with the embedded panel subject to periodical vibrations, so predictions on infrastructure deformations under external excitation can be modelled (Bougard 1998). In our case, on a panel about 18x20 cm, with one fixed end, a pendulum having the weight of $m\bar{g}$ and l length is hanged at distance q(t) from the panel plane. Different types of materials for the panel were investigated. In our case we have used steel, aluminium and textolit. The tests include the use of different masses and lengths for the pendulum, in order to asses its influence in damping the panel vibrations. Previous studies have investigated the damping properties of the oscillating pendulum by evaluation the pendulum mass movement. The previous model investigated the panel movement by studying the pendulum angular elongation in time - θ(t). The novelty of our approach is provided by the evaluation of the panel movement using the 1D scanning laser vibrometry. In this way, the panel vibration is measured directly, while the pendulum is used only as a damping element.

In our experiment, the pendulum was fixed in two different positions, as indicated in Figure 1.

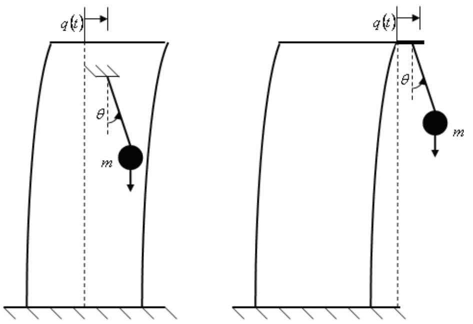


Figure 1. The set-up of the damping effect introduced by a pendulum.

The vibration modes of different panels were measured with the Polytec Scanning Vibrometer PSV-3D. In the 1D scanning mode, the system makes possible the mapping of the vibrating surface. This is done by estimating the temporal variation of the velocity vector over a user predefined grid. In our case, 10 x 10 testing points were used. In order to evaluate the temporal variation of the panel vibrations in each testing point the panels were excited with acoustic waves generated by a loudspeaker, the acoustic source being excited by the internal generator of the PSV-3D. In this way, the signal frequency, its amplitude and shape (sinusoidal, triangle or ramp) can be selected. In this set-up, the electrical signal used for the excitation of the loudspeaker is also used as the reference signal for velocity processing. The system allows also the FFT analysis of the acquired date in each investigated point. In the case of a sinusoidal signal the following parameters were employed: frequency of 500 Hz, 1500 Hz and 5000 Hz, respectively. With the help of Polytec Scanning Vibrometer 8.51 software one can visualize the vibrations in an animated mode. In Figure 2, the Fast Fourier Transformation Spectrum of steel panel vibration without the damping mechanism is illustrated. The sinusoidal signal had an amplitude of 10 a.u. and the frequency of the signal was 5000 Hz.

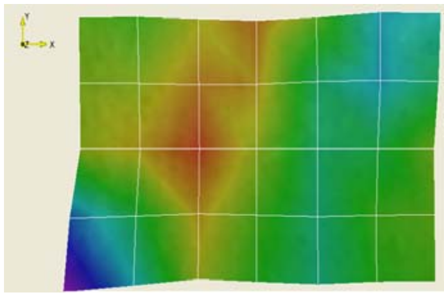


Figure 2. Print screen of a 1D animation of the steel panel

E. Deciu, C. Dragomirescu, Dynamics of Machinery, Editura PRINTECH, 2001, Bucharest, Romania.
A. J. Bougard, B. R. Ellis, Laser measurements of building vibration displacement, Proceedings of SPIE, Third International Conference on Vibration Measurements by Laser Techniques Advances and Applications, 16-19 june 1998, Ancona, Italy.

POSTER SESSION

P1: Breath diagnostics using ultrasensitive CO_2 laser photoacoustic spectroscopy system

C. ACHIM[a,b,*], R. CERNAT[a], A. M. BRATU[a], S. BANITA[a], D. DUTU[a], C. MATEI[a], M. PETRUS[a], M. PATACHIA[a,b] AND D.C. DUMITRAS[a]
[a]National Institute for Laser, Plasma and Radiation Physics
409 Atomistilor St., PO Box MG-36, 077125 Bucharest, Romania
[b]Faculty of Physics, University of Bucharest, Romania
[*]e-mail: cristina.achim@inflpr.ro

Keywords: laser photoacoustic spectroscopy, breath analysis, biomarkers

Photoacoustic spectroscopy has become a powerful technique for measuring extremely low absorptions independent of the path length and offers a degree of parameter control that cannot be attained by other methods. The absorption of laser radiation by a gas creates a pressure signal which is detected by a microphone. The resulting signal, processed by a phase sensitive detector, is directly proportional to the absorption coefficient and laser power.

Exhaled breath analysis is an attractive, promising and noninvasive novel approach for the detection of human biomarkers associated with medical diagnosis. Volatile compounds can be produced anywhere in the body and are transported via the blood stream and exhaled through the lungs. They can reflect physiologic or pathologic biochemical processes such as lipid peroxidation, liver disease or renal failure.

As a typical application, we present precise measurement of trace gases that can be found in the exhaled breath, some of them giving the possibility of a non invasive diagnosis. Exhaled ethylene from many patients was used as a biomarker for lipid peroxidation in lung epithelium following the inhalation of cigarette smoke and X-ray therapy. Also, the ammonia from exhaled air in patients with renal failure was measured and compared with breath test from health humans.

The rapid development of laser photoacoustic spectroscopy (LPAS) method and its use for gas analysis shows that this technique is promising for studying the composition of exhaled air and developing new diagnostic methods for biomedicine. Methods of LPAS are characterized by high sensitivity, accuracy, operating speed and selectivity of measurements.

References:

D. C. Dumitras, D. C. Dutu, C. Matei, A. M. Magureanu, M. Petrus, C. Popa, ''Laser photoacoustic spectroscopy: principles, instrumentation, and characterization", Journal of Optoelectronics and Advanced Materials ***9****, No.12, pp. 3655-3701 (2007)*

E. V. Stepanov, "Methods of highly sensitive gas analysis of molecular biomarkers in study of exhaled air", Physics of Wave Phenomena 15, No. 3, pp. 149-181 (2007)

D.C. Dumitras, D.C. Dutu, C. Matei, A.M. Magureanu, M. Petrus, C. Popa, M. Patachia "Measurements of ethylene concentration by laser photoacoustic techniques with applications at breath analysis",Romanian Reports in Physics 60, No. 3, pp. 593-602 (2008)

P2: Microwelding of stainless steel capsules for radioactive sources

O. Dontu[1], D. Besnea[1], I. Avarvarei[1], R. Ciobanu[1]

[1] Department of Mechatronics, Politechnical University of Bucharest, Splaiul Independentei 313, CH Building, Bucharest, Sector 6, 060042, Romania

Keywords: laser microwelding, radioactive capsules, Nd:YAG laser, welding parameters

This paper presents the results of the experimental research regarding microwelding parameters of sealed stainless steel capsules used for radioactive sources. The investigations were carried out using a ROFIN STARWELD PERFORMANCE SWP 6002 laser installation, a Nd:YAG pulsed laser, and a SEM INSPECT S microscope for measurements of the geometrical size of the welded zone in order to correlate the penetration and width of the different values of welding parameters. Also the metal loss during welding process was measured using a KERN electronic balance type ABJ 220-4M, as well as a microhardness measurements using a Shimadzu HMV 2T microhardness tester, in order to find the most suitable welding parameters.

The capsules are made of 304 type stainless steel 10TiNiCr180 with a balanced austenitic structure (chemical formula Fe, <0.08% C, 17.5-20% Cr, 8-11% Ni, <2% Mn, <1% Si, <0.045% P, <0.03% S). The dimensions of a capsule are: 5mm in diameter and 8mm in length.

Figure 1. The capsules next to a paper clip and a bottle cap

The use of small enclosed nuclear radiation sources has raised a large interest lately in many fields of activity such as: medicine, physics, mecatronics. One of the main requirement of radioprotection states that the enclosed nuclear radiation sources, namely the capsules in which the radioactive material is placed should be perfectly sealed through all their usage time.

The technical specifications and testing methods of the sealed capsules are established by SR ISO 9978 standard "Radioprotection. Enclosed sources of radiation" and the mechanical tests are established are established by ISO EN 15614-1 standard.

Figure 2, presenting the capsule inside the laser chamber

Several tests were performed modifying the laser working parameters, such as: the voltage in capacitor batteries, pulse time, pulse frequency and spot size of the beam. For each sample a metallographic analysis was carried out looking for welding defects and structural modification in capsule's material.

References:

Erich Folkhard, Welding Metallurgy of Stainless Steels, Ed. Springer-Verlag, Wien 1988

T. Zacharia, Heat transfer during Nd:YAG pulsed welding and its effects on solidification structure of austenitic stainless steels, Metallurgical Transactions , vol. 20A, may 1989

O. Dontu, Sudarea cu laser a unor oteluri inoxidabile utilizate in instalatii de process din industria chimica, revista de chimie, nr 3, 2005

Jyoti Mazumder, Laser-beam welding, welding, brazing and soldering, ASM Handbook, vol 6, pg262-265,1993

P3: Method of the dose measurements from intense laser - target interaction using ionization chamber

Scarisoreanu Anca, Badita Eugenia, Sima Eugen, Dumitrascu Maria, Mitru Ecaterina, Minea Radu and Scarlat Florea

Department of Electron Accelerators, National Institute for Laser, Plasma and Radiation Physics– INFLPR, 409 Atomistilor Street, P.O. Box MG-36, 077125, Bucharest-Magurele, Romania

Keywords: laser – target interaction, laser beam, dosimetry, ionization chamber .

The target irradiated by a relativistic laser beam (e.E.$\lambda > 2\pi/m_0c^2 \approx 3.2$ MeV) is generating charged or neutral particles function of the laser intensity (*Rao et al, 2007*). This may be a secondary radiation source. In the above relation, we used the following symbols: e and m_0 are the charge and rest mass of the electron, c is the light velocity; λ and E are the wavelength and the electric field intensity of the laser radiation. When the wavelength is exceeding the value $\lambda \geq 0.25 \times 10^{-9}$. m, the generated radiations are direct and indirect ionizing radiations and they are governed by the Radiological Safety Standards (NRS 2000). In order to use such sources in various domains it is important to conduct a dosimetric characterization of these sources. This paper presents some methods to conduct a dosimetric characterization by means of the secondary stand outfitted with ionizing chambers for X-ray, gamma radiations, photons, electrons, neutrons and protons. The ionizing chambers have been calibrated by PTW – Freiburg, Physikalisch - Technische Werkstatten - Germany and they are located and part of STARDOOR Lab in INFLPR.

References:

B. S. Rao, P. A. Naik, V. Arora, R. A. Khan, and P. D. Gupta, "Angular distribution and dose measurements of hard x-ray emission from intense laser-plasma interaction", J. Appl. Phys., 102, 2007 063307, 1-4.

P5: Reverse engineering for heritage conservation

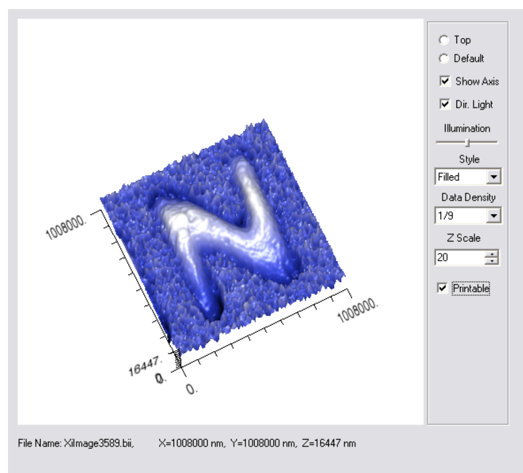
D. APOSTOL, I. APOSTOL, M. BOJAN, V. DAMIAN, I. IORDACHE

Laser Department, National Institute for Laser, Plasma and Radiation Physics, Măgurele, Ilfov, Romania, PO Box MG-36

Scanning technology presents an immense opportunity to create digital copies of real world objects such as cultural heritages. Laser scanner is simply the fastest, most comprehensive technology to move from the 3D scanner into useful data. It offers the most comprehensive set of tools available to ensure an accurate, detailed and easily stored, shared and measured 3D model. Laser scanner is already very useful in large scenes (historical site), statues or large objects digitization. We presents reverse engineering application to small objects like coins and mint symbols using commercially available profilometers as white light interferometer or stylus profilometers.

Reverse engineering technology enables the creation of a digital model using data collected from an existing object. Research from areas such as image processing, computer graphics, advanced manufacturing and virtual reality has converged around creating a computer-based representation of the authentic article. In engineering applications, comprehensive reconstruction of the part form is required to recreate the original object while deviating from the measured points by less than a predefined tolerance. In a broader sense, an object may be given a virtual representation based on physical form and possibly the design intent of the original article. With this in mind, data capture need not be the starting point or automated modeling of surfaces the end goal, leaving the door open for more interactive, knowledge driven approaches. Potential information sources for reverse engineering projects can be physical parts, CAD file formats, milling g-code, laser scan data and CMM data.

White light interferometry which uses polychromatic light in contrast to classical interferometry is a widespread method for optical surface profilometry. The spectral width of the light source employed in white light interferometry ranges from tens to hundreds of nm.. An important advantage of the white light interferometry is that it can be also used for measurement on rough surfaces even in the case of speckle imaging.



References

Advances in the Field of Reverse Engineering Colin Bradley and Bernadette Currie2, 1University of Victoria, cbr@engr.uvic.ca, 2British Columbia Institute of Technology, bcurrie@bict.ca;

Investigating Laser Scanner Accuracy Wolfgang Boehler and Andreas Marbs i3mainz, Institute for Spatial Information and Surveying Technology, FH Mainz, University of Applied Sciences, Mainz, Germany.

P6: Raman spectra measurements on droplets of water and DMSO

M. Boni*, V. Nastasa, I. Jepu, C. Lungu, A. Pascu, A. Staicu, M. L. Pascu

National Institute for Laser, Plasma and Radiation Physics, P.O.Box, MG-36, 077125, Bucharest, Romania
* Corresponding author; E-mail: mihai.boni@inflpr.ro

Keywords: micro-droplets, water Raman spectra, DMSO, Nd:YAG laser

The paper reports results regarding Raman spectra measurements we performed on (micro-) droplets of ultra-pure water and DMSO. The droplets were generated using a computer controlled capillary system (Hamilton - Microlab 500). The main characteristics of the pumping system are: accuracy ±1%; resolution 0.05% out of the syringe volume; the volume step adjustable from 0.05% to 100% out of the syringe volume; the droplet generation may be made in time intervals which varied from 1s to 250s for the total volume of the syringe. The pumped liquid volume is computer controlled.

The diameter of the generated droplets was in our experiments 3 mm; the droplet was produced using a calibrated capillary which had the internal/external diameter ratio 1.19mm/1.65mm. The liquid volume pumped to obtain the droplet, under computer control, was typically 12.5 µl. The Raman spectra were recorded using a computer controlled system (SpectraPro - 2750 monochromator coupled with a Princeton Instruments PI-MAX Intensified CDD camera).The water and, respectively, DMSO droplets were exposed to a pulsed, frequency-doubled Nd:YAG laser radiation (pulse time width 6ns, λ=532 nm, laser pulses repetition rate 10 pps). The beam was focused into the droplet's volume so that the diameter at the focus place was 2mm and the peak power energy density in the focus was (around) $3.18 W/cm^2$. The temperature of the droplets was monitored with the thermo-camera ThermaCAM® E45 (temperature ranges: -20° C to +250° C; accuracy ± 2° C or ± 2% of absolute temperature in °C). The results have shown that the substances that do not absorb at λ=532nm and those which do not emit fluorescence have no major changes in temperature (less than 1°C, which may be correlated with the temperature variations in the room). The fluorescent substances (typically Rhodamine 6G) show an increase in temperature during irradiation which was 10-12K. Water, as well as DMSO do not absorb at 532nm, so that following the interaction with the laser radiation the temperature increased with at most 1° C. The Raman spectra of DMSO and water were measured in two cases: bulk and droplets. In this paper the Raman spectra obtained from droplets were measured and a comparison was made with the spectra measured on bulk samples. The DMSO Raman spectrum for droplets excited at 532nm is given in Fig.1. The results have shown that the Raman spectra of DMSO and water obtained from droplets samples are in agreement with literature reports [1], [2]; the temperature of DMSO and water droplets, changes insignificantly during the exposure to laser radiation.

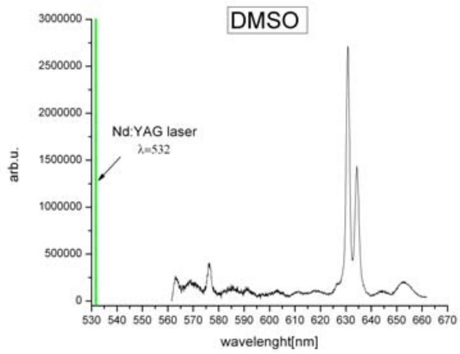


Figure 1. Raman spectra of DMSO

Conclusions: The Raman spectra measurements on micro-droplets may be done on less substance and one may use lower power laser beams. The applications which may be open by measurements of the Raman spectra on droplets are related to faster highlighting the changes in molecules after interaction with laser beams, in direct relation with the laser induced fluorescence measurements.

References:

R. G. Pinnick, A. Biswas, P. Chyălek, R. L. Armstrong, H. Latifi, E. Creegan, V. Srivastava, M. Jarzembski, and G. Fernández, Stimulated Raman scattering in micrometer-sized droplets: time-resolved measurements, Optics Letters, Vol. 13, Issue 6, pp. 494-496 (1988)

Wayde N. Martens, Ray L. Frost, János Kristof, J. Theo Kloprogge, Raman spectroscopy of dimethyl sulphoxide and deuterated dimethyl sulphoxide at 298 and 77 K, Journal of Raman Spectroscopy, 33(2). pp. 84-91 2002

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International Student Workshop on Laser Applications 2010 - ISWLA'10 -

P7: Volcanic ash monitoring over Bucharest area using a Lidar system

Emil Carstea[1], Radulescu Razvan[1], Livio Belegante[1]

[1]National Institute of R&D for Optoelectronic, Atomistilor 409, RO-77125, Magurele, Romania
Keywords: Lidar, volcanic ash, aerosols.

Atmospheric aerosols, in any form they take as volcanic ash, Saharan dust, soot etc. have an important role in determining the Earth radiation balance (Gobbi *et al.*, 2003; Barnaba *et al.*, 2004), and can also affect health and economy (for example aviation). Aerosols effects are highly dependent on the particle size and their optical properties (Chiang *et al.*, 2007). Despite their importance in environmental and climate effects studies, the characterization of aerosols is very difficult because of their spatial distribution and time of residence in atmosphere.

Nowadays, the analysis of aerosols is facilitated by lidars (light detection and ranging), which also measure trace gases, clouds and the basic atmospheric variables (temperature, pressure, humidity and wind). Lidars present several advantages like: high spatial and temporal resolution of the measurements, the possibility of observing the atmosphere at ambient conditions, the potential of covering the height range from the ground to more than 20 km altitude. Due to their advantages, lidars were used to characterize meteorological phenomena such as frontal passages, hurricanes, and mountain lee waves and detect stratospheric perturbation after major volcanic eruptions, intercontinental transport of air pollution, desert dust and forest-fire smoke (Wandinger 2005).

The lidar system consists of a transmitter (laser emit pulses into atmosphere) and a receiver (telescope), which collects the radiation backscattered from atmosphere constituents. The collected radiation is filtered by special optics and transformed in electric signal through photodetectors. This study reports a monitoring campaign, which was performed over Bucharest area in order to detect the volcanic ash, released by the eruption in Iceland. The first two volcanic ash events are noted, with data presented starting with April 17th. The highest particle density was recorded on April 17th and 21th. Figure 1 shows a lidar image (the temporal series of range corrected signal on April 21th), providing information about the layer altitudes. Distinct layers at 6 and 8 Km and a mixed layer with PBL, at 3 Km, can be seen. In figure 2 (not shown in abstract), the volcanic ash dispersion, over Europe, at 8 UTC April 21st is presented; exactly when the lidar measurements were performed. The lidar data are also used to validate the dispersion models (for example models developed by the Rhenish Institute for Environmental Research at the University of Koln).

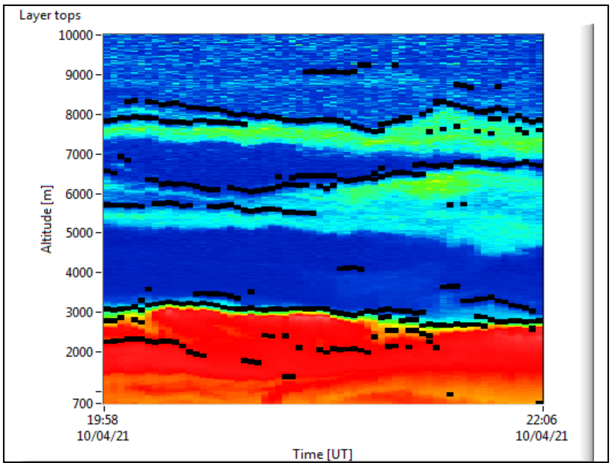


Figure 1. Volcanic ash layers on April 21, at 20 UTC(Temporal series of range corrected signal).

References

Barnaba F., De Tomasi F., Gobbi G.P., Perrone M.R., Tafuro A., Extinction versus backscatter relationships for lidar applications at 351 nm: maritime and desert aerosol simulations and comparison with observations, Atmospheric Research, 70, 2004, 229–259.

Chiang C.-W., Chen W.-N., Liang W.-A., Das S.K., Nee J.-B., Optical properties of tropospheric aerosols based on measurements of lidar, sun-photometer, and visibility at Chung-Li (251N, 1211E), Atmospheric Environment, 41, 2007, 4128–4137.

Gobbi G.P., Barnaba F., Van Dingenen R., Putaud J.P., Mircea M., Facchini M. C., Lidar and in situ observations of continental and Saharan aerosol: closure analysis of particles optical and physical properties, Atmos. Chem. Phys., 3, 2003, 2161–2172.Wandinger U., Introduction to Lidar, Springer Series in Optical Sciences, Springer Berlin, Vol., 102, 2005, 1-18.

P8: Optical properties of the atmospheric aerosols and them radiative forcing.

Andreea Boscornea [1], Raluca Bârlădeanu [1]

[1] University of Bucharest, Faculty of Physics, Dept. of Atmospheric Physics, P.O.Box: MG-11 077125 Magurele Romania.

Key Words: radiative forcing; Tropospheric aerosols; PM10; optical properties of aerosols

The aerosols have effects on human health and an important role in climate change. They have also a determining effect on visibility and contribute to the soiling of monuments.

The aim of present paper is to analyze optical properties and the direct effect of the Particulate Matter (PM_{10} and $PM_{2.5}$) measured into urban area. The statistical analysis of PM concentrations for one year was performed. The concentration values and chemical composition of the PM allowed to compute optical properties by using OPAC (Optical Properties of Aerosols and Clouds) soft (Hess, 1998). The Radiative forcing at surface was computed for the wavelength in the range 0.3-4.0micrometer and cloud free conditions. The up-scatter fraction value of the urban aerosol was 0.22 and surface albedo was assumed 0.2. The results have shown negative radiative forcing values in range -0.2÷-0.8 in summer and -0.7÷-2.4in winter.

P9: Biocompatibility studies of iron oxide coated hydroxyapatite

Carmen Steluta Ciobanu[1,2], Adrian Costescu[2], Ecaterina Andronescu[1]

[1]University POLITEHNICA of Bucharest, Faculty of Applied Chemistry and Materials Science, Department of Science and Engineering of Oxide Materials and Nanomaterials
1 – 7, Polizu Street, 011061, PO – BOX 12-134, Bucharest 1, Romania
[2]National Institute of Materials Physics, P.O. Box. MG 07, 077125, Magurele, Romania,

Bioceramic composites were obtained by combining two biocompatible components (hydroxyapatite and iron oxide nanoparticles). The preparation method (co-precipitation) of iron oxide nanoparticles is the most important challenges that will determine the particle size and shape, the size distribution, the surface chemistry of the particles and consequently their magnetic properties. The samples are characterized by X-ray diffractions. Their thermal behaviour is studied by thermogravimetric and thermodifferential analysis. Infrared spectroscopy and thermogravimetric analysis confirmed the presence of hydroxyapatite on the magnetite surface. The osteoblast cell was used to determine the cell proliferation, viability and citotoxicity interaction with samples.

P10: Polyelectrolite thin films as a matrix for embedding hybrid metal-organic compounds in nonlinear optical applications

Constantinescu Catalin[1], Anca Nedelcea[1]

[1] INFLPR - National Institute for Laser, Plasma and Radiation Physics, PPAM - Lasers Department, 409 Atomistilor blvd., Magurele, RO-077125, Bucharest, Romania

Keywords: polyelectrolite, PAA, thin films, MAPLE.

Polyelectrolites are polymers whose repeating units bear an electrolyte group. These groups will dissociate in aqueous solutions (e.g. water), the polymers consequently becoming charged. Polyelectrolyte chains confined by oppositely charged macroions can significantly modify the interactions between them; this polyelectrolyte-mediated interaction depends on various parameters characterizing the polyelectrolyte as well as the surface of the macroion, and it can be either repulsive or attractive. Though polymers are mostly used as a matrix to stabilize various colloidal systems, they can also induce flocculation either by depletion interaction or by bridging. In the case of charged polymers we refer to this additional attractive interaction as polyelectrolyte bridging.

Polyacrylic acid (PAA) is a good candidate to be used as an embedding matrix for hybrid metal-organic thin films and/or nanoparticles with applications in nonlinear optics. As thermal stability studies are to be considered before attempting any laser assisted processing experiments on organic materials, the thermal stability and behavior of PAA were investigated. PAA thin films were deposited on silicon and quartz substrates by matrix assisted pulsed laser evaporation (MAPLE), using a Nd:YAG laser working at 266 and 355 nm. Fourrier transform infrared spectroscopy (FT-IR), atomic force microscopy (AFM), X-ray photoelectron spectroscopy (XPS) and spectroscopic-ellipsometry (SE) were performed to disclose PAA thin film properties.

References:

C. Constantinescu, E. Morintale, V. Ion, P. Rotaru, M. Dinescu, "Polyacrylic acid: thermal stability study and thin films deposition by matrix assisted pulsed laser evaporation (MAPLE)", Applied Physics A: Materials Science & Processing (article submitted).

C. Constantinescu, A. Emandi, C. Vasiliu, C. Negrila, C. Logofatu, C. Cotarlan, M. Lazarescu, "Thin films of Cu(II)-o,o'-dihydroxy azobenzene nanoparticle-embedded polyacrylic acid (PAA) for nonlinear optical applications developed by matrix assisted pulsed laser evaporation (MAPLE)", Applied Surface Science 255 (2009) 5480.

A. Emandi, N. Jula, C. Vasiliu, M. Dinescu, C. Constantinescu, M. Calinescu, M. Vasilescu, "Some aspects about the properties of nanostructured organotranzitional Cu(II) complex on a polymeric matrix as optical sensor", in: Proceedings of the International Conference on Microelectronics and Computer Science - ICMCS 2007, September 19-21, Chisinau, Republic of Moldova (2007) pages 84–87.

P11: The influence of thickness layers of $Pb(Zr_{0.2}\ Ti_{0.8})O3$ – $CoFe_2O_4$ on structural and electrical properties

C.Dragoi[1,2], R.Radu[1],A.Costinoaia[1],V.Stancu[1], I. Pintilie[1]and L.Pintilie[1]

[1]*National Institute of Material Physic, Bucharest–Magurele, P.O. Box MG-7, 077125, Romania*
[2] *Faculty of Physics, Bucharest University , Atomistilor 105, Magurele, 077125, Romania*

Keywords: multiferroic, ferroelectric, ferromagnetic

Multiferroic $Pb(_{Zr0.2}\ Ti_{0.8})O3$ – $CoFe_2O_4$ (abbreviated as PZT/CFO) films were prepared on general Pt/Ti/SiO2 / Si substrates by using pulsed laser deposition (PLD). An excimer laser (KrF, 248 nm) with energy density of 1.5 J /cm^2 and 10Hz repetition rate was used. Substrate temperature was maintained constant at 600 °C, at an oxygen pressure of 0.2 mbar while the target to substrate distance was fixed at 6 cm.

Multilayer's were made by varying thicknesses of PZT / CFO in order to reveal the influence of thickness on structural and electrical properties. The effect of various PZT/CFO configurations (having three or eleven layers) has been systematically investigated.

The structure and preferred orientation of the films were examined by X-ray diffraction measurements, spectra revealed the existence of pure PZT and CFO phases without any intermediate phase. The thickness was measured using scanning electron microscopy SEM. The surface morphology was also investigated by SEM.

Platinum electrodes were deposited on the top surface for electrical measurements of the films. The deposition was performed through a metal mask, by sputtering. The electrode area was 0.2 mm^2.

Polarization – Voltage (P-V) hysteresis loops of PZT/CFO films show the presence of high leakage current even at low temperatures. Current – Voltage (I-V) characteristics performed between 50 K and 300 K revealed an increase in the leakage current with temperature.

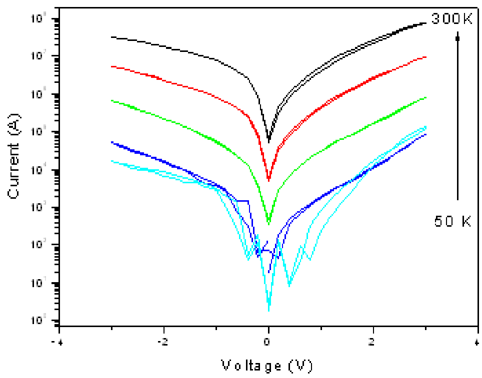


Fig 1. Revealed increase in leakage current with temperature

References:

Ramesh, R. Spaldin, N. A. Multiferroics: Progress and Prospects in Thin Films. Nat. Mater. ***2007****, 6, 21–29.*

Eerenstein, W.; Mathur, N. D.; Scott, J. F. Multiferroic and Magnetoelectric Materials. Nature ***2000****, 442, 759–65.*

*Scott, J. F. Data Storage: Multiferroic Memories. Nat. Mater.****2007****, 6, 256–57.*

P12: Method of dose measurements from intense laser - target interaction using dosimetric film

Scărişoreanu Anca, Dumitraşcu Maria, Badiţa Eugenia, Sima Eugen, Mitru Ecaterina, Minea Radu and Scarlat Florea

Department of Electron Accelerators, National Institute for Lasers, Plasma and Radiation Physics, 409 Atomiştilor Street, P.O. Box MG-36, 077125, Bucharest - Măgurele, Romania

Keywords: laser-target interaction, dosimetric film, absorbed dose, kerma in air

The interaction between a laser and a target (solid or plasma) in case of the laser operation in the relativistic regime, $a_0 = 8.5 \times 10^{-10} \lambda_0$ [μm] $(I_0[W/cm^2])^{1/2} \geq 1$, may generate charged or neutral particles (photons, electrons, positrons, protons, ions, neutrons etc.) of various energies, in function of intensity, I_0, and the wavelength λ, of the laser radiation (Rao *et al.*, 2007), the quantity a_0 being the normalized vector potential. The paper presents the method to measure of the dosimetric quantities the absorbed dose and kerma in air generated by such radiations as well as their angular distribution around the reaction chamber when the interaction is developing, using the dosimetric film. The film exposed in locations of radiologic interest, is processed by RTD-4 software MULTIDATA, which is capable to make a correlation between the film image density versus the absorbed dose. The radiation fields determined by such a method allow optimization of the use of secondary radiation sources determined by the laser-target interaction for various applications. The reference measurement samples, calibrated by PTW - Freiburg Physikalisch - Technische Werkstatten - Germany, along with RTD-4 software and the MULTIDATA electrometer are housed by the STARDOOR Lab in INFLPR.

B. S. Rao, P. A Naik, V. Arora, R..A. Khan and P. D. Gupta, Angular distribution and dose measurements of hard x-ray emission from intense laser-plasma interaction, J. Appl. Phys. 102, 2007, 063307, 1-4.

P13: Laser technology in archaeometry: cleaning metal artifacts (coins)

Dumitriu, Irina [1, 2], Fierascu, Radu Claudiu [1, 2] and Ion, Rodica Mariana[1, 2]
[1]Analysis Department, National R&D Institute for Chemistry and Petrochemistry - ICECHIM, 202 Spl. Independentei, 060021, Bucharest, Romania
[2]Faculty of Materials Engineering, Mechatronics and Robotics, ValahiaUniversity, 18-20 Unirii Bvd., 130082, Targoviste, Romania

Keywords: lasers, archaeometry, restoration, metal artifacts

The metal artifacts in general and coins in special, can be deteriorated due to their burial or atmospheric conditions (Ion *et* al., 2008, a & b, Fierascu *et al.*, 2009). Laser's properties to not cause damage to art objects make them to be successfully used in cleaning of various artifacts. Application of laser cleaning began in early 1970 on stone artifacts (Siano, 2007). In time, this method was developed and executed the tests on other types of artifacts.

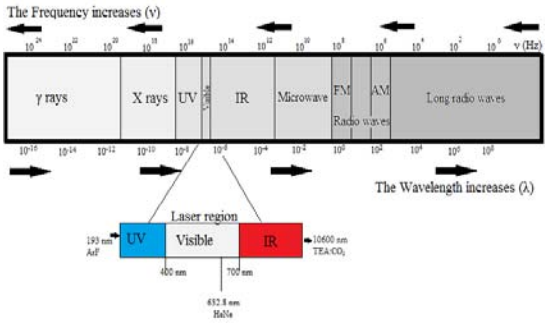


Figure 1. Schematics of the electromagnetic spectrum and the laser region (the most commonly used). It must be noted the existence of X-ray lasers and Far infrared lasers (FIR). The HeNe laser used in the study is highlighted.

The experimental setup is presented in figure 2.

Figure 2. The HeNe laser used in the study.

In this paper were performed tests of cleaning of some coins with different composition obtained from a private collection in different working conditions.
The coin analyzed were made from different materials (varying from silver to majority copper alloys).

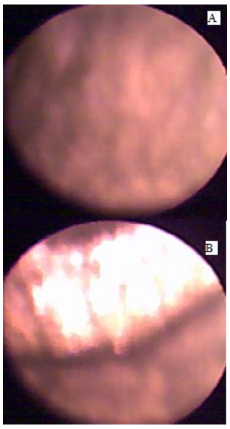


Figure 3. One of the coins cleaned in the study (a silver coin) – A – untreated and B- cleaned. Notice the silver core visible after cleaning.

The results suggest the possibility of using this type of laser cleaning of metal artefacts.

Fierascu Radu-Claudiu, Dumitriu Irina, Ion Mihaela-Lucia, Catangiu Adrian and Ion Rodica–Mariana, Surface and analytical techniques study of Romanian coins - European Journal of Science and Theology, March 2009, Vol.5, No.1, pp. 17-28

Ion R.M., I. Dumitriu, D. Boros, D. Isac, M.L. Ion, R.C. Fierascu, A. Catangiu, Characterization of corrosion products on roman mirror Metalurgia International, XIII(8), 2008, pp 43-46;

Ion R.M., Boros D., Ion M.L., Dumitriu I., Fierascu R.C., Radovici C., Florea G., Bercu C., Combined spectral analysis (EDXRF, ICP-AES, XRD, FTIR) for caracterization of bronze roman mirror — Metalurgia International, XIII(5), 2008, pp 61-65;

Siano S.: Principles of Laser Cleaning in Conservation Handbook on the Use of Lasers in Conservation and Conservation Science. COST G7 (2007).

P14: Ship-in-bottle porphyrin – zeolite nanomaterials

Victor Faraon[1,2], Rodica-Mariana Ion[1,2]

[1]Valahia University, Unirii Blvd. 18-20, 130024, Targoviste, Romania, e-mail: victor.faraon@gmail.com
[2]ICECHIM, 202 Splaiul Independentei, 060021, Bucharest, Romania, e-mail: rodica_ion2000@yahoo.co.uk

Keywords: metallo-porphyrins, zeolite, encapsulation.

In this paper, some metallo-porphyrins, like Co(II)-5,10,15,20-tetra-p-phenyl-porphyrin (CoTPP) and Co(II)-tetramethylporphyrin (CoTMP), were synthesized and encapsulated in different zeolites (X-71, MCM-41 etc.). In the encapsulated form, they exhibit photocatalytic properties and can also be used in the photodynamic therapy of cancer[1,2]. (Wang et al.,2004; Ion,2010)

The synthesized compounds were analyzed by means of some analytical methods, the most important being UV–spectroscopy (figure 1) and X-ray diffraction (figure 2).

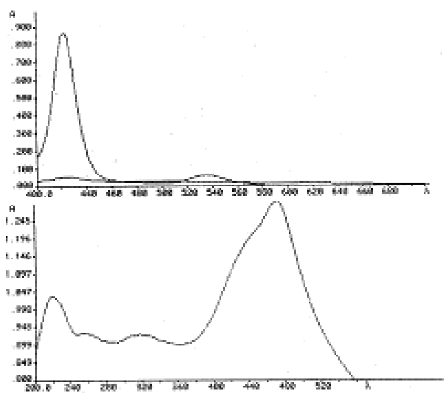


Figure 1. Absoption spectra of CoTMP in THF solution (up) and of COTMP encapsulated in X-71 (down).

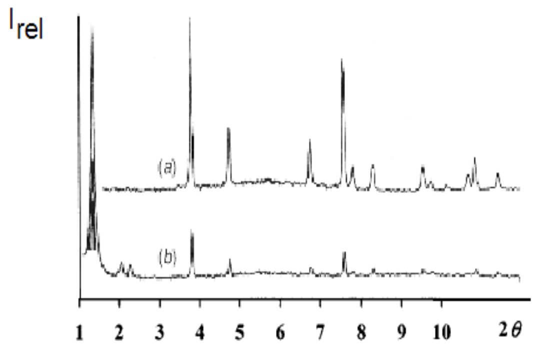


Figure 2. X-ray diffraction spectra of CoTPP encapsulated in AlMCM-41 and MCM-41.

Some preliminary photodynamic experiments of these new systems have been achieved (viability and proliferation) on cellular line (EL-4 and K562), by using He-Ne laser, are discussed.

References

Shizhong Wang, Ruomei Gao, Feimeng Zhou and Matthias Selke, "Nanomaterials and singlet oxygen photosensitizers: potential applications in photodynamic therapy", J. Mater. Chem., 2004, 14, pp. 487–493.

R.M.Ion, in Nanostructuring and Nanocharacterization, Vol.16, Ed. Academiei Romane, 2010, pp.272-293.

P15: Study of oxide thin films prepared through oxygen reaction on copper surfaces

C. R. Iordanescu[1], I. D Feraru[1], C. E. A. Grigorescu[1], M. Bercu[2] A. Kiss[1]

[1] INOE 2000 - National Institute for Optoelectronics
[2] University of Bucharest, Faculty of Physics

Keywords: copper oxide thin films, PLD, UV-VIS-NIR, Raman spectroscopy, FTIR

Oxide thin films growth by different mechanisms on copper surfaces has been studied with the aim to determine the optimal parameters for single-phase oxide formation. Several experiments were carried out, consisting in:
i) direct oxidation of the Cu surfaces through annealing in H_2O vapour and air, respectively;
ii) PLD deposition of Cu oxides films on Si substrates in oxygen atmosphere at temperatures ranging from 160 – 600 ^{0}C. Structural characterisation of the samples was done by FTIR, UV-VIS-NIR and Raman spectroscopy. The morphology was investigated by AFM, showing smoother and more homogeneous surfaces in the case of PLD films than in those produced by direct oxidation of metal Cu substrates. Elipsometry measurements were performed to investigate the influence of the substrate on the interface properties. The changes induced by post growth annealing were related to the main FTIR absorption bands at 615 cm^{-1} (Cu_2O) and 470 cm^{-1}, 540 cm^{-1} (CuO). The ratio between Cu_2O and CuO phases versus oxidation temperature saturates above 280 ^{0}C.
We have found that the Cu_2O-CuO system obtained above 250 ^{0}C develops for specific experimental conditions a large strain, leading finally to "smart cut" like behaviour of a thin CuO membrane. A phenomenological model has been proposed according to the evolution of Cu_2O and CuO distribution inside the film as a result of the oxidative species gradient across the thickness of the layer. According to the specific IR absorption bands of copper oxide found in the samples the thin films obtained below 250 ^{0}C show single phase Cu_2O. The extraction parameter as refractive index of the oxide layer has been done by a fitting procedure between the experimental spectra and the simulated one.

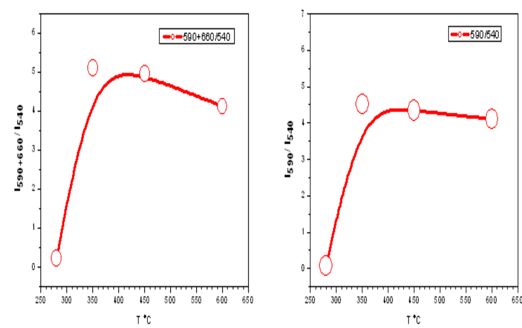


Fig.1 Integral intensity of $I_{590/540}$ and $I_{(590+660)/540}$ infrared absorption bands corresponding to Cu_2O/CuO ratio versus oxidation temperature. The growth to saturation of the assumed ratios indicates that the access of the oxidation species to the interface is limited as the oxide thickness increases. The slight decrease after saturation onset temperature indicates a slow growth of the CuO phase at the surface of the oxide where the oxidative species are in the highest concentration.

References:

G. Papadimitropoulos, N. Vourdas, V.E.M Vamavakas, D. Davazoglou, 2006, „Optical and structural properties of copper oxide thin films grown by oxidation of metal layers", Thin Solid Films 515, pp. 2428-2432.

Soumzendu Guha, Dale Peeble, J. Terence Wieting, 1991, Raman and infrared studies of cupric oxide, Bull. Mater. Sci., Vol. 14, No. 3, pp. 539-543.

Raid A. Ismail, 2009, Characteristics of p-Cu2O/n-Si Heterojunction Photodiode made by Rapid Thermal Oxidation, Journal of Semiconductor Technology and Science, Vol. 9, Nr. 1.

P16: Fullerene-based nanomaterials with future biomedical applications

Fierascu, Radu Claudiu[1, 2], Dumitriu, Irina[1, 2] and Ion, Rodica Mariana[1, 2]

[1]Analysis Department, National R&D Institute for Chemistry and Petrochemistry - ICECHIM, 202 Spl. Independentei, 060021, Bucharest, Romania
[2]Faculty of Materials Engineering, Mechatronics and Robotics, ValahiaUniversity, 18-20 Unirii Bvd., 130082, Targoviste, Romania

Keywords: fullerene, nanomaterials, synthesis, biomedical applications

After 1985, with the discovery of fullerenes by Kotro *et al* (1985), in the field of nanomaterials has emerged a new class of materials with promising applications in areas going from building to biomedicine.
In the last decade fullerenes derivatives were synthesized with applications in cancer therapy, controlled release of drugs, with antimicrobial role, and more (Fierascu *et al.*, 2007, Simon *et al.*, 2007, Kumar & Menon, 2009). Also, studies were conducted on HIV inactivation by fullerenes derivatives (Gao *et al.*, 2009).

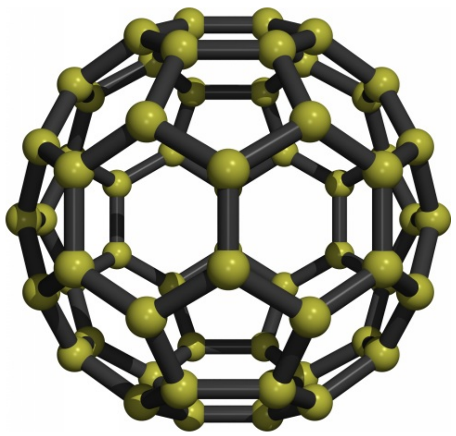


Figure 1. The buckminsterfullerene: C60 (www.ornl.gov)

The purpose of our study is the in vitro analysis of a novel compound – tetraphenyl-porhyrin-polyvinylpyrolidone-C60 fullerene (TPP-PVP-C60) – upon K562 leukemia cell line, in order to determine the toxicological outline of this modified fullerene and to evaluate its candidature for a potential photosensitizer agent. The triple complex - PVP+C60+tetraphenylporphyrin was synthesized in this paper.

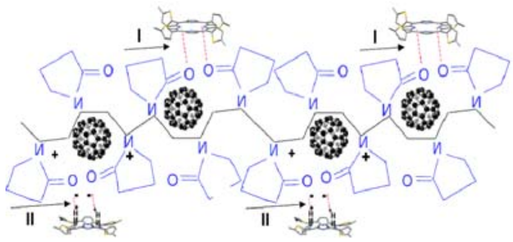


Figure 2. Proposed structure of the synthesized compound [Ion *et al.*, 2010]

References:

Fierascu Radu – Claudiu, Dumitriu Irina, Ion Rodica-Mariana, Biomedical potential fullerenes (C60) - www.eJournalNet.com, J.Int.Res.Pub., Issue Materials, Methods & Technologies, 2009, pp. 394-406;

Gao Yunyan, Ou Zhize, Yang Guoqiang, Liu Lihua, Jin Mimi, Wang Xuesong, Zhang Baowen, Wang Lingxuan, Efficient photocleavage of DNA utilizing water soluble riboflavin/naphthaleneacetate substituted fullerene complex, Journal of Photochemistry and Photobiology A: Chemistry, Volume 203, Issues 2-3, 15 April 2009, Pages 105-111

Kroto H. W., Heath J. R., O'Brien S. C., Curl R. F. and Smalley R. E., C60: Buckminsterfullerene, Nature, 318(No.6042), 1985, 162-163

Kumar Anish, Menon Shobhana Karuveettil Fullerene derivatized s-triazine analogues as antimicrobial agents European Journal of Medicinal Chemistry, Volume 44, Issue 5, May 2009, Pages 2178-2183

Ion Rodica-Mariana, Fierascu Radu-Claudiu, Neagu Monica. Constantin Carolina, Stavaru Crina, Porphyrin (TPP)–Polyvinylpyrrolidone (PVP)–Fullerene (C60) Triad as Novel Sensitizer in Photodynamic Therapy, Science of Advanced Materials, 2, 2010, 1-7

www.ornl.gov/~pk7/pictures/c60.html

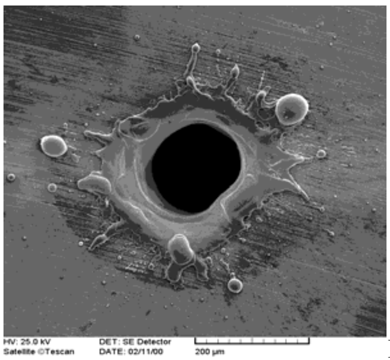
International Student Workshop on Laser Applications 2010 - ISWLA'10 -

P17: Observation of the material ejected and evaporated from the specimen of steel during laser irradiation, with the application of different distances between focus of the laser beam and the specimen

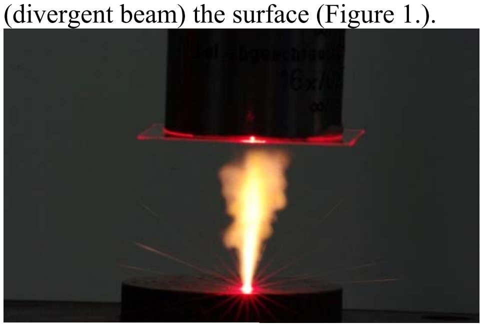
Janus, Bogdan

Institute of Physics, Technical University of Łódź, Wólczańska 219, 90-424, Łódź, Poland

Keywords: laser, steel, focus, evaporation, SEM



In many investigations the laser beam is focused in order to achieve the desired density of the energy. A specimen of steel St3SX was exposed to the laser treatment by means of the laser microanalyser LMA 10. The ruby laser working in free generation regime was the source of light (wavelength = 700 nm). Duration of impulse was 1 ms, and energy 1 J. The beam was focused on the specimen surface and 2.5, 5, 7.5, 10, 12.5, 15 mm below (convergent beam) and above (divergent beam) the surface (Figure 1.).



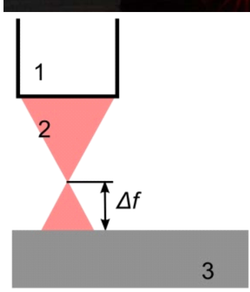
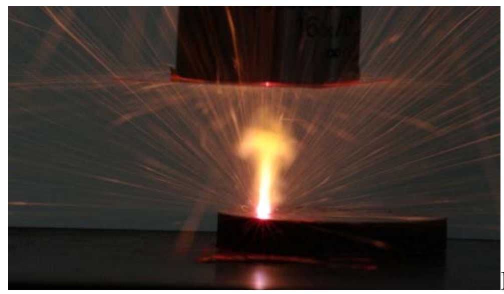


Figure 1. Scheme of experimental setup.
1 – objective, 2 – laser beam, 3 specimen of steel,
Δf – distance between focus of laser beam and specimen



Each illumination of the specimen has been photographed with the use of the digital camera and all the created craters with the use of SEM.

Figure 2. Photography of the specimen during laser irradiation (Δf = 0)

For the beam focused on, and near the specimen surface, evaporated material and ejected particles were observed (Figure 2. and 3.)

Figure 3. SEM photography of crater (Δf = 0)

For the beam focused far from the specimen surface (more than 7,5 mm) only evaporated material was observed (Figure 4.).

Figure 4. Photography of the specimen during laser irradiation (Δf = - 10 mm – convergent beam)

Differences in clouds of evaporated material and jets of ejected particles with the application of different distances between focus of the laser beam and the specimen were observed.

P18: Low-frequency inelastic scattering spectra of H-bonded liquids in terms of the fractal percolation theory

Maksymov Andrii, Yakunov Andrii and Bilyi Mykola
Department of Physics, National Taras Shevchenko University of Kyiv, Volodymyrska 64, 01601, Kyiv, Ukraine
Keywords: nanoinhomogeneity, percolation cluster, fractal dimensionality, fracton.

The structure of H-bonded liquids is described in terms of the fractal percolation clusters. This conception was successfully applied to describe inelastic scattering spectra of amorphous media. The low-frequency region of inelastic scattering spectrum is shown to reflect fractal features in case of H-bonded liquids. The H-bond network in crystalline phase has all the potential intermolecular H-bonds of each molecule coupled. Owing to irregular molecular arrangement in amorphous and liquid phases some bonds are free. For a certain amount of disconnected H-bonds there proves no way for vibrational excitation to visit remote parts of the medium using H-bond. At this degree of connectivity the medium becomes heaps of separated patches. The number of connected bonds, when the framework to travel all over the medium still exists, is called percolation threshold. And the molecular skeleton is an infinite percolation cluster. There are also finite clusters separated from the infinite one. All clusters are embedded one into another and tightened together thus reminding a puzzle. The infinite cluster fractionizes with decreasing number of bonds. When raising the number of bonds the infinite cluster puts on weight and the largest finite cluster descends. Their average size indicates the structure inhomogeneity size which is designated as correlation length. The mass of the infinite cluster for regions larger than correlation length scales in accordance with power law which exponent represents Euclidian space dimensionality. However for smaller regions the exponent is less than Euclidian. This means that the geometry of the network is tracery. The effective dimensionality can be calculated by the Hausdorff or Kolmogorov algorithm and may occur fractional. Since there are mathematical objects with fractional dimensionality called fractals, this exponent is called fractal dimensionality. Low-frequency inelastic scattering in liquids occurs on thermal vibrational excitations. Owing to thermal disorder the vibrational excitations are damped and behave mostly similar to those in amorphous media. Vibrational excitations which have wave length larger than the correlation length do not feel fractality of the medium and therefore their dispersion remains linear. This transition wave length corresponds to the crossover frequency. Vibrational excitations with lower frequencies are damped acoustic phonons and with higher – fractons. In experiments crossover frequency depends on the number of bonds and thus on temperature. The investigations were performed on the automated diffraction double grating spectrometer. Grating constant is 1200 grating grooves per millimeter. The reciprocal linear dispersion is 0,45 nm/mm and the width of spectrometer split equals 0,1 mm. Scattering was excited by argon laser on 514 nm wavelength. The Output power of the laser is 100 mW. Laser beam passed the ampoule in vertical geometry. Excitatory region was projected directly on the entrance slit of the monochromator. Binary H-bonded solutions were taken to perform controlled modifications of the fractal parameters as well as to eliminate a number of unknown variables produced by the model. The existence of the liner region in low-frequency spectral range for reduced intensity in log-log scale proves the fractal percolation clusters model to be valid in case of such media. The dependencies of the linear region's slope on concentration for different solutions are in good accordance with behavior of other physicochemical parameters that depend on H-bond network structure. In particular the glycerol-water fractal parameter at certain concentration reflects the competition between different H-bond networks. This concentration corresponds to the density anomaly at 40%. Such anomalies may be predicted for other solutions in this way.

References:

Alexander, S. and Orbach, R., "Density of states on fractals: fractons," J.Phys.Lett.(Paris), 43, L625-L631 (1982).

Majolino, D., Mallamace, F., Migliardo, P. et al., "Spectral evidence of connected structure in liquid water: effective Raman density of vibrational states," Phys. Rev. E 47(4), 2669-2675 (1993).

Alben, R., Weaire, D., Smith, J., E. et al., "Vibrational properties of amorphous Si and Ge," Phys. Rev. B 11(6), 2271 - 2296 (1975).

Puzenko, A., Hayashi, Y., and Feldman, Yu., "Space and Time Scaling in Glycerol-Water Mixtures," J. Non-Cryst Solids 353, 4518-4522 (2007).

P19: Langatate and langanite doped with Eu^{3+} possible new red phosphors

Matei, Cristina, Voiculescu, Ana Maria, Geogescu, Serban and Nastase, Silviu
Laboratory of Solid-State Quantum Electronics, National Institute for Lasers, Plasma and Radiation Physics, Magurele, PO Box MG-36, 077125, Bucharest, Romania

Keywords: langatate, langanite, europium, phosphors

The crystals from langasite family were initially intended as hosts for laser active media [1], but in present their main application is based on their very good piezoelectric characteristics [2,3].

In this paper we present a study concerning the luminescence properties of Eu^{3+}-doped langatate ($La_3Ga_{5.5}Ta_{0.5}O_{14}$ - LGT) and langanite ($La_3Ga_{5.5}Nb_{0.5}O_{14}$ - LGN) crystals in comparation with this materials obtained by sol-gel method. Eu-doped langanite and langatate crystals were synthetized in our laboratory from high-purity La_2O_3, Ga_2O_3, Nb_2O_5,Ta_2O_5, Eu_2O_3, according to $(La_{0.97}Eu_{0.05})_3Ga_{5.5}Nb_{0.5}O_{14}$ and $(La_{0.97}Eu_{0.03})_3Ga_{5.5}Ta_{0.5}O_{14}$ formulae. The oxides were mixed in an agate balls mill and calcinated at 1500ºC for 24 h. The powder was pressed in pallets and the crystals were grown along the Caxis in platinum crucibles in nitrogen atmosphere, using the Czochralski method. The powders of Eu^{3+}-doped LGS, LGN and LGT were obtained by milling of single crystals. LGN :Eu (3%) nanoparticles were prepared by citrate sol-gel method using citric acid as chelating agent. Two solutions were mixed, a nitrate (La $(NO_3)_3$, Ga $(NO_3)_3$ and $Eu(NO_3)_3$) and one of $Nb(OH)_5$ and citric acid. After Nb_2O_5 was dissolved in HF, was added ammonia to form $Nb(OH)_5$, which was dissolved in citric acid solution.

The solution was dry at 80^oC and the obtained gel was heated for 5 hours at room temperature: 700^oC, 800^oC, 800^oC,1000^oC. White powders are obtained.

When excited in the near UV (396 nm, transition $^7F_0 \rightarrow ^5L_6$), all the powders show bright red luminescence which suggests the possibility to use these materials as red phosphors. In this paper we use the reflectance measurements to compare the absorption and emission characteristics of Eu3+ doped in LGT and LGN powders. The main advantage of the reflectance measurementsperformed in this paper in the presence, on the same record, of both f-f absorption and emission bands.

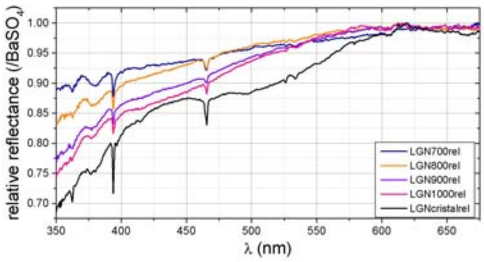


Figure 1: Reflectance spectra of Eu-doped LGN nanocrystals.

It is apparent that the most efficient is LGN crystal, and the most efficient nanopowders are those treated at 700 and 800^0C. At temperatures greater than 800ºC efficiency decreases.

References:

*A. A. Kaminskii, I. M. Silvestrova, S. N. Sarkisov, G. A. Denisenko, Phys. Stat. Solidi A **80**, 607 (1983).*

*J. Détaint, J. Schwartzel, A. Zarka, B. Capelle, J. P. Denis, E. Phillipot, Proc. IEEE Internat. Frequency Control Symposion, **58**,(1994)*

*R. C. Smythe, R.C. Helmbold, G. E. Hague, K. A. Snow, IEEE Trans. UFFC **47**, 355 (2000)*

P20: Time evolution of quinazoline derivative BG1188

Militaru, Andra[1], Smarandache, Adriana[1], Mahamoud, Abdallah[2], Damian, Victor[1], Alibert, Sandrine[2], Pascu, Mihail-Lucian[1], Pagès, Jean-Marie[2]

[1]National Institute for Laser, Plasma and Radiation Physics, Magurele, 077125, Bucharest, Romania
[2]UMR-MD1, Faculté de Pharmacie, Université Méditerranée, IFR88, Marseille, France

Keywords: quinazoline derivatives, time stability, UV-Vis spectroscopy, spectrophotometry.

This paper shows the time evolution measurements performed on BG1188 solutions in ultra-pure water; BG1188 is a quinazoline derivative having the formula $C_{12}H_{14}N_4O_3$ (molecular weight 262.26456 g/mol).

Quinazolines and quinazoline derivatives are an important group of compounds due to the variety of their pharmaceutical properties which lead to important effects such as: diuretic phenomena, antihypertensive and anticancer action, anti-allergic, antifungal and anti-infective effects.

The time evolution reveals for how long a medicine is stable and can be administered according to the recommended procedures. The ultrapure, de-ionized water used as solvent in the stability studies was delivered via a sterile filter. Stock solutions of BG1188 at $2x10^{-3}$M were prepared in ultrapure water. The BG1188 concentration range was: 10^{-6}M to 10^{-3}M. The solutions were kept in dark; two cases were observed/studied: * samples kept at 4°C and then measured at room temperature (22°C) after being extracted from the fridge and being kept half an hour to reach 22°C; * samples kept all the time at room temperature, 22°C.

The stability characterization of the samples was made using UV-Visible absorption spectra measurements for which the reference cells contained the solvent – ultrapure water. The spectrophotometer had an error limit of 0.004%; the errors related to the reproducibility of the positions of the optical cells used for measurements, varied between 1.041% at 10^{-3}M, to 19.493% for 10^{-6}M.

The absorption spectra of BG1188, measured between 200nm and 450nm, exhibit three absorption peaks: a broad one, centred on 313nm and two other, centred on 224nm and 207nm, which are sharper (Fig.1); the last two may contain absorption signals originating from the atmospheric Oxygen and consequently, only the peak at 313nm was considered as an indicator for the time evolution studies.

For the BG1188 in ultrapure water the reproducibility of the spectra is remarkably good since the peak values vary within the measurements errors. There were no significant differences observed between the spectra of the solutions kept at 4°C and 22°C, respectively. The results show that the BG1188 solutions in ultrapure water are stable for time intervals up to 2856 hours (119 days).

The absorption measurements performed between 10^{-6}M and $2x10^{-3}$M concentrations in ultrapure water allowed to compute a polymerization degree of 1.018; this means that for all the experiments only the monomer form of BG1188 was present in the ultra-pure water solutions.

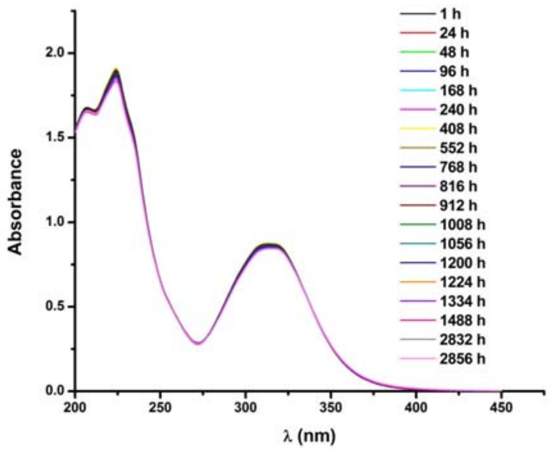


Figure 1. Absorption spectra revealing time evolution of BG1188 at 10^{-3}M in ultrapure water solution.

Although the degree of polymerization indicated that in BG1188 solutions there were present only monomers, aggregation phenomena take place that produce precipitates in the form of thin wires, of a broad range of dimensions (lengths and diameters) and shapes observed initially with the naked eye. At later stages, these wires mould into aggregates/clusters. The images of the aggregates reported in this paper were obtained using an optical microscope working in reflection or transmission. The wire like formations are produced gradually, starting from the first hours of the solutions preparation regardless the BG1188 concentration in ultrapure water; they are built from spherical, micrometric formations which develop connections leading to the wire-like shapes and are very stable with temperature.

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COST Action BM0701 (ATENS).

THEORETICAL ANALYSIS AND NUMERICAL MODELING OF INSTABILITY AND CHAOS IN LASERS

Minea Teofil
Faculty of Applied Sciences, Politehnica University of Bucharest
Splaiul Independentei, Nr. 313, Bucuresti, 060042

Abstract

Chaos in lasers is related to deterministic chaos in single mode lasers. The semi-classical laser dynamics emerges from coupling the Maxwell equations for a classical optical field with quantum equations for the atomic media. In this paper, the Maxwell-Bloch equations of the interaction field-substance in the rotating wave approximation (RWA) are reduced, through some transformations, to the dynamical equations of the Lorenz chaotic model. Furthermore, working on the obtained Lorenz system, chaotic behavior is being described with application in studying various operating modes of the laser.
Keywords: chaos, Lorenz system, Maxwell-Bloch equations

Introduction

In 1963 Lorenz reduced the equations for convective flow into three first order coupled nonlinear differential equations and demonstrated with these the idea of sensitive dependence upon initial conditions and chaos.[1]

The Lorenz equations are:

$$\frac{dX}{dt} = \sigma Y - \sigma X$$
$$\frac{dY}{dt} = -XZ + rX - Y$$
$$\frac{dZ}{dt} = XY - bZ \qquad \text{(I)}$$

Where the three main variables X, Y and Z are some amplitudes, their physical meaning is not being relevant in this context. But the structure of the equations (I), the parameters, and their values are all directly related to the laser problem. The connection between Lorenz equations and the laser equations is described in the next paragraphs.

The laser equations describe a travelling wave in a ring resonator which is excited by atoms or molecules with homogeneously broadened line. Homogeneously means in gas lasers case (as we are going to see in the next section gas lasers are the only type of lasers meeting the criteria for Lorenz type chaos) that we are only dealing with one velocity of the molecules.

Additional assumptions are used in the derivation of these equations:

– plane waves are used
– the atoms are supposed to have only two interacting levels
– the rotating wave approximation is applied (RWA) (which means that the basic quantum mechanical equations were averaged over a time interval which is long compared to the atomic oscillation period , but short compared to times over which the amplitudes of the laser mode vary.
– the slowly varying amplitude approximation is applied (if we are taking the time derivative of the laser field, we then neglect the derivative of the slowly varying field amplitude while keeping the derivative of the rapidly oscillating field phase. [2]

References

1. R.Dykstra, M.Y.Li and N.R. Heckenberg "Route to Chaos in the $^{15}NH_3$ far infrared ring laser"
2. Carl-Otto Weiss, Udo Hubner, Neal Broadus Abraham and Dingyuan Tang "Lorenz-like chaos in NH_3 - FIR laser"
3. Ya I Khanin "Fundamentals of laser dynamics"
4. H.Haken "Light volume 2- Laser light dynamics"
5. http://mathworld.wolfram.com/StablePolynomial.html
6. Tin Win, M.Y. Li, J.T. Malos and N.R Heckenberg, Opt. Commun. 103, 479(1993)

P22: Thomson scattering with high intensity laser pulses

Oprea, Andreea, Boca, Madalina and Florescu, Viorica

Department of Physics, University of Bucharest,
Bucharest-Magurele, MG11, 077125

Keywords: Thomson scattering, intense laser, energy spectrum.

In the framework of classical electromagnetism, we study the radiation scattering by a free electric charge in a laser pulse with fixed direction of propagation **n**, but arbitrary shape and duration. The validity of this approach has been confirmed in specific conditions. Our calculation is based on an alternative expression for the classical formula of the radiation emitted by an accelerated charged particle. We present first the derivation of this formula, then results of our numerical calculation.

The equation we use was obtained by transforming Jackson's equation (14.67) for the angular energy spectrum $d^2W/d\Omega_2 d\omega_2$. In the expression of the Poynting vector we use the particle position and velocity, as functions of the variable ♐$=t-\mathbf{n}\cdot\mathbf{r}/c$, and then we perform two successive integrations by parts. The expression we get contains three one-dimensional integrals over the variable ♐. This way we obtain an expression for the spectrum valid for any laser polarization, a generalization of an equation which was established before, by a different method, only for the case of linearly polarized laser. For the radiation spectrum we present a scaling law in its dependence on the laser and emitted frequencies.

In the case of a laser pulse of finite duration τ and central frequency ω the energy spectrum for a fixed observation direction is continuous, consisting in an infinite series of equidistant maxima whose position can be analytically calculated. We present numerical results for the energy spectrum $d^2W/d\Omega_2 d\omega_2$ for different scattering geometries, and study the effect of the laser field intensity and electron initial velocity on the position and shape of the maxima present in spectrum. In our calculation we consider a Gaussian laser pulse with duration varying from a few to a hundred of optical cycles, for the initial electron energy $E_e \in (mc^2, 10mc^2)$, and the laser field intensity of the order of atomic unit.

References:

*T. Heinzl, D. Seipt, and B. Kämpfer, Beam-shape effects in nonlinear Compton and Thomson scattering, Phys. Rev. A **81**, 022125 (2010).*

J. D. Jackson, Classical Electrodynamics, third edition, Wiley, 1998.

*G. A. Krafft, A. Doyuran and J. B. Rosenzweig, Pulsed-laser nonlinear Thomson scattering for general scattering geometries, Phys. Rev. E **72**, 056502.*

P23: Thermal stability – singlet oxygen quantum yields relationship of some metallophtalocyanine sensitizers for photodynamic tests

Simona-Florentina Pop[1,2], Rodica-Mariana Ion[1,2]

[1] Department of Analysis, National Research & Development Institute for Chemistry and Petrochemistry ICECHIM, Spl. Independentei, 202, sect. 6, Bucharest, Romania
[2]Valahia University, Targoviste, 18-20 Blvd. Unirii., Targoviste, Romania

Keywords: phthalocyanine, photodynamic activity, thermal analysis, singlet oxygen.

Metallophthalocyanines (MPcs) have potential applications in many areas such as in medicine and material science [1]. Owing to their strong and long-wavelength absorption and efficient reactive oxygen specie generation (ROS) phthalocyanines have emerged as a promising class of second-generation photosensitizers for photodynamic therapy (PDT) [2]. Over the last decade, a substantial number of phthalocyanine-based photosensitizers have been prepared and evaluated for their photodynamic activity, with the focus being on silicon, zinc and aluminium analogues as a result of their desirable photophysical properties. In this work, the stability of metallophtalocyanine has been studied through differential thermal analysis and thermogravimetry.

Quantum yields of singlet oxygen photogeneration were determined as previously explained in detail in air (no oxygen bubbled) using the relative method with DPBF as chemical quencher for singlet oxygen [3]. Singlet oxygen quantum yields were studied in toluene using a chemical method (1,3-diphenylisobenzofuran, DPBF). The Φ_Δ values for the studied phthalocyanines were $\Phi_\Delta = 0.52$ for ZnPc, 0.58 for CoPc and 0.55 for NiPc in toluene.

Thermal properties of the metallophthalocyanines were investigated by DTA/TG methods. It is well known that phthalocyanine unit is resistant to thermal oxidation [4]. DTA curves exhibited exothermic changes for the studied compounds in the region investigated [5]; it means that there was no melting point for any of the phthalocyanines.

The initial decomposition temperature decreased in the order: Pb containing phthalocyanine rapidly decomposed while Co, Cu, Ni, and Zn phthalocyanines showed better thermal stability under working conditions. The decomposition consists of two stages for all phthalocyanines. The first step in the decomposition started at ca. 45-310 ^{O}C for CuPc, ca. 45-265 ^{O}C for CoPc, ca. 45-298.7 ^{O}C for NiPc and ca. 45-230.7 ^{O}C for ZnPc. Then, the second step in the decomposition (the main decomposition) occurred at 690 ^{O}C for CuPc, 370 ^{O}C for CoPc, 368.9 ^{O}C for NiPc and 361.5 ^{O}C for ZnPc. These correspond to the loss and fragmentation of one unit of the peripheral environment of the phthalocyanine molecule. For instance, for CuPc, a group at peripheral part corresponding to one fourth of the ionized organic group left with an estimated mass loss of 33.41% (calcd. mass loss 33.59%); for CoPc, similarly, an estimated mass loss of 29.9% (calcd. mass loss 30.2%); in case of NiPc, the leaving group with observed mass loss of 38.1% could not be identified; for ZnPc, was an estimated mass loss of 43.3% (calcd. mass loss 43.2%).

Pop S.-F., Ion R.-M., Neagu M., Constantin C. Photodynamic Therapy on B16 Cells with Tetrasulphonated Porphyrin and Different Light Sources, Journal of Materials Science and Engineering USA, 2010, 4, 3.

Pop S.-F., Ion R.-M., Supramolecular aggregates porphyrins-phthalocyanines and their implications in photomedicine, J.Int.Res.Pub., Issue Materials, Methods & Technologies, 2009, pp. 108-116.

Young GJ, Onyebuagu W. Synthesis and characterization of di-substituted phthalocyanines. The Journal of Organic Chemistry 1990,55:p.2155–2159.

Delman AD, Kelly JJ, Stein AA, SimmsFB. Thermal analysis. In: Proceedings of the International Conference. 2nd ed., vol.1.NewYork: Academic Press; 1969, p. 539.

Shirai M, Kobayashi K, Takemae Y, Suzuki A, Hirabaru O, Hojo N. Functional metal-porphyrazine derivatives and their polymers, 2. Synthesis and properties of polyimides containing metal-phthalocyanines. Macromolecular Chemistry 1979;180:p.2073–2084.

P24: Characteristics of Methane-Air Mixture Combustion

Salamu, Gabriela[1], Voicu, Flavius[1], Leca, Aurel[1], Sandu, Oana[1], Pavel, Nicolaie[1], Dascalu, Traian[1], Dejanu, Marcel[2], Popa, Dinel[2], Parlac, Sebastian[2]
[1]Laboratory of Solid-State Quantum Electronics, National Institute for Lasers, Plasma and Radiation Physics, Magurele, PO Box MG-36, 077125, Bucharest, Romania
[2]Faculty of Mechanics and Technology, University of Pitesti, Targu din Vale Street, 110040, Pitesti, Romania

Keywords: Internal combustion, methane-air mixture, spark-plug, flame kernel, Schlieren method.

Combustion of lean mixture of fuel and air decreases NO_x concentrations in the exhaust gases, which is associated with reducing of fuel consumption as well as with environment protection. This kind of ignition has been used in gas turbines and direct injection spark ignition engines. It was recently shown that ignition induced by laser in internal combustion engines (Koefler *et al.*, 2007; Tsunekane *et al.*, 2010) presents many advantages over a conventional spark-ignition system, such as a higher probability to ignite leaner mixtures, reduction of erosion effects, increases of engine efficiency, or shorter combustion time. We are currently working toward realization of a diode-pumped high-peak-power passively Q-switched Nd:YAG/Cr^{4+}:YAG laser that is intended to be used for laser ignition of engines (Dascalu, 2009).

In this presentation we report, as a first step of our research toward realisation of a laser-induced ignition system, results on characteristics and dynamics of methane-air mixture ignition using a conventional electrical spark.

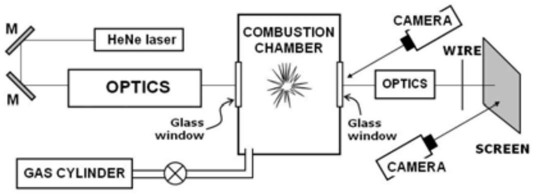

Figure 1. A sketch of the experimental set-up is shown. Ignition was obtained by electrical spark.

The experimental set-up is shown in Figure 1. Investigations were carried out in a constant volume combustion chamber at filling pressures between 0.5 and 1 MPa. The air was introduced in the chamber after mixing it with 5% methane concentration. Schlieren flow visualization technique (Settles, 2001) was used to investigate the developing flame ball characteristics. A 632 nm emitting diode laser diode was used as source of illumination. The images of the transmitted light through the chamber windows were detected by a digital camera, and lately analyzed by computer. Information, such as explosion time and flame speed, was determined from this analysis. As an example, Figure 2 presents Schlieren photographs of methane combustion in air at 0.5 MPa filling pressure of the chamber. The development of the flame front can be clearly seen, an in this case the combustion time was evaluated to be 2.3 sec. Influence of pressure and methane concentration on flame characteristics is discussed.

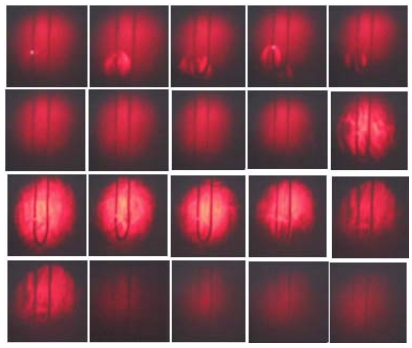

Figure 2. Development of the methane-air ignition in the combustion chamber at 0.5 MPa pressure.

Further investigations aim realization and analysis of ignition process realized with a laser system, and comparison of the results obtained with the classical electrical-spark device.

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H. Kofler, J. Tauer, G. Tartar, K. Iskra, J. Klausner, G. Herdin, E. Wintner, "An innovative solid-state laser for engine ignition," Laser Phys. Lett. ***4****, 322-327 (2007).*

M. Tsunekane, T. Inohara, A. Ando, N. Kido, K. Kanehara, T. Taira, "High Peak Power, Passively Q-switched Microlaser for Ignition of Engines," IEEE J. Quantum Elecron. ***46*** *(2), 277-284 (2010).*

T. Dascalu and N. Pavel, "High-temperature operation of a diode-pumped passively Q-switched Nd:YAG/Cr^{4+}:YAG laser," Laser Physics ***19****, 2090-2095 (2009).*

P25: Engineering of aperiodic optical superlattices in $LiNbO_3$:MgO crystal for miniature multiwave laser devices

R.V. Sargsyan , V.G. Babajanyan, R.B. Kostanyan and P.H. Muzhikyan

Institute for Physical Research, NAS RA, 0203 Ashtarak, Armenia

Superlattices, nonlinear material, harmonic

Investigations of “optical superlattices” created artificially in nonlinear optical crystals allow to get “metamaterials” with scheduled properties. A theoretical model based on detailed analysis of coupled equations for amplitudes of interacting waves in the nonlinear material under study is considered. Three nonlinear processes that can be implemented simultaneously in $LiNbO_3$:MgO crystal with predetermined nonlinear coupling coefficients are studied.

The model is used to calculate an aperiodic structure of domain blocks in $LiNbO_3$:MgO crystals capable to fulfill simultaneously quasi-phase-matching conditions for three second harmonic generation processes of radiations at 914nm, 1064 nm and 1342 nm.

The calculated structure of domain blocks was optimized to obtain approximately equal intensities of radiations at 457 nm, 532 nm and 671 nm.

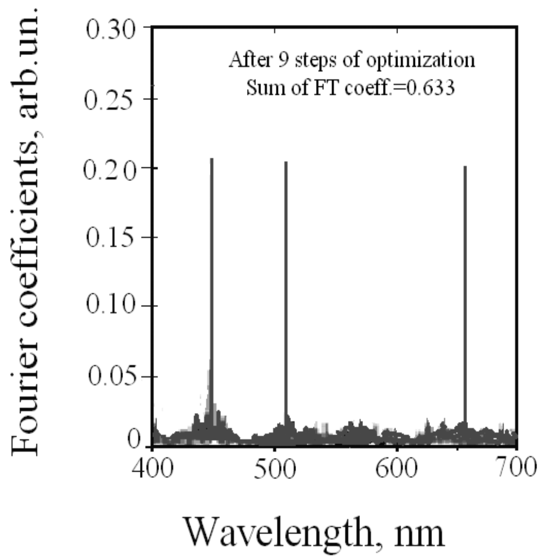

Figure 1. Fourier spectra of the calculated APOSL after 9 steps of optimization.

Study has allowed numerical definition of the APOSL structure designed for efficient and simultaneous implementation of three SHG nonlinear processes in the LN:MgO crystals.

To find out the desired construction of the APOSL inverse source problem was solved by the self-adjusting algorithm.

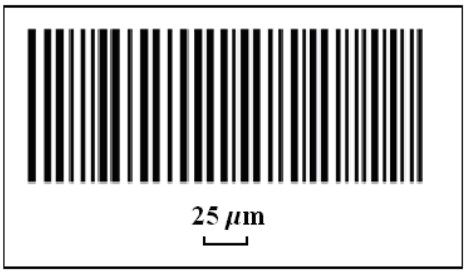

Figure 2. Gray scale diagram of a part of the calculated APOSL.

The results of such investigations will serve to design compact, multifunctional and efficient laser systems which are in great demand for obtaining miniature multicolor sources of coherent radiation for new generation color television, in quantum nonlinear optics, for optical communications, in biomedicine, for remote sensing, etc.

References

J.B. Pendry. Opt. Express, ***11*** *(2003) 639.*

C. Soukoulis. Photonic band gap materials, Plenum, NY, 1995.

H. Liu, Y.Y. Zhu, S.N. Zhu, et al. Appl. Phys. Lett., ***79*** *(2001) 728.*

J. Capmany, J.A. Pereda, V. Bermudez, et al. Appl. Phys. Lett., ***79*** *(2001) 1751.*

P.Li, X.Chen, Y.Chen, and Y. Xia. Opt. Express, ***13*** *(2005) 6807.*

G. Imeshev, M.M. Fejer, A. Galvanauskas, D. Harter. JOSA. ***B 18*** *(2001) 534.*

P26: Elipsometric Investigation Of Mechanically Polished Sitall And Quartz Glass

Poperenko L.V., Odarych V.A., Shestopal O.H., I.V. Yurgelevych

Department of Physics, Taras Shevchenko National University, 64 Volodymyrs'ka St., 01601, Kyiv, Ukraine

ellipsometric, sitall, refraction index, thicknesses, superficial layer.

Optical materials, such as sitall and quartz glass, are used in quality of substrates for causing of semiconductor active pellicle elements, nanostructures. So knowledge of properties of the broken surface layer, which appears at tooling, and control of quality of polish is an important task. Substrates from sitall and quartz glass were made on a state enterprise factory „Arsenal" on the special technology of deep polishing.

The ellipsometric investigations were conducted on a 632,8 nm wave length of LEF-3M compensatory zero ellipsometer. In the process of measuring was such determined elipsometric parameters of standards like, phase shift between p- and by the s- components of vector of polarization and azimuth Ψ recovered linear polarization, depending on the incident angle φ. Measuring of Δ and Ψ was made nearly corner of Brewster of materials. Recived dependences of cosΔ but tgΨ allow to talk about high quality of mechanical polish of investigational standards of sital and quartz glass. In particular, the small values of remaining ellipticity (for glassceramic tgΨ min = 0,00175, for quartz glass of tgΨ min = 0,00148) and transition change of cos Δ, from -0.9 to 0.9 at small changes (within the limits of 0.1°) argue this.

For interpretation of experimental results, to the polished layer on the sitalls and quartz glasses surface, there was applied the model of homogeneous dielectric layer on dielectric substrates. The refraction index n and thickness d for the polished layer was determined by the automated program basic equalization of ellipsometry, lies in basis of which.

In quality of refractive index was used a value from literature. Within the framework of the used model, the followings values of refraction index and thicknesses of the superficial polished layer were received : for the standard of sitall n=1.5365, d=303 nm, for the standards of quartz glass of n=1.454, 1455 and d=238, 245 nm.

It is necessary to mark that the refractive index of the polished layer of sitall was appeared greater than refractive index of substrates. For quartz glass there is an opposite situation. There are two factors which can influence on the value of index of refraction of the polished layer:
1) local high pressures that lead to the increasing of refraction index over the compression of base material; and 2) metal ions lixiviation with the polishing suspension that leads to the decreasing of refraction index in the surface area.

The total value of refraction index is determined by correlation between influences of these two factors.For quartz glass there were recived refraction index of superficial layer less than an index refractions of substrates (1.457). It is possible to draw conclusion, that for this material, possibly, the action of the second factor prevails. The action of polishing suspension, which results in impoverishment of surface of basis high-refractive ions, takes place.

For the sitall, refractive index of superficial layer is some greater than refraction index of substrates (1.535). Consequently, the action of the first factor can prevail in this case.

P27: Method of the ambiental and personal absorbed dose equivalent from relativistic laser-target interaction

Scărişoreanu Anca, Sima Eugen, Bădiţa Eugenia, Dumitraşcu Maria, Mitru Ecaterina, Minea Radu and Scarlat Florea

Department of Electron Accelerators, National Institute for Lasers, Plasma and Radiation Physics, 409 Atomiştilor Street, P.O. Box MG-36, 077125, Bucharest - Măgurele, Romania

Keywords: ambient dose equivalent, personal dose equivalent, laser-target interaction

Recent progress of the chirped pulse amplification technique allowed the overcome of the power threshold P = 1PW for a laser and the possibility to obtain some relativistic intensities, $I_0 \cdot \lambda^2 > 1.37 \times 10^{18}$ $W \cdot cm^{-2} \cdot \mu m^2$, in which I_0 and λ, represent the intensity and the wavelength of the laser radiation. The target installed in a vacuum reaction chamber is becoming a secondary radiation source (photons, X-ray, electrons, positrons, ions etc.), function of the laser power (Rao *et al*., 2007), when being irradiated by a laser beam. Such a secondary radiation source need to be dosimetric characterized according to the nuclear safety standards (NSR 2000). This paper presents a method to determine the personal dose equivalent and the ambient dose equivalent in Sievert units in the irradiation hall which houses the reaction chamber and in the irradiation hall adjacent rooms for the radiological protection of the personnel working in the relativistic laser installations. The measurement range for the photon radiation is encompassed between 5 keV and 1.25 MeV. The measurements were made by means of the secondary standards. These was calibrated with Co^{60} and Cs^{137} (1.25 MeV γ-rays and respectively, 0.662 MeV γ-rays, relative expanded uncertainty U_r = 3 % for the coverage factor k = 2) at PTW-Freiburg Physikalisch-Technische Werksttaten and PTB - Physikalisch-Technische Bundesanstalt, Germany, and they are now part of STARDOOR Lab in INFLPR.

References:

B. S. Rao, P. A Naik, V. Arora, R. A. Khan and P. D. Gupta, Angular distribution and dose measurements of hard x-ray emission from intense laser-plasma interaction, J. Appl. Phys. 102, 2007, 063307, 1-4.

P28: Influence Of Anharmonicity Of Normal Vibrations On The Deviation Of The N-O Chemical Bond In No_2 Molecule

Olesia Snezhkova , Boris Okhrimenko

National Taras Shevchenko University of Kyiv
64 Volodymyrs'ka Str., Kyiv, 01601, Ukraine
email: snezhkova@univ.kiev.ua

The phenomenon of deviation of chemical bond in molecule has been discovered in terms of inverse molecular spectroscopy problem. The main aim of the work is investigation of the force field matrix of NO_2 molecule with further determination of the potential energy when atom was displaced from equilibrium position in different directions. This allows one to determine the chemical bond direction of a molecule that coincides with the maximum of the potential energy when bending the atom. As was calculated this direction distinguishes from the line that couples atoms. The angle between these two directions is an angle of deviation of a *chemical bond*.

P29: Method of the ambiental and personal absorbed dose equivalent from relativistic laser-target interaction

Scărişoreanu Anca, Sima Eugen, Bădiţa Eugenia, Dumitraşcu Maria, Mitru Ecaterina, Minea Radu and Scarlat Florea

Department of Electron Accelerators, National Institute for Lasers, Plasma and Radiation Physics, 409 Atomiştilor Street, P.O. Box MG-36, 077125, Bucharest - Măgurele, Romania

Keywords: ambient dose equivalent, personal dose equivalent, laser-target interaction

Recent progress of the chirped pulse amplification technique allowed the overcome of the power threshold P = 1PW for a laser and the possibility to obtain some relativistic intensities, $I_0 \cdot \lambda^2 > 1.37 \times 10^{18}$ $W \cdot cm^{-2} \cdot \mu m^2$, in which I_0 and λ, represent the intensity and the wavelength of the laser radiation. The target installed in a vacuum reaction chamber is becoming a secondary radiation source (photons, X-ray, electrons, positrons, ions etc.), function of the laser power (Rao *et al.*, 2007), when being irradiated by a laser beam. Such a secondary radiation source need to be dosimetric characterized according to the nuclear safety standards (NSR 2000). This paper presents a method to determine the personal dose equivalent and the ambient dose equivalent in Sievert units in the irradiation hall which houses the reaction chamber and in the irradiation hall adjacent rooms for the radiological protection of the personnel working in the relativistic laser installations.The measurement range for the photon radiation is encompassed between 5 keV and 1.25 MeV. The measurements were made by means of the secondary standards. These was calibrated with Co^{60} and Cs^{137} (1.25 MeV γ-rays and respectively, 0.662 MeV γ-rays, relative expanded uncertainty U_r = 3 % for the coverage factor k = 2) at PTW-Freiburg Physikalisch-Technische Werkstatten and PTB - Physikalisch-Technische Bundesanstalt, Germany, and they are now part of STARDOOR Lab in INFLPR.

References:

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P30: Analytical studies of ferrite nanoparticles

Lucica Grigora Toma[1], Rodica Mariana Ion[1,2]

[1] Valahia University of Targoviste, Multidisciplinary Research Institute for Sciences and Technologies, 2 Carol I street, 130024, Targoviste, Romania
[2] ICECHIM, Analytical Department, Bucharest-060021, Romania

Keywords: composites nanomaterials, ferrite nanoparticles, AAS, ICP-AES, XRF

Nanomaterials based on ferrites represent a very attractive area to explore. The results show that the magnetic properties were improved by using dispersed nanoparticles, as ferrites.

Nanometer-sized magnetic particles hosted on network material were successfully prepared by a simple chemical process. The composites were characterized by atomic spectroscopy (AAS) and induced-coupled plasma atomic emission spectroscopy (ICP-AES). Also, the energy dispersive X-ray spectroscopy (XRF) allowed the observation of submicron particles. All the produced spherical beads have presented metallic particles ($NiFe_2O_4$, $CuFe_2O_4$, $CoFe_2O_4$, or $MnFe_2O_4$), either as isolated particles or agglomerates, located on their external and internal (within pores). The thermal stability of the composites, evaluated by thermogravimetric techniques, were found to be dependent on the amount of ferrite particles incorporated into them.

The size distribution of the nanoparticles was relatively narrow with good distribution. Nearly spherical nanoparticles, 7 nm in diameter, were identified as $CoFe_2O_4$ and had a well-defined crystalline structure.

International Student Workshop on Laser Applications 2010 - ISWLA'10 -

P31: Integration of a UV-VIS-NIR Nd:YAG laser system in a new LIDAR system

Mihai Cazacu[1,3], Ovidiu Tudose[2], Valentin Ristici[4], Doina Nicolae[5] and Ioan Balin[3]

[1]Faculty of Physics, Al. I. Cuza. University, 700506, Iasi, Romania
[2]Esyro (EnviroScopY SRL), Tehnopolis – Science and Technology Park, 700671, Iasi, Romania
[3]EnviroScopY SA, PSE - EPFL, Lausanne, Switzerland
[4]National Meteorogical Administration, Bucharest - Baneasa, Romania
[5]National Institute of Research & Development for Optoelectronics, 77125, Bucharest-Magurele, Romania

Keywords: Nd:YAG laser, Lidar

Aiming the remote sensing low cost, up-gradable and modular tools development for monitoring relevant atmospheric parameters processes in whole troposphere, the new LIDAR system i.e ^{mESY}LIDAR, dedicated for tropospheric aerosols and clouds high temporal (min) and spatial resolutions (m) investigations is based on a powerful Nd:YAG 30 Hz pulsed laser with harmonic modules for 532 nm and 355 nm, a 40 cm Newtonian telescope and on a new opto-mechanic detection module built in an "eye geometry" consideration.

Based on the patented lidar system (D. Nicolae & I. Balin *et all*., 2008), ^{mESY}LIDAR is a multi - wavelengths minilidar system with the transmitter based on a coaxial UV-VIS-NIR emission of a powerful and stable Nd:YAG laser (35 mJ at 355 nm, 100 mJ at 532 nm, 200 mJ at 1064 nm) with 0-30 Hz, variable repetition rate. The initial divergence of the 0.6 mm laser beam diameter of 0,75 mrad is improved 5x due to a 3λ beam expander (BE) giving thus a single beam of 30 mm diameter and final divergence of 0,15 mrad. The height repetition rate and a low divergence (which provides a lower attenuation of the incident beam energy) are useful to mediate the lidar profiles with a good signal noise ratio at high altitudes. These features of laser offer the possibility to perform measurements up to high altitudes (12 km at daytime and 15 km at night) and can also carry out studies of depolarization due to linearly polarized laser beam with horizontal polarization at 1064 nm and 355 nm and vertical polarization at 532 nm.

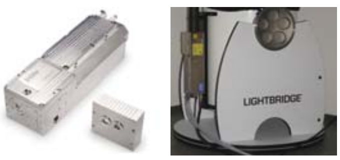
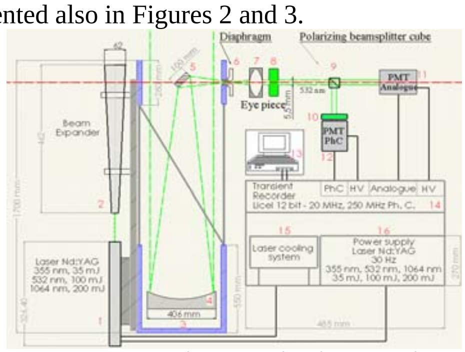


Figure 1. Nd:YAG - Laser head

The basic configuration has two simultaneous measurement channels i.e. 532 nm parallel/cross. More technical details on this LIDAR system configuration and an example of 3D profile are presented also in Figures 2 and 3.



1. Laser, 2. Beam expander, 3. Newtonian telescope, 4. Primary mirror, 5. Secondary mirror, 6. Diaphragm, 7. Eyepiece, 8. Interferential filter, 9. Polarizing beamsplitter cube, 10. Neutral density filter, 11. Analogue photodetector 12. Photon counting photodetector, 13. Computer, 14. Transient recoder – Licel, 15. Laser cooling system, 16. Laser power supply

Figure 2. Configuration of the ^{mESY}LIDAR.

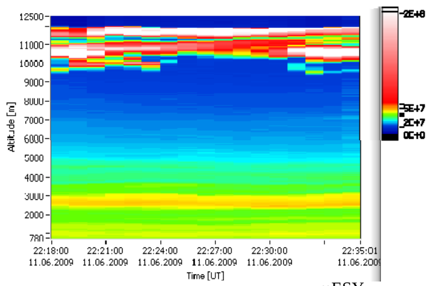


Figure 3. A 3D profile from the ^{mESY}LIDAR.

D. Nicolae, E. Carstea, I. Balin, A. Balanici, G. Picoulet, P. Ristori, MicroLIDAR, System for Detection of Aerosol and Atmospheric Clouds 3D Profiles, patent, 2008; A/00694/09.09.2008;

S. Stefan, D. Nicolae, M. Caian, Secretele aerosolului atmosferic in lumina laserilor, Ed. Ars Docendi Universitatea din Bucuresti, 2008

Ioan Balin, Measurement and analysis of aerosols, cirrus-contrails, water vapor and temperature in the upper troposphere with the Jungfraujoch LIDAR system. Thèse EPFL, no 2975, 2004.

P32:Polarization analyzing of DPSS beam with PAX polarimeter

Udrea Cristian[1], Gruia Ion[2], Logofatu Petre Catalin[3]

[1] National Institute for Laser, Plasma and Radiation Physics ,
Department of Lasers, Magurele, 077125, Bucuresti, Romania
[2] Department of Optics, Spectroscopy, Plasma and Laser, Faculty of Physics,
University of Bucharest, Magurele, Bucuresti, Romania

Keywords: polarization, polarimeter, analyzer

The polarization analyzing system is used to measure the state of polarization (SOP), in this case, of a Diode Pumped Solid State (DPSS) laser beam, for determinating the Stokes parameters.

The setup is formed by a polarimeter card (PAX 5710 [1]) which has an external sensor (PAX5710VIS) that measure light from 400 to 700nm. This sensor consists of a rotating quarter waveplate, a fixed linear polarizer and a photodiode. The linear polarized light travels along the fast axis and is not changed. After the waveplate rotates 45° the transformed polarization is circular right. Another 45° gives again linear polarization since the slow axis is parallel to the incoming linear polarization. A rotation of 135° yield circular left polarization and a half turn corresponding to 180° results in the original linear polarization. The following picture of the Poincaré sphere points up the change of the polarization. An eight shape is drawn on the sphere after a half revolution of the quarter waveplate.

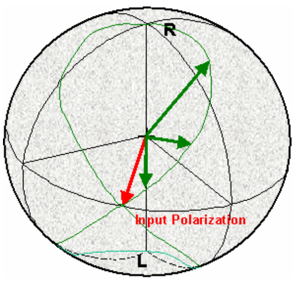


Figure 1. Polarization during a half turn of the l/4 waveplate

The polarizer transforms the polarization modulation into an amplitude modulation. The detector supplies a current that is proportional to the optical power and to the square of the electric field intensity. The photocurrent consists of three parts. A DC part, a part with the double quarter waveplate rotation frequency and a part with the quadruple rotation frequency with a phase shift.

One measure mode used in this experiment by the PAX software is Poincare Sphere Mode (show the actual status of the output polarization on the sphere, the orange point represented the actual output polarization).

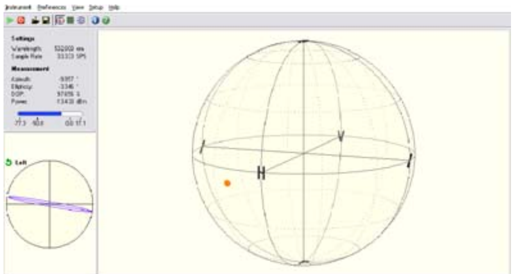


Figure 2 Representation of polarization of the DPSS laser beam at 22 mA current in the Poincare Sphere Mode.

Another mode used is the Scope Mode which is similar with an oscilloscope view. This mode display Stokes vector parameters (S_1, S_2 and S_3), Azimuth and Ellipticity, in separate graphics. Degree of Polarization and Power, are each shown in a separate diagram.

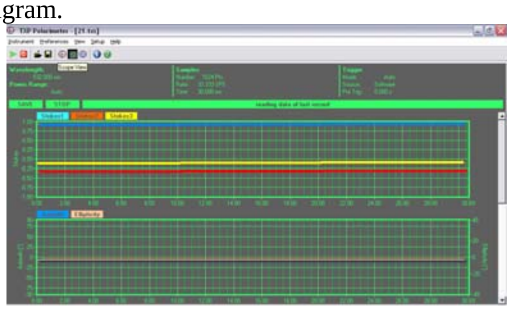


Figure 3 Measured modes in Scope Mode

Knowing Stokes vectors (S_1, S_2, S_3) we can determinate beam intensity S_0, which is:

$$S_0^2 = S_1^2 + S_2^2 + S_3^2$$

Thorlabs Instrumentation, Polarization Analyzing System, (PAX 5710), http://www.thorlabs.de/

P33: Ceilometer CL-31 a mini lidar used in the atmospheric studies

Ioana Ungureanu[1], Sabina Stefan[1]
[1]University of Bucharest, Faculty of Physics, P.O.BOX Mg-11, Bucharest, Romania,
e-mail:ioana_ungureanu_18@yahoo.com

Keywords: ceilometer, clouds, cloudiness, mixing layer height

The aim of paper is to present Vaisala CL-31 Ceilometer's applications in atmospheric studies, especially in lower troposphere, part named Atmospheric Boundary Layer, ceilometer CL-31 is installed at the Faculty of Physics Magurele (44.35N, 26.03 E). It is a mini-lidar that works at 910 nm wavelength and employs a pulsed diode laser LIDAR (light detection and ranging)technology, where short, powerful laser pulses are sent out in a vertical or near vertical detection.The ceilometer is ideal for meteorological applications where reliable detection of clouds is essential.In this paper the CL-VieW and Lab-View software have been used for data processing, in order to obtain the backscattering vertical profiles during the winter 2008-2009, the spring, summer and autumn of 2009. The special cases with precipitation or aerosol intrusions were discussed in connection with meteorological parameters, using HYSPLIT4 model and synoptic situations. The temporary variation of cloudiness, the frequuency occurrence of low clouds and fog has been performed.In addition, to validate the mixing layer height, determined by using ceilometer CL-31 data, a comparison with atmospheric soundings and Richardson numbers value was made.The results show the ceilometer's applicability to analyze atmospheric boundary layer structure and processes taken place into it.

References:

http://www.ready.noaa.gov/ready/open/hysplit4.html

http://www.wetter3.de/Archiv/

Steyn DG, Baldi M, Hoff RM (1999) The detection of mixed layer depth and entrainment zone thickness from lidar backscatter profiles. J Atmos Oceanic Tech 16:953–959

Holzworth, C. G.: Estimates of mean maximum mixing depths in the contiguous United States, Mon. Wea. Rev., 92, 235–242, 1964.

Holzworth, C. G.: Mixing depths, wind speeds and air pollution potential for selected locations in the United States, J. Appl. Meteorol., 6, 1039–1044, 1967.

Menut, L., Flamant, C., Pelon, J., and Flamant, P. H.: Urban boundary-layer height determination from lidar measurements over the Paris area, Appl. Opt. LP, 38, 945–954, 1999.

IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Stull, Roland B. 1988. An Introduction to Boundary Layer Meteorology, Kluwer Academic, 666pg.

P34: Straightforward optical transmission method for visualization of highly-absorbing and scattering objects

Karen Vardanyan, Anna Khachaturova, Sargis Varzhapetyan, Anahit Badalyan, Svetlana Shmavonyan, and Aram Papoyan

Institute for Physical Research, NAS of Armenia, Ashtarak-2, 0203 Armenia
vardanyankaren@gmail.com

We present technique and initial results of optical screening and imaging of highly scattering and/or absorbing media, including biological objects. The method relies on scanning a weak modulated laser beam across the tested object followed by highly-sensitive lock-in detection, PC-acquisition and data processing. Modulation of laser beam amplitude is synchronized with computer-controlled scanning step and subsequent synchronous detection followed by real-time data processing allowing to enhance the spatial resolution and significantly reduce the overall variation of the transmitted signal. The preliminary studies have shown principal applicability of the suggested technique for medical diagnostics, biology, quality control and homeland security.

P35: Non contact long range profilometer for cultural heritage

T. Vasile[1], D. Apostol[2], I. Iordache[3], V. Damian[4], F. Garoi[5] and M. Bojan[6]

[1] National Institute for Laser, Plasma and Radiation Physics , Department of Lasers, Magurele, 077125, Bucuresti, Romania

Keywords: profilometry, triangulation.

Cultural heritage conservation technologies uses many instruments from high sensitivity scanning probe microscopes to observe minute details to laser scanners for large sites digital registration. The objects of interest are ceramics, china, coins, paintings, statues, buildings, sites.

Profilometry at high resolution – contact (stylus) or noncontact (White Light Interferometry) are also useful. Stylus profilometers are destructive; WLI has very small field of view (FOV). As a consequence we decided to build a non contact (optical) high sensitivity profilometer using triangulation principle for 12X9 cm range.

The developed profilometer is composed of a laser source, a linear PSD (position sensing detector from THORLABS) and a 2D step motor translation table (PRIOR ProScan II). The diffuse reflection of the laser beam on the object surface is focused on the detector. According to the optical triangulation relationship between the detector's output values and the surface displacements, the three dimensional profile of a scanned object can be obtained. Coins and medals are primarily objects to be digitized using our profilometer.

References:

Hoa G. Nguyen, A Simple Method for Range Finding via Laser Triangulation, January 1995.

Dirk Stöbener, Distance Measurements with Laser Triangulation in Hot Environments, June 22-27, 2003

P36: Optical and structural characterization of InN thin films grown by radiofrequency discharge assisted pulsed laser deposition

Nedelcea Anca, Matei Andreea, Stokker Flavian,
Moldovan Antoniu, Valentin Ion, Birjega Ruxandra, Dinescu Maria

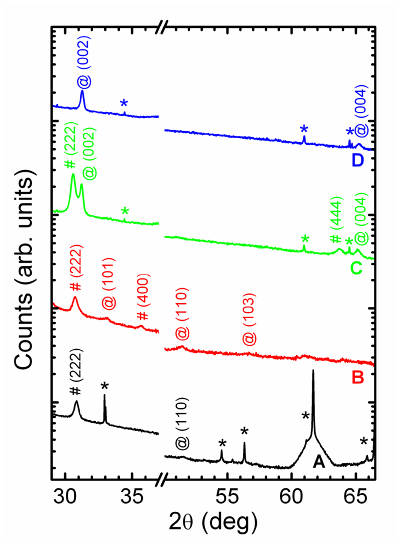
INFLPR - National Institute for Lasers, Plasma, and Radiation Physics
Magurele RO-077125, Bucharest, Romania

Keywords: InN, thin films, RF-PLD

InN has attracted much attention due to its optical and electrical properties that make it suitable for the fabrication of infrared optical devices and high-speed electronic devices.

In this work we report on the optical and structural properties of InN thin films grown by radiofrequency plasma discharge assisted pulsed laser deposition (RF-PLD) on sapphire and Si. The optical parameters are determined by spectroscopic-ellipsometry (SE). Due to the fact that there is little data available in the scientific literature for InN optical constants, the obtained refractive indexes (n) and absorptions (k) are discussed. X-ray diffraction (XRD), and atomic force microscopy (AFM) analyses are used for complementary characterization of the deposited layers.

The influence of substrate type and growth parameters on the morphology and structural properties of the resulting InN thin films is discussed. Although growth of InN from a metallic In target using nitrogen radiofrequency plasma assisted pulsed laser deposition was achieved for all the samples, growth conditions were found to play an important role on the crystal quality of the resulting thin films.



References:

T. Matsuoka, H. Okamoto, M. Nakao, H. Harima, E. Kurimoto, Optical bandgap energy of wurtzite InN, Appl. Phys. Lett. 81 (2002) 1246-1248.

K. Mitamura, T. Honke, J. Ohta, A. Kobayashi, H. Fujioka, M. Oshima, Characterization of InN grown directly on Al_2O_3 (0001) substrates by pulsed laser deposition, J. Cryst. Growth 311 (2009) 1316-1320.

Surname	Forename	Institution	country	Paper	Contact email
Achim	Cristina	National Institute for Laser, Plasma and Radiation Physics	Romania	P	cristina.achim@inflpr.ro
Andrei	Ionut-Relu	National Institute for Laser, Plasma and Radiation Physics	Romania	PO	ionut.andrei@inflpr.ro
Avarvarei	Iulian	Politehnica	Romania	P	iula185@gmail.com
Badita	Eugenia	National Institute for Laser, Plasma and Radiation Physics	Romania	P	eugenia_badita@yahoo.com
Bawaj	Mateusz	Nicolaus Copernicus University	Polonia		m.bawaj@stud.umk.pl
Bojan	Mihaela	National Institute for Laser, Plasma and Radiation Physics	Romania		mihaela.bojan@inflpr.ro
Boni	Mihai	National Institute for Laser, Plasma and Radiation Physics	Romania	P	mihai.boni@inflpr.ro
Boscornea	Andreea	Faculty of Physics/ University of Bucharest	Romania	P	boscornea.a@gmail.com
Bulinski	Mircea	Faculty of Physics/ University of Bucharest	Romania	IL	mircea_bulinsky@yahoo.com
Carstea	Emil	National Institute of R&D for Electronics and Optoelectronics	Romania		emil@inoe.inoe.ro
Chitu	Catalin	Energetic High School	Romania	PO	catalinchitumail@yahoo.com
Cojocaru	Ruxandra	Politehnica	Romania	PO	rxs_f@yahoo.com
Dabu	Razvan	National Institute for Laser, Plasma and Radiation Physics	Romania	IL	razvan.dabu@inflpr.ro
Dinescu	Maria	National Institute for Laser, Plasma and Radiation Physics	Romania	IL	maria.dinescu@inflpr.ro
Dragoi	Cristina	National Institute of Material Physic	Romania	P	crista_mitchel@yahoo.com
Dumitrascu	Maria	National Institute for Laser, Plasma and Radiation Physics	Romania	P	maria.dumitrascu@inflpr.ro
Dumitriu	Irina	National R&D Institute for Chemistry and Petrochemistry - ICECHIM	Romania	P	dumitriu.irina@yahoo.com
Faraon	Victor-Alexandru	National R&D Institute for Chemistry and Petrochemistry - ICECHIM	Romania	P	victor.faraon@gmail.com
Feraru	Ionut-Daniel	National Institute of R&D for Electronics and Optoelectronics	Romania	P	feraru_i@yahoo.com
Fierascu	Radu-Claudiu	National R&D Institute for Chemistry and Petrochemistry - ICECHIM	Romania	P	radu_claudiu_fierascu@yahoo.com
Frumosu	Flavia Dalia	Politehnica	Romania	PO	flavia_frumosu@yahoo.com
Iconaru	Simona Liliana	National Institute of Material Physics	Romania	PO	simonaiconaru@gmail.com
Janus	Bogdan	Institute of Physics, Technical University of Łódź	Polonia	P	janus@onet.pl
Kolenderska	Sylwia	Nicolaus Copernicus University	Polonia	PO	sylwkol@wp.pl
Kordas	Wojciech	SPIE Student Chapter	Polonia	PO	wojciech.kordas@pwr.wroc.pl
Lupei	Voicu	National Institute for Laser, Plasma and Radiation Physics	Romania	IL	voicu.lupei@inflpr.ro

Maksymov	Andrii	Kyiv National University of Taras Shevchenko	Ucraina	P	chuangsuvan@gmail.com
Marmureanu	Luminita	National Institute of R&D for Electronics and Optoelectronics	Romania		luminita.marmureanu@gmail.com
Matei	Cristina	National Institute for Laser, Plasma and Radiation Physics	Romania	P	cristina.matei@inflpr.ro
Michael	Alley	Penn State University	USA	IL	malley@engr.psu.edu
Mihai	Laura	National Institute for Laser, Plasma and Radiation Physics	Romania	PO	laura.mihai@inflpr.ro
Munteanu	Dragos	“Grigore Moisil” Theoretical High School, Bucharest, Romania 3Faculty of Automatic Control and Computer, University “Politehnica”of Bucharest, Romania	Romania		
Nastasa	Viorel	National Institute for Laser, Plasma and Radiation Physics	Romania	PO	viorel.nastasa@inflpr.ro
Nedelcea	Anca	National Institute for Laser, Plasma and Radiation Physics	Romania	P	nastasa_viorel@yahoo.com
Nicolae	Doina	National Institute of R&D for Electronics and Optoelectronics	Romania		nnicol@inoe.inoe.ro
Oprea	Andreea	Faculty of Physics/ University of Bucharest	Romania	P	andreeaoprea22@yahoo.com
Pascu	Mihai	National Institute for Laser, Plasma and Radiation Physics	Romania	IL	mihai.pascu@inflpr.ro
Poienescu	Aurora-Anca	Valahia University of Targoviste	Romania	PO	poinescua@yahoo.com
Pop	Simona-Florentica	Valahia University of Targoviste	Romania	P	popsimfc@yahoo.com
Popescu	Silviu	National Institute for Laser, Plasma and Radiation Physics	Romania	PO	silviu.popescu@inflpr.ro
Pucińska	Joanna	Wroclaw University of Technology SPIE Student Chapter	Polonia	PO	joanna.pucinska@pwr.wroc.pl
Radu	Catalina	Faculty of Physics/ University of Bucharest	Romania	P	ct082003ro@yahoo.com
Radulescu	Razvan-Cosmin	National Institute of R&D for Electronics and Optoelectronics	Romania		razvan@inoe.inoe.ro
Rumiński	Daniel	Nicolaus Copernicus University	Polonia	PO	drdr@fizyka.umk.pl
Salamu	Gabriela	National Institute for Laser, Plasma and Radiation Physics	Romania	P	gabriela.salamu@inflpr.ro
Sargsyan	Robert	Institute for Physical Research of NAS Armenia	Armenia	P	vardanyankaren@gmail.com
Shestopal	Oleksandr	Kyiv National University of Taras Shevchenko	Ucraina	P	ar.shestopal@gmail.com
Smarandache	Adriana	National Institute for Laser, Plasma and Radiation Physics	Romania	PO	adriana.smarandache@inflpr.ro
Snezhkova	Olesia	Kyiv National University of Taras Shevchenko	Ucraina	P	snezhkova@univ.kiev.ua

Sporea	Dan	National Institute for Laser, Plasma and Radiation Physics	Romania	IL	dan.sporea@inflpr.ro
Stancu	Radu	Politehnica	Romania	PO	radu_florin_stancu@yahoo.com
Svanberg	Katarina	Department of Oncology, Lund University Hospital, Lund University	Sweeden	IL	katarina.Svanberg@med.lu.se
Tamborski	Szymon	Nicolaus Copernicus University	Polonia	PO	sodalis@fizyka.umk.pl
Timus	Clementina	Romanian SPIE Student Chapter	Romania	IL	clementina.timus@inflpr.ro
Toma	Lucica Grigora	Valahia University of Targoviste	Romania	P	grigora29@yahoo.com
Tudose	Ovidiu-Gelu	SC EnviroScopY SRL	Romania	P	ovidiu.tudose@enviroscopy.com
Udrea	Cristian	National Institute for Laser, Plasma and Radiation Physics	Romania	P	cristian.udrea@inflpr.ro
Ungureanu	Ioana	Faculty of Physics/ University of Bucharest	Romania	P	ioana_ungureanu_18@yahoo.com
Vardanyan	Karen	Institute for Physical Research NAS of Armenia	Armenia	P	vardanyankaren@gmail.com
Vasile	Tiberius	National Institute for Laser, Plasma and Radiation Physics	Romania	P	tiberius.vasile@inflpr.ro
Zamfirescu	Marian	National Institute for Laser, Plasma and Radiation Physics	Romania		marian.zamfirescu@inflpr.ro