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Table of contents

Invited Lectures

I.01

Interferometric measurement of the electro-optic and pyroelectric coefficients of lithium niobate

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The interferometric measurement of electro-optic and pyroelectric coefficients of lithium niobate, important for applications of this crystal in nonlinear photonics, in particular for soliton waveguides recording, is introduced and discussed.

For the measurement of the electro-optic coefficient, the phase of the light passing through the investigated crystal is changed by applying an external electric field, whereas for the measurement of the pyroelectric coefficient, the optical phase is changed by heating the crystal. These phase changes can be determined by placing the crystal in one arm of an interferometer and monitoring the shift of the fringes in the interference fringe pattern. The design of the experiments, in order to minimize the influence of parasitic effects (photorefractive, photovoltaic) in the measurement of both coefficients is discussed. The influence of thermo-optic effect that also change the phase of the light when heating the crystal is carefully taken into account and it is subtracted from the overall phase change in the measurement of the pyroelectric coefficient.

Using the interferometric technique, the r_{33} electro-optic coefficient of Er-doped lithium niobate and, for the first time by this all-optical method, the pyroelectric coefficient of the lithium niobate, have been determined [1, 2].

Acknowledgements: The author acknowledges the project PN 09 39 01 03.

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I.02

Quantitative phase imagining (QPI): when metrology meets biology

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Most living cells do not absorb or scatter light significantly, i.e. they are essentially transparent, or phase objects. Phase contrast microscopy proposed by Zernike in the 1930's represents a major advance in intrinsic contrast imaging, as it reveals inner details of transparent structures without staining or tagging. While phase contrast is sensitive to minute optical path-length changes in the cell, down to the nanoscale, the information retrieved is only *qualitative*. *Quantifying* cell-induced shifts in the optical path-lengths permits nanometer scale measurements of structures and motions in a non-contact, non-invasive manner. Thus, quantitative phase imaging (QPI) has recently become an active field of study and various experimental approaches have been proposed.

Recently, we have developed Spatial Light Interference microscopy (SLIM) as a highly sensitive QPI method. Due to its sub-nanometer pathlength sensitivity, SLIM enables interesting structure and dynamics studies over broad spatial (nanometers-centimeters) and temporal (milliseconds-weeks) scales. I will review our recent results on applying SLIM to basic cell studies, such as intracellular transport and cell growth. I will end with a discussion on using SLIM for label-free diagnosis of blood and biopsies.

I.03

Tuned perovskite nanostructures with novel functional properties grown by laser ablation

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Perovskite materials are intensively studied for their wide range of applications, from optoelectronics, spintronics and multistate memories to the photocatalytical ones. In this study, we have investigated the functional properties of different perovskite materials nanostructures produced by laser ablation techniques. Thin films of ferroelectric relaxor PLZT (Pb1-xLax(Zr1-yTiy)1-x/4O3), have been integrated in a oxidic heterostructure for electro-optical investigations. The quadratic electro-optic behavior of PLZT thin films having the composition PLZT: 22/20/80 and optical properties has been studied by means of variable angle spectroscopic ellipsometry (VASE) method in reflection mode. The birefringence values up to $\delta\Delta = 0.17°$ have been obtained for quadratic compositions at λ=540 nm and 65° angle of incidence. In the case of photovoltaic and photocatalytic applications, bismuth ferrite (BiFeO3, BFO) based materials have a major advantage respect to the classic ferroelectric materials such as lead zirconate titanate (PZT), which has a small value for the band gap. BFO is a ceramic material with perovskite structure, high remnant ferroelectric polarization (95 $\mu C/cm^2$) and Curie temperature (Tc~1103 K), which simultaneously exhibit both ferroelectric and ferromagnetic properties. The band gap value corresponding to maximum absorptivity at visible wavelengths is much smaller than for most of the ferroelectric materials. We have synthesized BFO- based nanostructures by pulsed laser deposition (PLD) and laser ablation in different liquids (deionized water, alcohols). To evaluate their functional multiferroic and photocatalytic properties, the BFO- based nanostructures produced by laser ablation in liquid have be deposited as thin films by MAPLE (Matrix assisted Pulsed Laser Evaporation) technique. The influence of experimental parameters such as solvent type, laser wavelength or thickness of the deposited BFO nanostructures on the local piezoelectric response, optical, multiferoic and photocatalytic properties has been studied using techniques such as XRD, HRTEM, SE, UV-VIS, PFM or dielectric/ferroelectric spectroscopy.

Acknowledgements: 18 RO-CH/2013 IZERZO-142176 project

I.04

New and efficient methods for laser surface nanopatterning

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Femtosecond and picosecond laser pulses are intensively used for fundamental research and technological developments in the field in material processing and characterization. Due to the heat affected zone of the irradiated surface reduced below the size of the focused laser spot, the ultrashort laser pulses can precisely process the materials at sub-micrometer level. However, when large area has to be processed, the total processing time becomes a technological issue.

In this work two approaches for fast laser processing of large area are presented. The first one is based of self organization of quasi-periodical surface nanostructures induced by laser irradiation in ultrafast laser pulses regime. The Laser Induces Periodical Surface Structures (LIPSS) appears almost on all type of materials. Their orientation can be controlled by the polarization of the laser. The morphology depends on the substrate type, as well as on the laser beam parameters such as laser intensity, number of pulses, pulse duration and temporal pulse shape.

The second method for large area processing is based on optical near-field enhancement of single femtosecond laser pulses using transparent mask as optical concentrators. Transparent mask are produced in photoresists and used as focusing micro-optics for laser ablation of structures below the diffraction limit. Potential applications of laser nano-textured surfaces are also discussed.

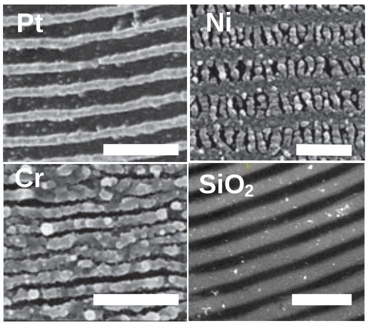

Fig. 1. LIPSS on various materials. Scale bar is 1 μm.

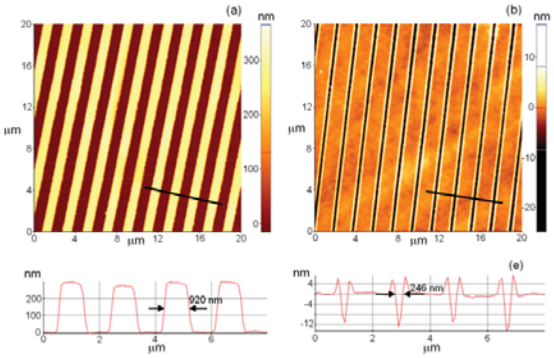

Fig. 2. The AFM image of the photoresist mask (a); The imprinted pattern produced by near-field laser ablation.

Acknowledgements: This work was supported by a grant of the Ministry of National Education, CNCS – UEFISCDI, project number PN-II-ID-PCE-2012-4-0539.

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I.05

Sm^{3+}-doped $Sr_{1-x}La_xMg_xAl_{12-x}O_{19}$ (ASL) single crystals for visible yellow-orange lasers

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In the last few years, yellow-orange lasers in the range of 570-620 nm have attracted a lot of attentions for important applications in the fields of medicine, astronomy, remote sensing and visual displays. Laser emission in this wavelength range can be obtained either by direct emission from materials activated with suitable laser ions or by nonlinear optical methods such as sum-frequency mixing and stimulated Raman scattering (SRS); this wavelength range cannot be generated by the frequency-doubling technique because there are no solid-state lasers emitting in the corresponding range of fundamental frequencies. The visible emission properties of some trivalent rare earths (RE^{3+}) can avoid the difficulties of nonlinear processes, but the pumping problems with classical lamps or luminescence quenching processes, have determined a reduced number of studies for many years. Presently, this can be surmounted by the recent development of InGaN laser diodes in the 405 nm range. Very recent publications highlighted the potential of Sm^{3+}-doped single crystals for the design of all-solid-state yellow-orange lasers employing optical pumping with InGaN laser diodes [1-5].

$Sr_{1-x}Sm_yLa_{x-y}Mg_xAl_{12-x}O_{19}$ (Sm:ASL) crystals are of interest as solid-state laser materials emitting in the visible range, especially for diode pumping due to their partially disordered nature. This work reports on the synthesis and growth conditions of Sm:ASL single crystals of good optical quality by the Czochralski method. Structural properties were investigated by X-ray diffraction measurements. The polarized absorption and emission spectra of Sm^{3+} ions in the grown crystals were measured and analyzed. It was concluded that Sm:ASL single crystals are promising candidates to obtain efficient yellow-orange laser emission.

Acknowledgments: This work was financially supported by the Romanian National Authority for Scientific Research, CNCS – UEFISCDI, PN-II-ID-JRP-2011-1 under Grant Agreement No. 3 RO-FR/03.01.2012.

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I.06

High Intensity Multiple THz Sources and its Applications

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Intense THz transients interact with gases and solid matter as well as proteins and biological tissues and they can be used to modify molecular orientation and rotations, spin, electrons, phonons. The numerical simulations of protein behavior as well as the experimental techniques are of great interest for biology and medicine [1,2]. The development of innovative tools and techniques is vital for improving the research capability and opening new applications in the high intensity terahertz regime.

Well established techniques like pump-probe requires high intensity THz sources with a delay of tens of picoseconds range and tailored shape, polarization, and energy. Here we report on two methods for generation of multiple high intensity THz pulse by using air-plasma filament two-color technique [3].

Optical pulses of few mJ and about 40 femtoseconds length at 800 nm fundamental wavelength (FW) are split by an assembly of thin film beam splitter (TFBS) and a mirror (Fig. 1). The delay between optical pulses and their energy ratio are controlled by the distance between TFBS and mirror and the polarization orientation [4]. The pulses are then focused through a BBO crystal to generate second harmonic (SH) and then, by balance action of self-focus and defocus, two plasma filament delayed by τ are created. The combined action of FW and SH on plasma filament creates an asymmetrical electromagnetic field that interacts with charged particles generating two high intensity THz transients which are recorded by using electrooptical sampling in ZnTe crystal, Fig. 2. To further increase the delay between the THz pulses the above described method was combined with splitting the optical pulse by spectral clipping [4].

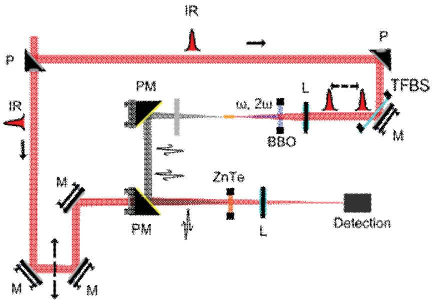

Fig. 1 Experimental setup for TFBS and mirror splitting.

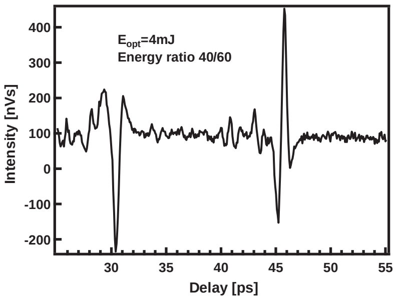

Fig. 2. Two THz transients measured by FS EO method

In conclusion we proved the multiple THz transients generation with controlled delay and energy ratio that is useful for nonlinear THz condensed matter experiments and study of protein conformational changes under intense THz pulses irradiation.

Acknowledgements: The research was funded by UEFISCDI trough the grant PN-II-ID-PCE 2011-3-0801 and LASERLAB EUROPE 284464.

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I.07

Passively Q-switched Nd:YAG/Cr^{4+}:YAG Lasers for Automobile-Engine Ignition

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The ignition of engines with internal combustion using a laser has been extensively studied during last years. It was shown that in comparison with a conventional spark-ignition system the laser-induced ignition has some attractive advantages, such as higher probability to ignite leaner mixtures, reduction of erosion effects and increase of engine efficiency, or shorter combustion time. On the other hand, realization of a compact laser with size comparable to that of an electrical spark plug and that can withstand and operate in conditions of vibration and temperature similar to those encountered during the engine operation is a challenging task.

In this talk we will present our experience toward realization of a laser-spark device. We will discuss two-laser configurations, the end-pumping scheme and a novel design in which the laser medium is pump directly through a prism, which were investigated in order to miniaturize the laser and make it suitable for engine ignition. Laser-spark devices with dimensions close to a classical electrical spark plug were built employing passively Q-switched composite Nd:YAG/Cr^{4+}:YAG ceramic media.

Finally, a static engine automobile was fully run with its four cylinders being equipped with laser-spark devices.

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I.08

Modification of surface properties of Vancomycin following exposure to UV laser beam

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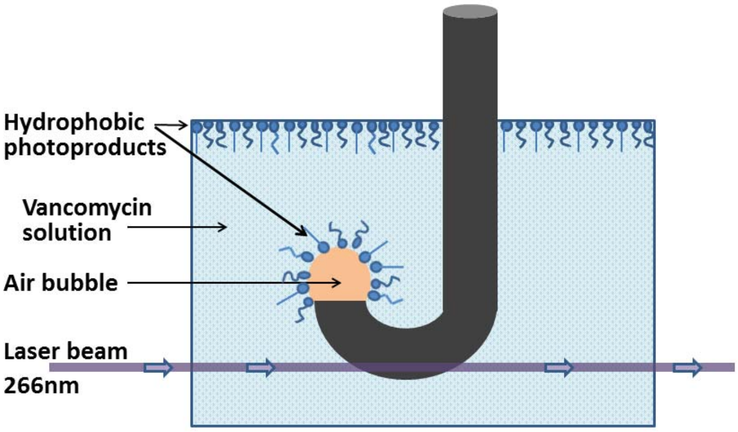
The paper shows results about UV laser beam interaction with Vancomycin (VCM) solutions in ultrapure water performed on bulk (5mL) samples introduced in the measuring compartment of a SINTERFACE PAT-1 equipment. The laser beam is emitted at 266 nm in pulsed regime (pulse time width 5 ns, pulse repetition rate 10 pps, average beam energy 7 mJ). The photoproducts and the molecular fragments resulting from the parent VCM and generated by exposure to 266 nm are evidenced by UV-VIS absorption and FTIR measurements as well as by liquid chromatography electro spray ionization time-of-flight mass spectrometry (LC/ESI-TOF-MS) evaluations.

A novel method is reported to characterize surface active compounds produced in VCM solutions during exposure to UV laser radiation, by measuring, in real time, the dynamic interfacial tension of the irradiated solutions in emerging, constant volume bubble configuration. The bubble is generated by computer controlled Hamilton dedicated system. The core of the experimental set – up is shown in the figure where the cell in which the interaction of the laser beam with the VCM solution and the air bubble used to measure the surface tension variations are drown.



The results show that amphiphilic photoproducts are generated after the interaction of VCM molecules with laser beam that migrate at the interface air bubble/VCM solution. They accumulate at the interface leading at transition surface effects. In the paper, four such amphiphilic photoproducts were identified and their chemical structures were proposed.

Acknowledgements: The work was supported by the bilateral Romanian – Italian program encoded RO13M05 entitled "Laser beams interaction with micro-droplets having controlled content" and the COST Action MP1106 "Smart and green interfaces - from single bubbles and drops to industrial, environmental and biomedical applications. The Romanian partner was also supported by the project NUCLEU PN0939/2009.

I.09

Nanostructures by soft pulsed laser techniques for applications in drug delivery, biomimetism or biosensing

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We review recent results in organic/inorganic composite nanostructured layers synthesized by PLD, MAPLE and LDW. The layers were optimized based upon the results of investigations performed by SEM, TEM, SAED, XTEM, AFM, GIXRD, XPS or FTIR methods. Biocompatibility, bioactivity and biodegradation were assessed by dedicated in-vitro tests.

Pullulan triacetate (a prospective candidate for drug delivery systems) was synthesized by PLD and MAPLE techniques and found that only MAPLE is adequate for a high fidelity compositional and structural transfer.

The coating of metallic implants with composite alendronate-HA or Sr-HA layers by MAPLE and PLD, respectively, was demonstrated to enhance human osteoblasts proliferation and differentiation, while inhibiting osteoclasts growth, with benefic effects for the treatment of osteoporosis. Magnesium substituted OCP and strontium substituted OCP deposited by MAPLE on Ti substrates enhance osteoblast activity and differentiation.

Urease immobilized by MAPLE in form of thin films was shown to preserve its activity in breaking down and diagnose of urea content in blood.

The application of MAPLE was extended to the transfer and immobilization of IgG molecules. We studied the effect of the lipid addition in the initial solution upon the protein thin films adhesion to various substrates.

We showed that the composite PMMA-bioglass films deposited by MAPLE efficiently protects metal implants against corrosion in human fluids.

The transfer of pure levan and oxidized levan by MAPLE was achieved without addition of plasticizers or pigments. The nanostructures exhibited high specific surface areas fully compatible with potential use in drug delivery systems.

The MAPLE obtained nanocomposites Ag:HA-organosolv lignin (Lig) were noncytotoxic, supporting the normal development and promoting the proliferation of the adhered human mesenchymal cells. The lignin addition boosted the anti-microbial activity of HA doped with silver ions against the both bacterial and fungal biofilms.

Mesotetraphenylporphyrin clean and liquid-free micropatterns on Si substrates were produced by LDW. The propulsor metal film thickness was found to be a key parameter, which determines the laser fluence range allowing the clean transfer, predominant mechanism of the blister formation and laser-induced heating of the transferred material.

Human plasma proteins (fibronectine, vitronectine) applied by MAPLE on PLD HA coated metallic implants significantly increased cell adhesion and activated osteointegration.

Levan and oxidized levan were mixed by combinatorial MAPLE in a databank containing all possible compositions between the two compounds. The gradual modification of physico-chemical and biological characteristics was demonstrated along the deposited compositional library.

Our conclusion is that the thin films prepared by PLD, MAPLE and LDW techniques were identical in chemical composition, structure, morphology, and most likely functionality resembling the base material, as proved by physical-chemical characterization and in-vitro testing.

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I.10

Photodynamic studies of some molecules of interest in drug carrier systems

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The drugs which are inactive *in vitro* but can become active in biological environment are termed "prodrugs". Among the various external triggers that can activate the drug is the UV-visible light. Photoactivated drug carriers systems is an option to be taken into account in advanced delivery by controlled release of the active form of the drug, in order to optimize the medication and reduce side effects. Already clinically applied, photodynamic therapy uses visible light to excite a photosensitizer (PS) which generates reactive species (reactive oxidative species, singlet oxygen, intermediate radicals) against nearby cancer cells.

The visible light, between 600-800nm, due to the better penetration in the tissue is most suitable for triggering. This can be used for release of drugs linked to a PS. The light irradiation of the compound in the absorbing spectral range of PS generates singlet oxygen which can break the linker between the PS and the drug. In this way, the drug can be released and becomes free and active in the chosen/selected site.

Photophysical properties of PS are important in photodynamic therapy, where these compounds are proposed as photosensitizing agents. We report here some significant solvent effects on the photophysical properties of Zn phthalocyanine (ZnPc) observed in binary solvent mixture dimethyl sulfoxide/water at several ratios of cosolvents.

Photocleavage of different substrates as potential linkers for drug delivery compounds is investigated. The role of singlet oxygen and the kinetic rates implied in the photoreactions were determined. The study were performed on several olefins (heterosubstituted alkenes). The rate constants for quenching of the singlet oxygen generated by Verteporfin by these compounds were determined. The photoproducts were analyzed by FTIR spectroscopy. The IR experimental spectra were compared with simulated ones using Gaussian 09 (DFT (Density Functional Theory) with B3LYP method and 6-311G basis set).

Within the same global frame, a photodynamic study of Verteporfin covalently conjugated with SWCNTs is reported. Singlet oxygen generation and fluorescence quantum yield are determined for these complexes.

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I.11

CO_2 laser photoacoustic spectroscopy in new applicative results

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Using a very sensitive instrument based on CO_2 laser photoacoustic spectroscopy [1, 2], several applications developed in our laboratory offered very interesting new results. They are systematised in 7 directions which are shortly described below.

1) New precise values of **absorption coefficients** were measured for molecular gases at the wavelengths of the CO_2 laser, namely **methanol, ethanol and carbon dioxide**. A high accuracy was assured by: a) using a frequency stabilized laser (1 MHz laser linewidth), so the absorption coefficients are measured only at the top of the laser line; b) using certified gas mixtures; c) avoiding saturation and the influence of foreign gases; and d) averaging over several independent measurements at each line to improve the overall accuracy of the results.

2) Measurements of **ammonia and ethylene in exhaled breath at patients with renal failure** indicated that a non-invasive ammonia test can be applied for selecting the optimum hemodialysis session duration and could also serve as a broad noninvasive screen for incipient kidney disease. The increasing ethylene concentration that occurs immediately after hemodialysis treatment is proving the higher rate of oxidative stress due to dialysis.

3) Using the exhaled ethylene as a biomarker, we monitored the evolution of the oxidative attack before, immediately after and at 15 minutes from the **radiotherapy**. The breath air samples from patients subjected to radiation treatment with a high dose fraction, demonstrated that patients treated by external radiotherapy suffer a slight increase in the generation of oxidants; however, in accordance with the clinical practice, this increase is sufficient to assess the body response to the treatment: the smaller the increase, the higher the radio-resistivity developed by the patient.

4) Studying the **surgical smoke** produced by CO_2 laser vaporization of different biological tissues, we measured the concentration of 9 gases: carbon dioxide, methanol, water vapors, acetonitrile, acrolein, ammonia, benzene, ethylene and toluene. We found that the average measured concentrations for three gases (acetonitrile, acrolein and benzene) are many times higher than the limits accepted by established organizations.

5) A new study was aimed to determine if **electronic cigarettes** (E) are less dangerous than **traditional cigarettes** (T). Analysing the behaviour of the ethylene biomarker at active smokers, a decrease of about 35% was obtained by switching from T to E cigarettes, and a corresponding increase of about 50% by replacing E with T cigarettes. Based on our results, we concluded that E-cigarettes are at the first glance safer than T-cigarettes.

6) Another experiment was aimed to investigate the oxidative stress for women practicing Kangoo Jumps (KJ) **aerobics**. Because it is not possible to directly measure free radicals in the body, we approach that by measuring the exhaled ethylene as by-product resulting from free radical reactions. Comparing the levels before and after the exercise program, we detected a lower concentration after the aerobics session, proving once again the health benefits of sports.

7) Valuable information was further obtained in **plant physiology**, especially on the behavior of fruits and vegetables in aerobic and anaerobic conditions. Measuring the plant hormone ethylene released by strawberries, raspberries, cherries, bananas, apricots, tomatoes, mushrooms, and zucchinis, we identified a very useful and easy applicable criterion to discriminate between organic and nonorganic samples (a much lower emission of ethylene from organic fruits and vegetables).

We conclude that a CO_2 laser photoacoustic spectroscopy based instrument can be successfully used in many life sciences fields.

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I.12

Titanium doped sapphire ultra-short duration and intense laser
Description, issues and state-of-the-art

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Since the beginning of the 90's the generation of high-intensity laser pulses has known an unprecedented evolution thanks to the conjunction of the possibility of the Chirped Pulse Technique and the availability of spectrally broad-band laser media. Lasers capable of producing multi-pétawatt pulses can now be built.

The application of the Chirped Pulse Amplification (CPA) technique to solid state lasers has made possible the generation of energetic few optical cycle pulses. Nowadays nearly all high peak-power, ultrafast laser systems make use of the CPA technique, followed by optical pulse compression (Fig. 1).

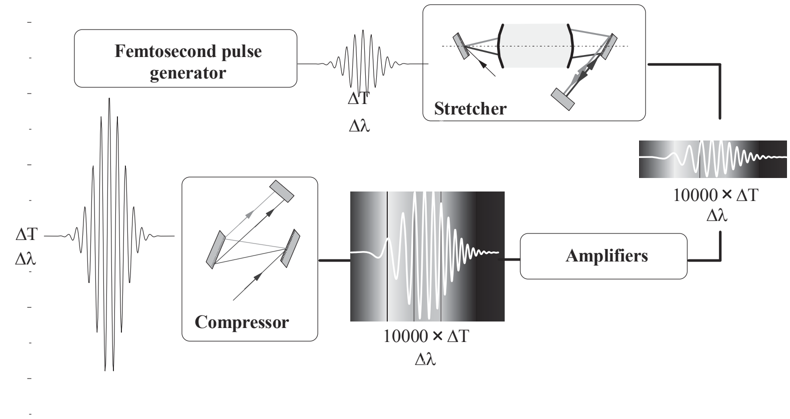

Figure 1: Schematic diagram of a Chirped Pulse Amplification based laser system.

One of the most used amplifier media is the titanium doped sapphire crystal as its optical and mechanical properties are especially relevant for the generation of high energy as well as high average power short pulse duration pulses. The main interest for that type of pulses is the peak intensity which is inversely proportional to the pulse duration and focal spot dimensions. Therefore the output pulses have to exhibit very high quality in both temporal and spatial domains.

The presentation will go through the detailed architecture of CPA laser systems; generation of the seed pulse, design of stretcher, different types of amplifiers, compressor set-up. The difficulties and issues of such systems will be introduced and solutions will be described.

The presentation will end with the worldwide current state-of-the-art of high intensity laser systems.

I.13

Laser driven experiments at Extreme Light Infrastructure-Nuclear Physics (ELI-NP)

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ELI Nuclear Physics facility currently under construction in Magurele, Romania [1] is part of the pan-European distributed facility that addresses specific research subjects in the field nuclear physics, secondary radiation sources (in Czech Republic [2]) and attosecond science (in Hungary[3,4]).

ELI-NP will make possible experiments used at higher and lower repetition rate as well as higher or lower peak powers of 100TW, 1PW and 10PW and corresponding intensities up to the range of 10^{23}W/cm^2. The initial laser driven experiments are grouped in four main research directions: laser driven nuclear physics, studies of strong field quantum electrodynamics, combined laser-gamma beam experiments and applications related to materials in radiation fields. The facility will also take advantage of the ultrashort time scales of secondary radiation pulses and the relatively broadband spectrum of radiation, complementary to the traditional nuclear physics research laboratories.

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Oral Presentations

O.01

Spectroscopy for breath biomarkers analysis at young population with mental disorders

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The CO_2 laser photoacoustic spectroscopy technique – LPAS that is developed in this research complies with this requirement, ensuring the advantages of health state assessment by monitoring the evolution of biomarkers in human body.

We characterize by breath air the assessment of ammonia and ethylene in mental disorders, but the techniques can be easily extended to other pathological issues.

LPAS is maturing rapidly in its applications to real world problems. Applications of LPAS include spectroscopic experiments, concentration measurements of trace gas (such as breath diagnostics, security and workplace surveillance, air-quality measurements, atmospheric monitoring), accurate determination of thermophysical properties, detection of dynamic processes, relaxation processes and measurement of aerosols. The laser based instruments can also be used for the detection of a wide variety of industrial gases, a broad range of chemical warfare agents, blistering agents and poisonous gases or explosives. Considering the wide gamut of application areas, the requirements for LPAS are various and the development and implementation of versatile analytical tools is challenging. We can perform the analysis of exhaled breath air by LPAS method, taking advantage of its important features like: multicomponent capability, high sensitivity and selectivity (to be immune to interference), high accuracy and precision, large dynamic range (usually larger than six orders of magnitude, from 100 ppt - parts per trillion till 100 ppm - parts per million), minor sample preparation, good temporal resolution, ease of use, versatility, reliability, robustness, and a relative low cost per unit [1-3].

Our studies can demonstrate that LPAS is a sensitive, non-invasive and real time method to accurately investigate exhaled breath of children with mental illness and can be adapted also to other applications in the clinic.

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O.02

Laser Emission from Diode-Pumped Nd:YAG Waveguide Lasers Realized by Femtosecond-Writing Technique

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Femtosecond (fs) laser pulses are becoming an important tool for three-dimensional modifications in various materials. The pulses interact nonlinearly with the material [1], thus a variation of the refractive index appears in the irradiated region [2]. Waveguiding is possible in the volume confined between the written tracks (double-wall or more complex structures) [3].

In this work we report on realization of circular cladding waveguides in Nd:YAG ceramic media by direct femtosecond-laser writing with a helical translation technique. Efficient laser emission at 1.06 μm and 1.3 μm is obtained under the pump at 808 nm with a fiber-coupled diode laser. The laser medium was a 5.0-mm thick, 1.1-at. % Nd:YAG ceramic (Baikowski Co. Ltd., Japan). For inscribing we used a chirped pulsed amplified system (Clark CPA-2101) that delivered laser pulses at 775 nm with duration of 200 fs, at 2-kHz repetition rate and energy up to 0.6 mJ. The laser crystal was moved along a helical trajectory during the writing process [4], thus eliminating the regions with unchanged refractive index as obtained in the classical step-by-step technique [5]. Laser pulses with 3.4-mJ energy at 1.06 μm and 1.2 mJ at 1.3 μm under the pump with 13.1 mJ at 807 nm are obtained from a circular waveguide of 100-μm diameter. The helical movement of the laser medium during fs-laser writing allows realization of efficient integrated lasers consisting of cladding waveguides pumped by diode lasers.

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O.03

Enhanced fluorescence in pending micro-droplets that contain emulsions

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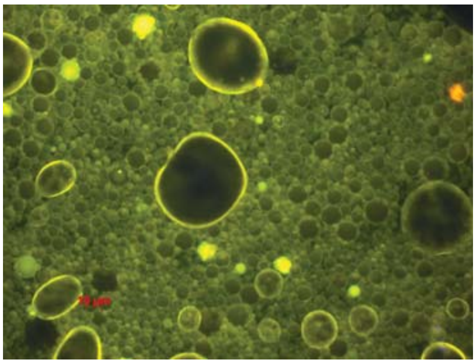
In this paper is studied the fluorescence emission of emulsions containing a mixture of Rhodamine 6G (Rh6G) dissolved in distilled water and Oily Vitamin A. The induced lasing is measured on a droplet that hangs at the extremity of a needle [1]. At low pumping energies is obtained an enhanced fluorescence with respect to the case of the measurements made in bulk or in droplets which contain solutions (not emulsions) of Rh6G in ultrapure water. By increasing the pumping energy a narrow lasing line is obtained.



Microscope image of an emulsion produced by the Double Syringe System method.

The results include the comparison between optical emission obtained from simple solution of Rh6G droplets and from droplets which contain an emulsion of Rh6G in water and oil. Rh6G is a fluorescent marker used in solution to study the activity of cancer cells. If the marker is introduced in the target tissue as an emulsion of Rh6G and oily Vitamin A, the fluorescence radiation excited in the same conditions as in liquid phase is much more intense. This would allow to use emulsions of Rh6G or, more general, fluorophores as markers at lower concentration levels and consequently at smaller toxicity and/or photo-toxicity. At the same time, lower energy laser beams may be used.

The emulsion was produced by the Double Syringe System method [2,3]. The obtained emulsions were stabilized using a Tween 80 surfactant at a concentration below cmc.

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O.04

The influence of the bottom electrode on the structural and electrical properties of $Pb(Zr_{0.2},Ti_{0.8})O_3/CoFe_2O_4$ multiferroic structures

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Multiferroic materials present an increasing interest in the last ten years due to the simultaneous existence of electric and magnetic order and potential applications in multifunctional devices [1]. Multi-layered thin films with alternating ferroelectric and ferromagnetic layers exhibit much higher spontaneous polarization, magnetization and magneto-electric (ME) coupling than in known single-phase materials [2]. The multiferroic properties of composite materials that contain magnetic $CoFe_2O_4$ (CFO) and ferroelectric $Pb(Zr_{0.2},Ti_{0.8})O_3$ (PZT) layers in different geometries are intensively studied[3].

Here two heterostructures of CFO/PZT have been deposited by pulsed laser deposition (PLD) on $SrTiO_3$ (STO) (100) substrate. Layers with 50 nm of PZT and CFO were sequentially deposited on STO substrate with two different bottom electrodes: $SrRuO_3$ (SRO) and $La_{0.7}\ Sr_{0.3}MnO_3$ (LSMO) in order to explore the influence of bottom electrode on structural and electrical properties. The epitaxial quality of the films was checked by X-ray diffraction measurements and also by transmission electron microscopy (TEM). Electrical characterisation comprising hysteresis measurement, capacitance-voltage (C-V), capacitance-frequency (C-f), current-voltage (I-V) reveals the influence of the interface with the bottom electrode on the electrical properties as dielectric constant, remnant polarisation, coercive field and charge transport mechanism.

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O.05

Growth and preliminary characterization of $La(Ca_{1-x}Sr_x)_4O(BO_3)_3$ single crystals for SHG in NCPM conditions of 1.03 µm laser emission

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At this time, the availability of laser frequencies in the visible range is limited by laser materials and pump sources. Frequency conversion of solid-state lasers operating in the near infrared range by nonlinear optical (NLO) crystals has become the most available method to obtain shorter wavelength lasers with high beam stability, low cost and compactness. Thus, the reliance on nonlinear methods of frequency generation demonstrates the need for new nonlinear crystals with the ability to frequency convert a wide variety of laser wavelengths.

$LaCa_4O(BO_3)_3$ (LaCOB) crystal is a member of the $ReCa_4O(BO_3)_3$ family (where Re = Y, La, Gd, Y) and crystallizes in the monoclinic biaxial system belonging to the *Cm* space group [1-3]. Previous researches on NLO properties of LaCOB crystal [4] has shown that non-critical phase matching (NCPM) wavelength along Z axis is about 1042 nm, which is very close to the emission wavelength of highly efficient Yb:YAG solid-state lasers in the 1030 nm spectral range.

For frequency conversion applications, NCPM is advantageous because of its large angular acceptance and because it eliminates the walk-off between fundamental and harmonic radiations which lead to the highest efficiency. Thus, by a partial cationic substitution of Ca^{2+} ions with Sr^{2+} ions in LaCOB crystal its NLO properties can be modified in a controlled way in order to achieve new NCPM conditions for second harmonic generation (SHG) of fundamental wavelengths in the 1030 nm range, preserving in the same time the congruent melting character which offers the possibility to obtain large crystals from melt. In this way it will be possible to obtain high-power green laser emission (~ 515 nm) by SHG of powerful Yb:YAG lasers in NCPM conditions that ensure maximum conversion efficiency. Single crystals of $La(Ca_{1-x}Sr_x)_4O(BO_3)_3$ with large size and good quality have been grown by Czochralski method. X-ray measurements have been carried out to characterize the structural changes with compositional parameters *x*. The NCPM wavelengths were measured and compared with theoretical predictions. According to our assumptions, the obtained results demonstrate that the grown crystals can convert the infrared radiation (~ 1030 nm) into green light (~ 515 nm) by type-I NCPM SHG processes along Z axis.

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O.06

Temporal characterization of long chirped laser pulses

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The present work addresses the characterization of complex pulses with chirp and spectral phase jumps generated in chirped pulse laser systems. Such laser pulses belong to the broad class of shaped pulses that find widespread use in the modern research studies. Their characterization is essential for the developments of related applications.

Characterization of the chirp in stretched laser pulses is performed with a novel, simple method, based on the use of a plasma mirror switch coupled with a spectrometer. For a 36nm full width half maximum bandwidth and 360ps chirped laser pulse, the spectral phase of the pulse was measured in few hundred of points. Besides the chirp measurement, the approach allows the detection of jumps in the optical path, hence spectral phase jumps corresponding to less than 3ps [1].

Several methods to measure the temporal structure of the chirped pulse were previously demonstrated. The one in [2] is based on temporal and spectral simultaneous interference signature measurement, bringing the advantage of the single shot measurement for nanosecond long chirped pulses. Spectral interference was also used in [3].

Here, a complementary method is proposed, based on very fast nonlinear optical processes, namely plasma mirror reflectivity switch [4]. The plasma mirror effect on a piece of transparent glass is used for the sampling of the electric field of a chirped laser pulse with sub-picosecond resolution. Beside its simplicity, and low cost, our method has the advantage to provide, measurements of spectral phase jumps in strongly chirped pulses, as needed for experiments similar with the ones reported in [5,6].

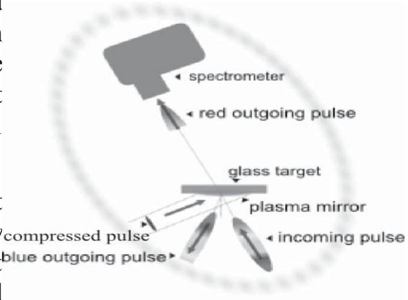

Figure: Ilustration of beams at the interaction.

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O.07

Synchronization issues of high power ultra short pulse lasers

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In recent years, the improvement of the technology for high power ultra-short pulse lasers triggered the development and construction of facilities and laboratories that generated new ultra-short pulse driven applications in various scientific and technological fields. These lasers use CPA (Chirped Pulse Amplification) or OPCPA (Optical Parametric CPA) architecture. Such approaches involve the concentration of the laser pulse energy in a very small time interval (from tens to hundreds femtoseconds) in order to obtain a large pulse peak power.

One main feature of such lasers is the intrinsic very small temporal scale of the pulses that generates unique insight in a broad range of phenomena. The associated challenge is the synchronization of the laser itself with the experiment setup, or to synchronize several lasers between them and together with the experiment [1]. In this case, the specially built femtosecond oscillator must be synchronized to an external RF signal generator or another laser oscillator. The present paper reviews synchronization configurations and their limitations, clock jitter, clock skew and how these parameters affect the synchronization process.

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O.08

Spectral evidence of Vancomycin's modification under exposure to laser radiation

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Vancomycin (VCM) is a highly toxic antibiotic that is used normally for treatments in solution form. If a VCM solution in ultrapure de-ionized water is exposed to laser radiation of suitable characteristics, modifications of VCM molecules occur and new photoproducts are generated.

The exposure of VCM was made using a pulsed laser beam emitted as the fourth harmonic of a Nd:YAG laser fascicle (λ=266nm), the average beam energy varying within the interval 1–40mJ. The exposure time was chosen function of several parameters such as: solution volume, laser beam characteristics (energy, focus waist and place, beam divergence) and irradiation geometry.

Different results were obtained depending on the experimental conditions: from generating hydrophobic and hydrophilic photoproducts to foam production from VCM solutions.

The UV-Vis absorption, FTIR and MS spectra of VCM solutions recorded before and after exposure to laser beams were employed to detect the modifications of VCM molecules and the formation of photoproducts that appear during/as a consequence of the irradiation.

The laser induced fluorescence (LIF) spectra yielded real-time information about the modifications of VCM molecules while exposing the medicines solutions to the laser beam.

Real-time measurement of surface properties of gas bubbles that are pendant in solutions evidenced the formation of amphiphilic photoproducts generated in the surrounding VCM solutions by exposure to UV laser beams.

On the other hand the exposure of VCM solutions in particular conditions to UV laser beams leads to foam formation. Optical microscopy measurements were employed to characterize the dimensions of the gas bubbles in the VCM foams.

Foams generation in VCM solutions during laser irradiation requires a bubble nucleation, most probably generated by the transient acoustic waves induced by the laser pulse [1, 2]. In the foam generation, modifications of the VCM molecules at interaction with the UV laser beam are produced. These modifications are especially implying the tyrosine radicals in the glycopeptide, as indicated by the absorption spectra.

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O.09

Interaction of solutions containing phenothiazines exposed to laser radiation with materials surfaces, in view of biomedical applications

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Solutions of phenothiazine derivatives (Chlorpromazine, Promazine and Promethazine) were exposed to UV laser radiation in order to be applied on different materials surfaces. The contact angles formed with the cotton, polyester and Parafilm M surfaces were measured in view of their implementation in several dermatological treatments (skin injuries, surface infections and/or skin cancer).

Phenothiazine drugs are photosensitive compounds, and therefore when they are exposed to white light or to UV radiation experience modifications at molecular level, which lead to the enhancement of their antibacterial activity [1,2]. These drugs are known as non-antibiotics and solutions obtained by exposure to UV laser beams can be used as part of a new method to fight multiple drug resistance acquired by bacteria and/or malignant tumours [3].

In this study, Chlorpromazine, Promazine and Promethazine were prepared in ultrapure water and were exposed to pulsed Nd:YAG laser radiation emitted at 266 nm, by 4th harmonic generation. The irradiated solutions have been studied using pH measurements, UV/Vis/NIR absorption spectrophotometry, laser induced fluorescence, thin layer chromatography (TLC) and surface tension measurements.

The contact angle results show improved wetting properties of solutions containing phenothiazines in comparison to ultrapure water. Cotton textile can be impregnated more easily with drug solution than polyester, in view of biomedical applications. The results present best wetting properties for CPZ solutions on cotton textile (unirradiated and 4 hours irradiated samples as well).

The knowledge about the above mentioned materials surface properties is significant when solutions of modified phenothiazines are poured on them and they are further applied on treated surfaces (skin, for instance). Their use may have the possibility to deliver the drugs slowly, in order to obtain an efficient treatment in an optimal time interval and at low toxicity levels.

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O.10

Pure and doped hydroxyapatite thin films synthesized by pulsed laser deposition for metal implant coatings

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Hydroxyapatite (HA) is a widely used biomaterial for implant thin films, largely-recognized for its excellent capability to chemically bond to hard tissue inducing the osteogenesis without anti-immune response from human tissues. Nowadays, intense research efforts are focused on development of antimicrobial HA doped thin films. In particular, the HA and HA doped with Silver (Ag:HA) are expected to inhibit the attachment of microbes and contamination of metallic implant surface [1].

We report successful transfer by advanced laser techniques of pure HA, Ag:HA on Ti and Ti modified with TiO_2 nanotubes substrates. Obtained coatings preserved their initial composition, as demonstrated by physico-chemical analyses: FTIR, XRD and EDS data.

The high values of surface roughness of thus assembled composite thin film are in good compliance with the potential use in medicine and biology. Titanium surface modified in such a manner would help host cell proliferation and subsequently osteointegration of implant material. The biological assays demonstrated the high antifungal efficiency of heat treated Ag:HA thin films deposited on Ti modified by TiO_2 nanotubes substrates which completely exterminated *Candida albicans* and radically reduced the *Aspergillus niger* number of colonies.

These results proved that the applied method allows the fabrication of efficient shield barriers against adherence and contamination with pathogenic fungi.

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O.11

Photodissociation study of non-antibiotic drug modifications by exposure to UV laser radiation

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Phenothiazines are compounds that contain two benzene rings ortho-fused with a thiazine ring known for their pharmaceutical properties. They are used as sedative, tranquilizer, antituberculotic or bactericide agents and can form radical-cations due to their low oxidation potential. A more recent application of phenothiazines uses them as markers for DNA.

Two schemes of Chlorpromazine (CPZ) - a phenothiazine derivative - photodissociation as a result of its interaction with a UV laser beam emitted at 266 nm by a Nd:YAG laser are reported. The techniques used were: absorption spectroscopy, Thin Layer Chromatography, Laser Induced Fluorescence, pH, Fourier Transform Infrared Spectroscopy and Liquid Chromatography - tandem Time of Flight Mass Spectroscopy (LC-TOF/MS). Using LC-TOF/MS the concentrations of each photoproduct in percentage were extracted for the respective time intervals of irradiation and the rates of photoproducts formation were obtained.

Singlet oxygen generation quantum yield was determined relative to the standard ZnPc in DMSO. The quantum yield for the singlet oxygen generation by the CPZ in D_2O solution was determined. To estimate the interaction of the singlet oxygen with the CPZ, time-resolved phosphorescence transients were registered for different CPZ concentrations in order to determine the quenching rate constant of the singlet oxygen.

With respect to the antimicrobial activity of the mixture of photoproducts obtained after irradiation of the sample, CPZ solutions exposed 60 minutes and 240 minutes to 266 nm laser beam, respectively, were tested against *Staphylococcus aureus* ATCC 25923 strain.

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O.12

Study of colloidal systems properties in view of their use in medical treatments

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One of the main issues of the XXIst century is represented by the multiple resistance to treatment with drugs (MDR), developed by bacteria and malignant tumors; therefore finding ways to fight MDR is of significant interest. One of the alternatives to the existing medicines and treatment procedures in fighting MDR is strengthening the effects of medicines by improving their delivery methods. Such a method is represented by the generation, transport and use of micro/nano-droplets which contain drugs. This approach can reduce the medicines consumption by generating micro-droplets which contain drugs incorporated in solvents substances; the micro-/nano-droplets can favor a faster delivery to the targets and a higher drug concentration in them.

This paper reports the results obtained for different type of colloidal systems and their possible use either as vehicles to transport medicines incorporated into them to specific targets or, locally, to treat dermal and/or venous diseases.

Different mixing methods lead to colloids with different targeted properties specific to their intended use.

In this study, emulsions and foams are generated using several mixing techniques. The results are compared as regards the component droplet/bubble size distribution and their stability in time.

The droplets/bubbles diameters were measured using both, light scattering and microscopy methods. It is found that at appreciably high energy input (high rotation speed, large pressure difference), droplets diameters smaller than 100 nm can be produced [1].

Also, the factors that could influence the stability of the obtained colloids have been studied. The effect of different surfactants on foams and emulsions added at various concentrations is evaluated. It was observed that by adding small concentrations of anionic or nonionic surfactants, the stability of a given foam can be increased with very small variations of the mean bubble size [2].

The interaction of laser radiation with some of the studied colloidal systems is also presented [3].

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O.13

Characterization and DNA binding studies of new hydantoin derivatives by electronic spectroscopy

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Hydantoin derivatives are important candidates to be used as potential anticancer drugs [1-3]. Recent studies show that 5-hydroxyhydantoin and 5-methil-5-hydroxyhydantoin may work as blocking lesions for DNA polymerases [4]. Some hydantoin derivatives can inhibit the P-glycoprotein efflux pump of mouse T-lymphoma cells and act synergistically with the cytostatic drug doxorubicin [5].

Extensive research studies are carried out and results are reported in order to minimize the side effects of these antitumor agents. For this purpose, new synthesized hydantoin derivatives are proposed to spectroscopic characterization and DNA binding examination [6].

This study presents the spectral properties of 5-(3-chlorobenzylidene)-2-thioxoimidazolidin-4-one ($C_{10}H_7ClN_2OS$, M=238.69 g/mol), generically called SZ-2 as well as of DNA having different densities and originating from salmon sperm, using UV-Vis-NIR and FTIR spectroscopic methods.

Also, the SZ-2 affinity for DNA binding is estimated based on electronic absorption properties of SZ-2 and DNA complex.

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O.14

Ethylene and ammonia traces measurements from healthy humans with different food diets by LPAS technique

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The dietary patterns or food preferences are “decided” by our social, cultural and economic background, and continuously influenced by different physiological and psychological factors [1,2]. Unbalanced life styles, characterized by a diet rich in fat and calories, alcohol drinking and tobacco smoking, and low intake of vegetable, fruits and fibers (referred to as a "western diet") as well as sedentary style (i.e., no- or low-exercise) has been associated with chronic diseases: obesity, cancers, dyslipidemia, diabetes, hypertension cardiovascular, and hypertension [3] and diseases associated with obesity, including type 2 diabetes, high blood pressure, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, respiratory problems, and certain cancers [4].

Exhaled breath is a mixture of more than a thousand molecules, some of which are present at parts per billion (ppb) or even parts per trillion (ppt) concentration levels [5]. These molecules provide a unique breath profile of the health condition and have endogenous and exogenous origins. The sources of endogenous molecules are normal and abnormal physiological processes, whereas the sources of exogenous molecules are: inspiratory air, ingested food and beverages, or any exogenous molecule that has entered the body by other routes (e.g. dermal absorption) [6]. The concentrations of some of the exhaled molecules can be used as biomarkers for the identification and monitoring of human diseases or wellness states [7].

Laser photoacoustic spectroscopy (LPAS) is a fast and precise technique capable of detecting breath biomarkers at low concentrations [8,9]. Our study reports measurements of breath ethylene and breath ammonia levels of healthy persons with different food diets (mixed, vegetarian, raw vegan and Dukan diet) using the LPAS technique. The purpose of this study was to monitor the response of the organism to food diets. The measurements of ammonia were covered the range 880 – 2800 ppbV while the ethylene in the range 39 – 1080 ppbV. Analysis of ethylene and ammonia traces from the human breath may provide information about the oxidative stress and metabolic disturbances.

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O.15

Hybrid Imaging System for Tumor Detection

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Various methods of imaging have become available over the last decades making patient observation, disease diagnosis and therapy follow-up feasible, and above all non-invasive. Since the 1990s, hybrid imaging by means of software and hardware image fusion alike allows the intrinsic combination of functional and anatomical image information. Combined imaging has revolutionized the medical diagnosis, increasing the chances of early diagnosis, improving the accuracy of the anato-metabolic collected data, or allowing the precise monitoring of interventional procedures, while the patients avoid multiple examinations and radiation exposure.

In the case of malignant diseases, the hybrid imaging methods are mainly evolving on two directions: improving the discrimination rate between benign and malign nature of tumors, and helping the surgeon to assess the tumor spreading during resection procedures, both fields being for the moment covered only by post-interventional pathological examination.

We present a new system based on the combination of the spectral domain optical coherence tomography (SD-OCT) and reflectance/fluorescence spectroscopy. Both techniques have in common that simultaneously measure multiple wavelengths of reflected light across the spectrum, but offers different information about the tissue structure. The system includes a self-developed OCT arm and a commercial available hyperspectral imaging module. The SD-OCT system is equipped with a 1310 nm light source, which has a bandwidth of 80 nm and a maximum power of 20 mW, offering an axial resolution of 7 µm for the biological tissue. The hyperspectral imaging module is working in the spectral range 400 - 1000 nm, with a nominal spectral resolution of 2.73 nm. The CCD camera has a monochrome 2/3" sensor, being able to acquire 1.5 Mega pixel images at 11 fps.

The measurements will systematize the images obtained on animal tissue samples (mainly, pig and chicken organs), for different wavelengths and operational regimes, in the same time considering the aspects of data acquisition and image treatment.

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O.16

Chlorpromazine Vibrational Spectroscopy - A Computational Study

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Chlorpromazine (CPZ) is a multipurpose drug from the phenothiazine class that binds to various receptors in the central nervous system and is mostly used to treat psychotic diseases [1].

It has been recently found that laser treated CPZ solutions exhibit an inhibitory effect on bacterial growth at concentrations even lower than that of the untreated CPZ. The laser treatment of the compound consists of exposing a CPZ·HCl solution in ultrapure water to a UV laser beam which has a wavelength bandwidth that may be as narrow as 10^{-3} nm, unlike those produced by incoherent UV sources that provide a wide spectrum of wavelengths [2]. During this procedure, CPZ goes through certain photochemical processes that result in the formation of photoproducts which are structurally related to the parent molecule (CPZ).

Vibrational spectroscopy is an important tool in understanding the physicochemical and pharmaceutical properties of drug compounds. As stated by Pulay and Meyer in the early 1970's, "ab initio molecular orbital calculation has become a most useful procedure for the calculation of normal vibrations of molecules through optimization of the molecular geometry" [3].

DFT level studies have been conducted on phenothiazine derivatives obtained by means of organic synthesis and practical measurements supported the theoretical models [4]. Therefore, the aim of this study is to identify the characteristic functional and fingerprint vibration modes for drug molecules related to CPZ and to provide some useful information when dealing with mixtures such as those obtained following CPZ irradiation.

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O.17

Characterization of laser radiation interaction with liquid droplets and bulk that contain solution of chlorpromazine in water

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Results regarding the interaction of microdroplets that contain solutions of phenothiazines (Chlorpromazine Hydrochloride - CPZ) in ultrapure water, in pendant positions in air and of the same bulk liquid with pulsed laser beams emitted at 266 nm or 355 nm are reported.

The radiation utilized in experiments was emitted by a pulsed Nd:YAG laser system which makes available the third harmonic (355nm) or the fourth harmonic (266nm) of the fundamental beam emitted at 1.064μm; the laser pulse FWHM is 6 ns and the pulse repetition rate is 10 pps. The average energy of the laser beam is typically 3 mJ when applied on droplets and 7 mJ when applied on bulk solutions with the same content as the droplets.

The effects of laser irradiation at the two wavelengths on the medicine solution in droplets and bulk were analyzed at the same irradiation dose and time intervals. The resonant interaction leads to modifications of the molecular structures of the parent compound. The amounts of photoproducts identified *via* TLC increase with prolonged exposure to the laser beam at 266nm and 355nm of the CPZ compound. Most of the formed products are more polar than the unirradiated (control) CPZ [1].

It was shown that the parent compound in microdroplets is transformed in photoproducts in a time interval that is several times shorter at 355 nm than at 266 nm laser exposures. Also, while exposing CPZ in ultrapure water solutions as microdroplets to 355 nm laser beam, a photoreaction compound less polar than the control unirradiated CPZ is produced.

The exposure to UV laser beams of existing medicines in solutions is an alternate approach in order to obtain photoproducts that are efficient against bacteria and/or tumors [2].

The new photoproducts make the irradiated solution efficient against Gram-positive bacteria such as *Staphyloccocus aureus* that are normally resistant to unirradiated CPZ [3].

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Poster Presentations

P.01

The study of the third-order optical nonlinearity of metal nanostructures using the effective medium theory

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The sub-wavelength surface plasmon optics, which allows the possibility to control the optical linear and nonlinear response of metal nanostructures by their design, is important for new photonic functionalities and devices based on enhanced light-matter interaction at the nanoscale [1, 2].

In this work, we present the results of our theoretical study on linear and nonlinear optical properties of colloidal metal nanoparticles. The optical properties of the nanostructured materials can be described using the effective medium theory (EMT) [3-16]. This theory predicts that in some circumstances the composite material can have the third-order optical nonlinear susceptibility larger than the nonlinearities of its components. Our theoretical studies have been made for colloidal nanoparticles of Ag and Au in water and benzene. The dependences of the real and imaginary parts of the complex optical linear refractive index and of the third-order optical nonlinear susceptibility of these composites on volume fill factor are presented.

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P.02

Characterization of the LFF chaotic regime of an ECSL system working at and over laser threshold current

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An experimental analysis of phenomena observed in the laser emission of an External Cavity – Semiconductor Laser (ECSL) system operating in the low-frequency fluctuations (LFF) regime has been carried out. The chaotic behavior of the semiconductor laser emission with external feedback is influenced by laser parameters. The optical feedback coefficient, the injection current and diode temperature greatly influence the chaotic system evolution. In this paper we present data about the stability of the LFF chaotic dynamics regime of semiconductor lasers for different sets of experimental parameters. During the measurements the injection current was adjusted at values near and over the threshold current corresponding to a fixed temperature. The stability of the LFF regime was evaluated at higher than threshold values of the injection current. Measurements at temperatures of the laser active medium higher than the room temperature were also performed.

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P.03

Lasing emission by pending micro-droplets that contain laser dye

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In this paper is presented the resonant interaction between laser beams and individual pendant droplets which contain water seeded with a laser dye, Rhodamine 6G (Rh6G) [1, 2]. When the laser beam is partially or fully absorbed by the droplet's components the interaction is called resonant. Following absorption laser induced fluorescence (and even lasing) effects are produced. In the reported experiments was studied the resonant interaction, a single droplet behaving as an optical spherical cavity in which the signal is amplified, as in the well-known whispering gallery modes (WGMs) case.

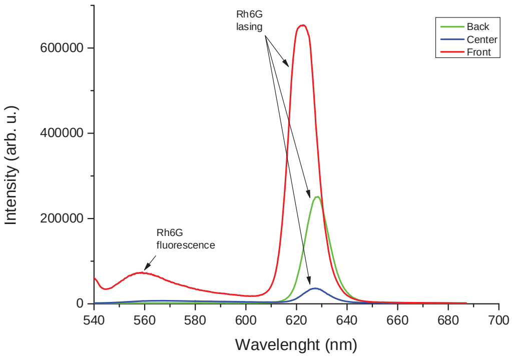

Fig. 1. Lasing and fluorescence spectra obtained in a pendant droplet containing Rh6G solution in distillated water (10µl).

The solvent used is distillated water, and it was chosen due to the long time evaporation, which assures a high lifetime of each droplet at the same/constant volume. For the resonant interaction measurements it was evaluated the laser induced fluorescence (LIF) of the droplets, and it was observed that, by varying several parameters such as dye concentration, volume of the droplets and the focus position on the droplet, a LIF amplification is obtained in the droplet, which leads to lasing emission. The lasing emission can be tuned by varying the parameters mentioned above [1]. For the irradiation it was used a Nd:YAG laser system, emitting by second harmonic generation at 532 nm. The LIF signal was collected with an optical fiber (400µm inner core). The signal was analyzed with a high resolution spectrograph (Princeton Instruments; Acton SpectraPro 2750).

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P.04

Unresonant effect of laser beams on pending micro-droplets

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Literature reports present results about laser interaction with droplets that contain single liquids or mixtures of liquids, placed on superhydrophobic surfaces or interaction with jets of liquids. In this paper is presented the unresonant interaction of laser beams with single pendant droplets, containing solvents (distilled water, alcohol or DMSO) or solutions (mixtures of solvents with laser dyes, Rhodamine 6G or DCM) [1, 2].

When the laser beam is not absorbed by the droplet material, exerting only pressure (mechanical) effects on the droplet itself, the effects on the droplet are defined generically as unresonant interaction between a laser beam and a pendant droplet. These unresonant effects can produce vibrations of the droplet, or emissions of jets, ligaments, or secondary droplets of liquids out of the main droplet. The emission of secondary droplets can reach speeds that exceed the speed of sound.

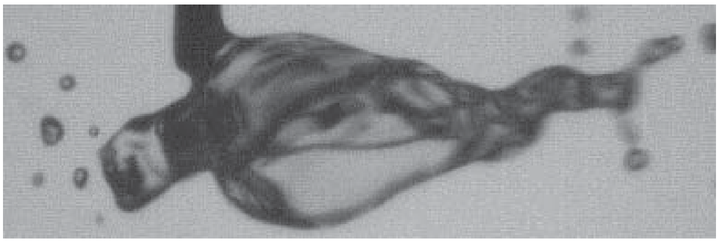

Fig. 1. Mechanical effects of interaction between a laser pulse and a water droplet.

The unresonant interaction is studied by the Drop Shape Analysis Method in real time, using a High Speed Camera - Fastcam Photron 1024PCI recording at a speed of 10 kiloframes/second; the maximum resolution of 1024 x 1024 pixels was only possible at 1000 frames/second [1]. All the effects on the microdroplets at unresonant interaction are obtained after the laser beam crosses it; one may consider that the microdroplet is «frosen» while the laser beam is propagating through it. The effects of the laser beams on microdroplets in pendant position depend on: laser beam characteristics, droplets constituents and exposure geometry.

A typical mechanical effect of a laser beam on a water droplet at unresonant interaction is shown in the figure, where the beam has 532 nm wavelength which is very little absorbed by the water.

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P.05

Photoinduced diffraction gratings in As_2S_3

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In this paper, we present the results of our experimental studies on laser induced complex gratings in amorphous arsenic trisulphide (As_2S_3) thin films. The As_2S_3 chalcogenide glass is an important nonlinear optical material with applications in all-optical switching, optical limiting, optical guiding, optical imaging and storage.

The gratings were recorded in As_2S_3 by the interference of two green writing beams (Ar laser, λ=514.5 nm). This writing wavelength, at the band-gap energy of the material (2.39 eV), induces changes of refractive index and absorption coefficient and modifies the thickness of the films in the illuminated areas. Consequently, the gratings induced in As_2S_3 are complex amplitude and phase gratings, due to the modulation of the absorption coefficient and of the refractive index and the relief, respectively. The change of the absorption coefficient and its temporal evolution, for a time similar to the recording time of the grating, are studied by using a single Ar laser beam. The evolution of the phase component of the recorded grating (refractive index and relief modulations) is investigated by monitoring the diffraction efficiency of a He-Ne probing beam (λ=632.8 nm), which is not sensitive to the amplitude component of the grating (modulation of the absorption coefficient). The relief of the recorded grating was investigated by atomic force microscopy. The diffraction of the He-Ne probing beam on the gratings recorded in As_2S_3 is modelled in the frame of the Raman-Nath diffraction theory. The magnitudes of the absorption coefficient, refractive index and relief changes have been determined.

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P.06

Corn and sun-flower reflectance study using THz Imaging and UV-NIR spectro-radiometry

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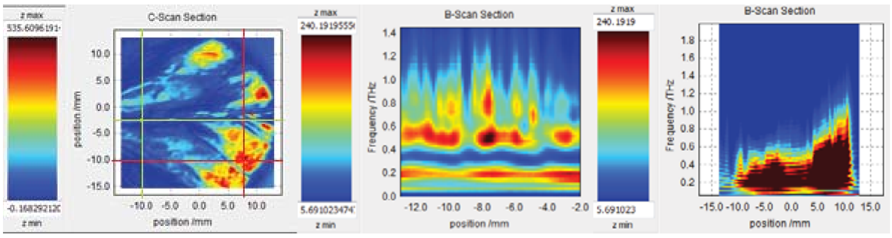
THz imaging and UV-NIR spectro – radiometry are very useful tools for vegetation evaluations (water stress, chlorophyll quantity and general health of the plant). In this work is presented a preliminary reflectance study of sunflower and corn leaves, comparing laboratory and field reflectance results in the spectral range of 250-2100 nm and THz imaging (0-2 THz). The laboratory diffuse and total reflectance spectra were obtained using a spectro - radiometer from Gooch&Housego, working in the range of 0.200 to 30 µm, using the tungsten standard lamp and the silicon detector. The field diffuse reflectance measurements were done using an Ocean Optics spectrometer working the range of 200 – 900 nm, together with the WS-1-SL diffuse reflectance standard. The field standard reference and optical fiber measurement system was calibrated against the laboratory set up. An example of sunflower leaf XY scanning in the range of 0.1-2 THz is represented in Fig 1a, where the structure of the leaf is visible as highlighted by the water content. A cross section corresponding to mid leaf vein is illustrated in Fig. 1b – the yellow horizontal line in Fig.1a. The leaf blade appears in red color in Fig.1a and is given in detail in Fig.1c – red horizontal line. It can be noticed that along the vein, through the water is passing, the reflectance is higher at two main frequencies: 0.2 and 0.5 THz, with very low reflectance at 0.4 THz. In the case of Fig.1c the reflectance is high for a larger spectral range (0.1-1 THz).



a b c

Fig.1. The THz imaging representation of one sunflower leaf example, on: a) XY scanning plan; b) XZ scanning plan – in depth – with focus on leaf mid vein; c) XZ scanning plan – with focus on leaf blade.

A detailed study of this work can be found on the extended version of this paper.

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P.07

Efficient laser emission from a disordered Yb:CLNGG crystal

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Disordered crystals are a strong candidate as host materials for trivalent rare earth active ions, such as Nd^{3+}, Yb^{3+}, Tm^{3+}, Ho^{3+}, Er^{3+}, etc., because they provide different lattice positions for the dopant ions. This implies that, they possess wide absorption and emission spectra, like laser glasses. On the other hand, they are of relatively high thermal conductivities comparable with those of single crystals, and much higher than those of glasses. Due to these properties, disordered crystals are very suitable for mode-locked ultra-short pulsed lasers. For the case of ytterbium- doped crystals, the gain bandwidth of the laser transition is larger compared with neodymium- doped ones. This allows for generating ultra-short pulses.

In this work, efficient laser emission at room temperature with a disordered $Yb{:}Ca_{2.371}Li_{0.275}Nb_{1.7105}Ga_{3.0145}O_{12}$ (Yb:CLNGG) crystal is reported. The crystal used in the experiment was grown by the conventional Czochralski method, with the Yb concentration of 4.3- at.% (in crystal) and 3.5 mm length[1]. The laser performance was studied employing a plane- plane resonator. Pumping was made in quasi- continuous wave mode (quasi-cw) at 972 nm with a fiber- coupled diode laser. The laser crystal yielded pulses with maximum energy of 6.2 mJ for an absorbed pump pulse energy of 22.8 mJ for OCM of transmission T=0.25. The slope efficiency (with respect to the absorbed pump pulse energy) was η_{sa}= 0.33. The emission spectrum (FWHM) of ~ 6 nm narrowed to ~ 3 nm while the OCM transmission increased from T=0.03 to 0.60. Further experiments aim the generation of ultra-short mode- locked laser pulses.

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P.08

Fabrication of photonic crystal structures by femtosecond laser ablation on TiO_2 films

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A photonic structure on TiO_2 thin films was designed to show photonic band gap (PBG) in the near-infrared range, at the telecommunication wavelengths. The periodical structure was produced by femtosecond laser ablation. The plane wave expansion method was used to compute the photonic band gap of the laser ablated structure. The impact of limited laser processing accuracy on the photonic band gap has been studied as variation of the radius of the holes. The structure was produced by tightly focused femtosecond laser beam in multi-pulses ablation regime, using a Ti:Sapphire CPA laser system with pulse duration of 200 fs and energy per pulse of tens of nJ for a focusing optics with numerical apperture NA = 0.5. The optimum irradiation conditions were found as folowing: number of pulse $N = 15$ and laser beam energy $E = 58$ nJ. The resulting periodic stucture has an estimated photonic band gap centered at 1.53 μm with a bandwidth of about 42 nm.

P.09

Preliminary results on Sm^{3+}:YSAG transparent ceramic

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Cubic $Y_3Sc_xAl_{3-x}O_{12}$ (YSAG) crystals are attractive laser-host materials due to their high thermal conductivity, broad spectral region, chemical stability, strong Stark splitting and relatively low phonon energies. However, it is very difficult to grow large-size single crystals with high quality because of the high melting point (~1950^{0}C). On the other hand, polycrystalline ceramics have lower sintering temperature, about 1750^{o}C. Moreover, because of the absence of segregation coefficient, ceramics can be doped with a higher fraction of active ions and can be fabricated in larger sizes compared to single crystals. In this work we present the results of our research on the production of samarium doped YSAG (Sm^{3+}:YSAG) transparent polycrystalline ceramics for visible laser emission [1, 2].

High purity α-Al_2O_3 (99.99+% purity, ~100-nm diameter), Y_2O_3 (99.99% purity, 20 to 40 nm diameter), Sc_2O_3 and Sm_2O_3 (99.99% purity) powders were used as starting materials. The selected composition is $Sm_{0.03}Y_{2.97}Sc_2Al_3O_{12}$. The powders were magnetically mixed in stoichiometric ratio in anhydrous ethylic alcohol for 24 h. As sintering additive, 0.5 wt.% of tetraethyl orthosilicate (TEOS) was used. The alcohol solvent was removed by drying the slurry at 80^{0}C. The dried powder was milled and pressed at low pressure (10 MPa) into pellet with half of inch diameter in a metal mold and then cold isostatically pressed at 240 MPa. Before sintering the sample was heated at 800^{0}C for removing organic substances used in preparation.

Fig. 1 Photo of the 1.0-at.% Sm:YSAG ceramic.

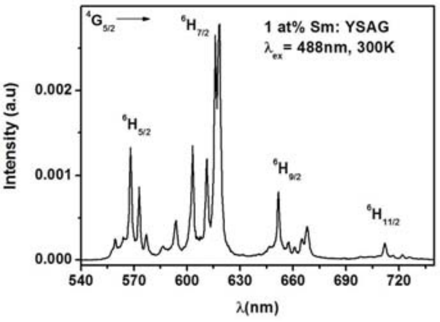

Fig. 2. Emission spectrum of the 1.0-at.% Sm:YSAG at 300 K under excitation at 488 nm.

Transparent Sm^{3+}:YSAG ceramic (Fig. 1) was obtained by sintering 4 h at 1700°C in high vacuum atmosphere. Emission and absorption spectra of the 1.0-at.% Sm^{3+}:YSAG at 300 K and 10 K were recorded (Fig. 2).

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P.10

Plasma crystals dynamics in different magnetic field configurations

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The existence of small particulates (dust) in fusion devices has been known for a long time [1]. It is important to assess and understand the processes by which dust is formed and by which it interacts with the fusion device and its plasma [2], but also it is necessary to develop a dust removal technology [3].

In this paper, we report on our efforts to control the direction of the dust particles which levitates in a conventional parallel-plate radio-frequency (RF) plasma system. Experiments are carried out with metallic and nonmetallic particles with spherical and cylindrical shape.

The external magnetic field is produced by a matrix of permanent magnets arranged in different configuration, and by a multilayer coil disposed around the RF electrode. The applied external magnetic fields in the area of interest are in the mT range.

The particles are trapped in the sheath of the discharge and in certain conditions of pressure and RF power [4, 5] they escape to the exterior with a few mm/s speeds, following a radial direction. The dynamic behavior of dust particles has been investigated using a high-speed camera [5].

Acknowledgements: LAPLAS 2014 NUCLEU

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P.11

A 1-D dusty plasma photonic crystal

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It is demonstrated numerically that a 1-D plasma crystal made of micron size cylindrical dust particles can, in principle, work as a photonic crystal for terahertz waves [1]. The dust rods are parallel to each other and arranged in a linear string forming a periodic structure of dielectric-plasma regions. The dispersion equation is found [2,3] by solving the waves equation with the boundary conditions at the dust-plasma interface and taking into account the dielectric permittivity of the dust material and plasma. The interparticle distance in a plasma crystal is of the same order magnitude with the wavelength of THz waves, i.e.., a few hundred microns. The allowed and forbidden bands of the 1-D plasma crystal are numerically found for different types of dust materials, separation distances between the dust rods and rod diameters [4]. The distance between levitated dust rods forming a string in rf plasma is shown experimentally to vary over a relatively wide range, from 650 μm to about 1350 μm, depending on the rf power fed into the discharge.

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P.12

The semi-analytical solution of non-Fourier heat equation for laser-solid interaction

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Heat conduction problem in many engineering situations has been analyzed by using the heat conduction equation based on the classical Fourier model [1]. However, Fourier's law implies that any thermal disturbance on a body is instantaneously felt throughout the body, that is, the propagation speed of thermal disturbances is infinite. Clearly, this phenomenon is the paradoxical result from the physical point of view due to the fact that thermal waves travel with a finite speed. Despite this apparent paradox, the classical heat conduction equation based on Fourier model is quite acceptable for the majority of practical situations. However, it fails to adequately predict temperatures in situations for extremely short periods of time, extreme temperature gradients, and temperatures near absolute zero. Therefore, non-Fourier model has been used to alleviate these shortcomings in the analysis of the temperature field in the laser applications. The surface sources are activated on the solid surface with very high heat flux for a short period of time. In other words to find out the temperature of laser-solid interaction the first step is to solve the Fourier heat equation. This can be regarded like a first approximation, because it is suppose that the speed of thermal waves in solid target is infinite. For ultra short laser pulses (fs) this assumption breaks down. In the present study we give the semi-analytical solution for the non-Fourier heat equation, which involve a finite speed for the thermal wave's propagation in solids. For finding the solution the Laplace transform and boundary conditions play an important role [2,3].

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P.13

Coaxial plasma gun used in dusty plasma experiments

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A miniature coaxial gun inserted between the plane parallel electrodes of a radio-frequency (rf) plasma was used to produce a plasma jet consisting of electrons and argon ions [1]. The coaxial gun had two electrodes made of stainless stell, a long center rod and a coaxial outer cylindrical shell. A compressor coil was mounted at the gun nozzle to radially compress the plasma jet. The axial JxB force ejected plasma out of the gun at a speed of a few km /s. We were interested in producing a well collimated jet stream which was directed towards a dusty plasma crystal made of aligned cilindrical particles or interaction beetwen this jet stream and vulcanic ash from Island of Hawaii. In the first case the dust particles were rods with a length of 300 microns and diameter of 5 microns and in the second the ash called „Martian Regolith simulant"[2] is made of grains wich size is under 100 microns. The discharge voltage of the gun was between 0.1kV and 8 kV and the discharge current was in a range of kA. Images of the dust particles interacting with the plasma flow were captured with a PhastCam 1024 PCI having the capability to acquire at thousands of frames/s, a lens provided with a set of 3 spacers (68 mm in length) and a teleconverter 3x. The camera speed was set at 250 fps with an exposure of 4 ms. Interesting phenomena could be studied in this type of experiment such as dust particle acceleration or particle oscillations.

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P.14

Pyroelectric effect on Pb($Zr_{0.2}$,$Ti_{0.8}$)O_3 structures

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Ferroelectric Pb($Zr_{0.2}$,$Ti_{0.8}$)O_3 (PZT) films were grown by two methods (sol gel and pulsed laser deposition) on different substrates, platinized silicon (Pt/Si) and strontium titanate (STO) in order to study how the pyroelectric effect is influenced by the substrate quality. In the case of the structure deposited on STO with (001) orientation, a SRO epitaxial buffer layer was used, this acting as a bottom electrode and also is an excellent template for the heteroepitaxial grwth of high-quality ferroelectric perovskite. The structural and morphologic properties of the films were examined by X-ray diffraction (XRD), transmission electron microscopy (TEM) and atomic force microscopy (AFM), and their ferroelectricity was tested by performing capacitance-voltage (C-V) and hysteresis measurements at room temperature.

The pyroelectric measurements of the PZT thin films were performed in modulated light, using a laser diode with 800 nm wavelength and a mechanical chopper having variable frequency. It can be described by analysing frequency dependence of the pyroelectric signal, collected with a field effect transistor (voltage mode) and measured with a lock-in amplifier [1].

It was found that pyroelectric properties of ferroelectric thin films strongly depend of the substrate and are related to the microstructure, defects, internal stress, the orientation of the spontaneous polarization, so the polycrystalline films leads a small pyroelectric response [1,2,3]. Our results confirm that high crystalline quality and optimal domain orientation lead to improved the pyroelectric properties [1,4].

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P.15

Non-linear applications of ferrocene thin films grown by matrix-assisted pulsed laser evaporation

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Ferrocene-derivatives have been intensely studied for applications in optoelectronics and sensor development, in bulk or as thin films. In this work, we report on the growth of such thin films by matrix-assisted pulsed laser evaporation (MAPLE), at low fluences (0.2–0.7 J/cm^2), using a Nd:YAG pulsed laser device (4ω / 266 nm, τ = 7 ns, ν = 10 Hz). Spectroscopic-ellipsometry (SE), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and atomic force microscopy (AFM) techniques, were used to investigate the structure, morphology and optical properties of the films. Second harmonic generation (SHG) capabilities were evidenced when irradiating the films by a Ti:sapphire pulsed laser (1ω / 800 nm, τ = 60 fs, ν = 80 MHz, P = 700 mW).

P.16

Optical properties of Nickel oxide thin films obtained by pulsed laser deposition and radio-frequency assisted

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Nickel oxide thin films were obtained by Pulsed Laser Deposition (PLD) and radio-frequency assisted PLD (PLD-RF) techniques on Si and SiO2 substrates. Nickel oxide thin films are obtained by irradiating a Ni metallic target in oxygen atmosphere. The influence of substrate temperature on the properties of the thin layer was carried out.

Topography of surface of Nickel oxide thin films was studied using atomic force microscopy (AFM). Optical properties of nickel oxide (NiO) thin films are investigated using spectroscopic ellipsometry.

The dielectric function of Nickel oxide was calculated using Gauss oscillators model. The dispersion of the refractive index in the 250 −1700 nm range was calculated. Thicknesses of the films and of their rough layer are extracted from Cauchy model. Other optical properties as optical band-gap and extinction coefficient were also extracted.

P.17

Simultaneously measurement of thermal conductivity and Seebeck coefficient of nanostructured thin films using a scanning hot probe technique

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A variety of SThM methods have been explored since the invention of the scanning tunneling microscope (STM) and the atomic force microscope (AFM).This work reports on thermoelectric measurements in nanostructured thin films using a scanning hot probe technique. In this method a resistively heated thermal probe of an Atomic Force Microscope (AFM) is brought in contact with the sample surface giving rise to a temperature gradient and a Seebeck voltage in the specimen. The average temperature rise of the probe is determined from the change in its electrical resistance. The heat transfer rate between the probe and the sample is estimated using a heat transfer model that takes into account the major heat transfer mechanisms in the system. The heat transfer mechanism between tip sample was investigated in detail. The relative contribution of solid-solid contact, water meniscus, and air to the heat transfer mechanism was determined for the kind of tip that we have used in our experiments. The effective contact area radius between tip and sample is 2 microns. The thermal conductivity is determined from the measured thermal resistance of the film. The Seebeck coefficient value is calculated using the measured temperature drop and the Seebeck voltage in the plane of the sample. The method is calibrated on glass and bismuth telluride substrates. The Seebeck coefficient is calculated and validated by measurements on BiTe bulk sample. After this the Seebeck coefficient was measured on a BiTe nanoparticles thin film deposited on glass. The thermal conductivity for the same film was measured. Experimental results are presented for the thermal resistance and Seebeck coefficient of thermoelectric films composed of bismuth telluride and lead telluride nanoparticles and nanorods deposited on a glass substrates.

P.18

Biopolymer compositional gradient thin film assemblies synthesized by Combinatorial MAPLE: physico-chemical and *in-vitro* cell response studies

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There is an increased interest in fabricating smart bioactive materials for the synthesis of new nanostructures for improving the osseointegration process and tissue engineering. Here, we introduced combinatorial matrix-assisted pulsed laser evaporation (C-MAPLE), an innovative method for the fabrication of organic thin films to be used as cell-instructive materials. Two distinct C-MAPLE targets consisted of levan and oxidized levan were irradiated and vaporized to obtain thin films with compositional gradient for surface functionalization. The coatings were obtained using a KrF* excimer laser source ($\lambda = 248$ nm, $\tau_{FWHM} \leq 25$ ns) [1]. The ablated material was collected and assembled onto Si (100) wafers or Ti blades. The aim of this study was to rapidly create a compositional library of two polymers with specific properties in a single-step process, in order to select an optimum dosage with emphasis on medical application. The obtained thin films preserved the base material composition as confirmed by Fourier transform infrared spectroscopy [2]. The gradient of the thin film composition was validated by fluorescence microscopy while *in vitro* cell culture assays illustrated characteristic responses of cells to specific surface regions. The proposed fabrication method results in the preparation of a new bioactive material, which could control the cell signaling response [3]. This approach can be extended to screen new bioactive interfaces for tissue regeneration.

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P.19

Silk Fibroin – poly(3-hydroxybutyric-acid-co-3-hydroxyvaleric-acid composite biodegradable polymer coatings for biomedical applications

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Composite SF-PHBV (silk fibroin – poly(3-hydroxybutyric-acid-co-3-hydroxyvaleric-acid)) biodegradable coatings were deposited by Matrix Assisted Pulsed Laser Evaporation – MAPLE method, studying their applicability for controlled drug release and/or tissue engineering and regeneration applications in medical implants. Individually, the chosen biopolymers show excellent biocompatibility, but different degradability and tensile strength properties, herewith combined for attending the targeted biomedical uses. MAPLE is a recent method allowing the functional transfer of various organic or complex molecules, mixed or as multilayers.

MAPLE composite coatings with different SF: PHBV weight ratios, as well as, comparatively, simple coatings have been obtained using a KrF* excimer laser source operated at low fluences. They have been deposited on titanium, silicon or glass substrates from frozen solutions, with chloroform as solvent.

The stoichiometric transfer as composite thin films was demonstrated mainly by FTIR. XRD confirmed the partial crystalline PHBV polymer phase and suggested the amorphous presence of SF. Water-degradation, SBF-degradation and wettability studies proved these composite films as highly hydrophilic surfaces, with the increase of PHBV component conferring a more resistant behaviour, a slight decrease of hydrophilicity and a slower biodegradation. These assays provided supporting results for drug delivery applications, where degradation rate may be tuned by controlling different composite material characteristics, primarily mixture ratio and/or crystalline status.

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P.20

Carbon thin films doped with Ag and Si for biomedical applications

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Diamond like carbon (DLC) was found to be a promising material for biomedical applications due to its biocompatibility, hemocompatibility, corrosion resistance, tribological and mechanical properties.

The aim of this research was to produce adherent Ag/Si doped carbon layers deposited onto medical grade titanium substrates in order to provide antimicrobial medical implants with good mechanical properties and ability to accelerate the osteointegration process.

Our experiments involved the incorporation of Si into carbon layers for improving corrosion resistance in body fluid conditions and interfacial toughness of the medical implants. In order to obtain antimicrobial medical implants with enhanced antimicrobial properties we incorporated Ag in carbon nanopowders.

Thin films of Ag/Si diamond-like carbon were grown onto medical grade titanium substrates by PLD, MAPLE and C-PLD methods using a KrF* excimer laser ($\lambda = 248$ nm, $\tau_{FWHM} = 25$, $\nu = 10$ Hz).

The obtained thin films were physico – chemically investigated. Transmission electron microscopy, energy dispersive X-ray spectroscopy, Fourier transform infrared spectroscopy, nanoindentation were applied to evaluate the morphological, structural, chemical and mechanical properties of the implant-type coatings.

The biological response of the obtained thin films was evaluated by in vitro investigations of the adherence, proliferation and cytotoxicity of the cells cultivated on the surface.

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P.21

Comparative study of polycaprolactone and polylactic acid coatings-Physico, chemical and compositional investigations.

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We report successful transfer by MAPLE and Dip Coating (DC) of Polycaprolactone (PCL) and Polylactic acid (PLA), and mixtures of the two compounds (25-75%, 50-50%, and 75-25%), in order to identify an optimum compositional blending with respect to theirs structural, morphological, and wettability properties. MAPLE is a reliable technique to deposit high quality thin films of complex materials like polymers and proteins while DC is a faster method that allows obtaining uniform thin films by optimizing the retraction speed and the concentrations of the solutions.

Fourier transform infrared (FTIR) spectroscopic results confirmed for both deposition methods the preservation of the chemical composition while the X-ray diffractograms revealed the diffraction peaks typical for PCL and PLA polymers. SEM images showed a surface morphology of coatings which strongly depends on the polymeric mixture ratio and deposition parameters. Wettability tests performed on PCL/PLA coatings exhibited a hydrophilic behaviour.

P.22

Polymeric coatings based on poly(ε-caprolactone)/poly(lactic acid-co-glycolic acid) deposited by MAPLE and dip-coating techniques: a comparative study

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Biodegradable polymers properties are preserved in vivo for a limited period of time and then slowly degrade into materials that can become soluble or are metabolized and excreted from the body [1].

Simple and mixtures of poly(ε-caprolactone) (PCL) and poly(lactic acid-co-glycolic acid) (PLGA) in different ratios (1:3, 1:1, 3:1) have been deposited by matrix assisted pulsed laser evaporation (MAPLE) and dip-coating to produce thin films on titanium, glass and silicon substrates. We identify the optimum deposition conditions with respect to the structural, morphological, and wettability properties of thin films. In the case of MAPLE technique, PCL/PLGA composite films were deposited at different laser fluences, in the range (300-500) mJ/cm^2, while the immersion/ extraction speed was varied for dip-coating (10, 60 and 100 mm/min). Fourier transform infrared (FTIR) spectrometry evidenced that the chemical composition of coatings deposited by the two methods was preserved whereas the X-ray diffraction (XRD) studies revealed the presence of diffraction peaks of PCL only. SEM investigations exhibited a dependence of surface morphology on the chemical composition, polymeric mixture ratio and deposition method. Depending on the polymeric mixture ratio and deposition method, wettability tests performed on the polymeric coatings showed a hydrophilic or superhydrophilic behavior. Also, the kinetics of the polymeric coatings degradation was evaluated with respect to polymeric blend ratio and deposition methods.

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P.23

Complex transition metal oxides grown by combinatorial PLD technique

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Coatings of various transition metal oxides were grown by Combinatorial Pulsed Laser Deposition (CPLD) technique to evaluate the structure, surface morphology, composition and optical properties with respect to their emissivity for outer space radiator applications. CPLD is a powerful, rapid and inexpensive technique used to obtain data libraries of complex multicomponent compounds.

The depositions were carried out in a high vacuum reaction chamber using a KrF* excimer laser source (λ=248 nm, $\tau_{(FWHM)}\approx$25 ns). In our experiments HfO_2 with TiO_2 and ZrO_2 with HfO_2 were mixed in order to select the composition ratio with the best combination of high emissivity, thermal stability and thermal shock resistance properties. Composite mixtures of transition metal oxides were deposited on (100) Si wafers and fused silica slides into oxygen atmosphere of 10 Pa. Targets-substrate separation distance was 5 cm while the distance between the laser spots was set at 30 mm. During the laser ablation, the substrates were heated at 400 °C to improve the crystallinity of combinatorial oxide thin films. X-ray reflectivity (XRR), x-ray diffraction (XRD), spectroscopic ellipsometry (SE), optical spectrophotometry, Rutherford backscattering spectrometry (RBS) and X-ray fluorescence (XRF) investigations were performed to identify the optimal composition that maximizes the optical properties in respect with the targeted application.

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P.24

Synthesis by solid state reaction and luminescence properties of calcium scandate ($CaSc_2O_4$) doped with Ho^{3+} and Yb^{3+}

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The calcium scandate ($CaSc_2O_4$) is a very promising host for efficient up-/down-conversion [1] due to low energy phonons (540 cm^{-1}), short distances between positions that can be occupied by the dopants (assuring an efficient energy-transfer) and high solubility of ytterbium ions. $CaSc_2O_4$ has the $CaFe_2O_4$ structure, space group Pnam (D_{2h}^{16}). Sc^{3+} ions occupy two octahedral positions while Ca^{2+} ions occupy an eightfold coordinated position. The Yb^{3+} ions (ionic radius 0.868 Å) substitute isovalently the Sc^{3+} ions (ionic radius 0.75 Å).

The calcium scandate ceramic samples doped with Ho^{3+} (1 at.%) and Yb^{3+} (from 0 at.% up to 10 at.%) was synthesized by solid state reaction from stoichiometric quantities of high purity oxides (Sc_2O_3, Ho_2O_3, Yb_2O_3) and $CaCO_3$.

The $CaSc_2O_4$ samples were characterized by XRD and optical spectroscopy techniques; no extra phases were observed. The luminescence spectra were excited at 488 nm with an Argon laser and recorded in the wavelength domain 500–1600 nm. The decays of ($^5S_2$, $^5F_4$) and $^5I_6$ levels were excited with the second harmonic (532 nm) of the Nd:YAG laser and their effective lifetimes were calculated.

Three energy transfer processes between Ho^{3+} and Yb^{3+} were considered: ET1 ($^5S_2$, $^5F_4$; $^2F_{7/2}$) → ($^5I_6$; $^2F_{5/2}$), ET2 ($^5I_6$; $^2F_{7/2}$) → ($^5I_8$; $^2F_{5/2}$), and ET3 ($^5I_8$; $^2F_{5/2}$) → ($^5I_6$; $^2F_{7/2}$). The ET1 and ET2 processes accelerate the decays of ($^5S_2$, $^5F_4$) and $^5I_6$, respectively [2].

The overall quantum efficiency of the $CaSc_2O_4$:Ho:Yb system (defined as the ratio of the number of photons emitted in the spectral range 500–1600 nm to the number of absorbed pump photons) increases, for pumping in $^5F_3$ (at 488 nm), in the presence of Yb^{3+}, by maximum 30%. The main contribution to the quantum efficiency increase is given by the Ho^{3+} transition $^5I_6$-$^5I_8$ (at ~ 1.2 μm). As the result of the energy transfer processes involving Yb^{3+}, the intensity of the emission lines originating in $^5S_2$, $^5F_4$ (at 550 nm, 760 nm, 1020 nm, and 1400 nm) diminish while the intensity of the $^5I_6 \rightarrow {}^5I_8$ emission line (at. ~ 1200 nm) increases.

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P.25

Fabrication of biodegradable silk fibroin - poly(sebacic acid) diacetoxy terminated composite coatings for local proteins release

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We have investigated the physical properties and degradability of poly(sebacic acid) diacetoxy terminated (PSADT) coatings reinforced with silk-fibroin (SF). PSADT/SF composite coatings were fabricated by Matrix Assisted Pulsed Laser Evaporation (MAPLE) using a KrF* excimer laser source operated at low fluences for biomedical applications (local drug delivery).

The composite coatings were deposited on titanium, silicon and glass substrates from solutions based on chloroform as solvent and mixtures of SF with PSADT in different weight ratios. The structural, morphological, and wettability properties of the SF/PSADT composite coatings were optimized with respect to the laser fluence up to 500 mJ/cm^2.

The stoichiometric transfer as composite thin films was demonstrated by FTIR spectra, which showed that all MAPLE films contain specific bands of both constituent materials, suggesting in the mean time the slight crystalline, predominantly amorphous presence of SF. XRD confirmed the partial crystalline PSADT polymer phase.

SEM micrographs of the biocomposite coatings exposed mainly flower-like aspect uniform films, characteristic to PSA polymer, with a large specific area, appropriate for low wettability contact angle. Their morphology slightly depends on the chemical composition, mixture ratio and deposition conditions. The wettability studies on SF/PSADT coatings showed a superhydrophilic behaviour, with contact angle < 10°. The physico-chemical investigation's results encourage release applications, where degradation may be adjusted by control of the mixture ratio, surface morphology, crystalline status and/or coating thickness.

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P.26

Embedded lysozyme into degradable polycaprolactone -polyethylene glycol coatings fabricated by Matrix Assisted Pulsed Laser Evaporation and Dip Coating Techniques

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In this study we report on the polycaprolactone (PCL)-polyethylene glycol (PEG) and PCL-PEG-lysozyme deposition on titanium and (100) double side polished silicon substrates via Matrix Assisted Pulsed Laser Evaporation (MAPLE) and dip coating (DC) techniques. PCL is known for its excellent tensile properties, flexibility and biodegradability while PEG is recognized for its good biocompatibility [1-2]. The aim was to obtain composite coatings with different biodegradation kinetics for controlled protein release. The physico-chemical properties of the composite coatings were investigated by Fourier Transform Infrared spectroscopy (FTIR), XRD and Scanning Electron Microscopy (SEM). The results proved a stoichiometric and functional transfer of the deposited polymeric systems. For composite films, we noted a summation of PEG and PCL diffraction peaks, indicating that both polymers can crystallize and form distinct crystallites.

Wettability studies proved that the composite films exhibit highly hydrophilic surfaces and these first results provide the evidence for controlled protein release applications, where degradation rate may be tuned. Degradation testes were performed in stimulated body fluid (SBF) solution at 37 °C in a dynamic regime using a bioreactor which simulates the flow of blood in our vessels. In vitro cell culture tests on PCL-PEG and PCL-PEG-lysozyme films showed appropriate viability, good spreading and normal cell morphology. The release tests of lysozyme, along with all investigations essentially signify that these biodegradable composite coatings are potential promising candidates for local protein delivery applications.

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P.27

Singlet oxygen interaction with some olefins as potential linkers in targeted drug delivery

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In order to fight multiple drug resistance acquired by bacteria, the controlled releases of the active form of the drug by light activated drug carriers is an option that can be taken into account. Laser radiation can be used in the release of the drug, due to the ability to manipulate light in terms of its wavelength, intensity, and site of application.

Two potential linkers for drug carriers were studied in order to determine that by photocleavage they are good candidates in controlled drug release of a chosen drug. The linkers used in the study, 7-(4-chlorophenyl)hept-6-enoic acid and 7-(ferrocene)hept-6-enoic acid, belong to the olefin class. The mixtures of the studied olefins with a Cresyl Violet derivative (used as photosensitizer - PS) were exposed to low energy visible light. The singlet oxygen generated by the PS induces the cleavage and consequently the involvement of singlet oxygen and the quenching rates implied in the photoreactions were studied. The photoproducts were analyzed by FTIR spectroscopy.

There are two competitive reactions that can occur as a result of the interaction with photosensitized singlet oxygen: 2+2 cycloaddition and the ene reaction. The heterosubstituted olefins can form by 2+2 cycloaddition reaction dioxetane intermediates which are unstable and their double bond C–C breaks.

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P.28

Antimicrobial activity of irradiated CPZ against Gram-negative and Gram-positive bacteria

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Phenothiazines exposed to white light or UV radiation undergo a variety of reactions that result in the degradation of the parental compound and the formation of new species. Chlorpromazine (CPZ) exposed to the 266 nm laser beam of given energy levels yielded species derived from it, whose number increased with the duration of exposure.

The exposure products were examined with respect with their antibacterial activity against panels of Gram-positive and Gram-negative bacteria that differed in the expression of their efflux pumps as well as in the activity against their efflux pumps.

The results of this study support the conclusion that exposure of a biological agent to a high energy laser beam at a wavelength that matches the maximum absorbance of the compound, results in increased antibacterial activity as compared to the parental compound.

The results also suggest that the effect of irradiating a compound with a 266 nm (UV) laser beam generates new species with antimicrobial activity. With the exception of *Salmonella enterica serovar Enteritidis* strains, the photoproducts issued from the irradiated CPZ demonstrated greater antimicrobial properties than the unirradiated product, against the bacteria employed in this study. Although the products of irradiation produced a barely significant reduction of the minimum inhibitory concentration (MIC) of CPZ, they inhibited the efflux pump systems only of *Salmonella enterica serovar Enteritidis*.

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P.29

LPAS Analysis of Exhaled Breath via the Mouth and Nose

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Breath analysis continues to be an attractive field for noninvasively diagnosis of serious illnesses. Biomarker analysis in exhaled breath may be the most simple, rapid and safest way to accurately determine the stage or the severity of a disease. Although numerous biomarkers have been identified so far, very little is known about their origin, if they are metabolic or not [1-3].

Mouth-exhaled breath *vs.* nose-exhaled breath was investigated using a CO_2 laser photoacoustic system (LPAS), a well known method in the field of trace gas detection [4].

We investigate exhaled breath via both mouth and nose before and after brushing with toothpaste/baking soda, we identify the better rout for breath analysis and we detect the important endogenous biomarkers without contaminant sources.

The levels of all four trace gases are much lower for nose breathing compared with mouth breathing. Compared to initial concentrations, the levels of all four trace gases are much lower after brushing with toothpaste and after brushing baking soda.

To diagnose metabolic diseases, the volunteers should be instructed to use toothpaste before each breath test sampling, to avoid oral bacteria. Contamination of breath exhaled via the mouth can occur and measurements should be carried out of both mouth and nasal breath to identify the sources of different trace gases.

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P.30

Stability studies of quinazoline derivatives designed as EPI's

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Quinazoline derivatives have a wide range of biomedical activities and applications, including anti-cancer, anti-inflammatory, anti-bacterial, analgesic, anti-virus, anti-tuberculosis, anti-malarial, anti-hypertension, etc [1].

Several series of quinazoline derivatives were designed as efflux pump inhibitors (EPI's), to increase the antibiotic susceptibility of multidrug resistant (MDR) bacteria. Among them, several compounds increased the activity of chloramphenicol against a panel of MDR Gram-negative isolates [2].

The stability of new designed compounds is an important factor in getting approval for biomedical applications. Stability studies take in consideration factors like solvent, temperature, time, and illumination conditions.

Two derivatives, labeled BG1189 and BG1190, were considered for these stability studies. The concentration of the studied solutions in ultrapure de-ionized water was 10^{-3}M, chosen in the interval of concentrations tested for antimicrobial activity.

The tridimensional optimization of BG1189 and BG1190 was performed with Gaussian 09 simulation software. Same software was used to predict their FTIR spectra.

The stability of BG1189 and BG1190 was studied by UV-Vis absorption spectroscopy.

The UV-Vis absorption spectra recorded immediately after the preparation of solutions and at different periods of time were compared to analyze the time stability of quinazoline derivatives in ultrapure de-ionized water, important for shelf life of medicines.

Influence of temperature on stability of BG1189 and BG1190 solutions was studied considering three usual temperatures for storage and application of a medicine: 4°C (refrigerator temperature), 22°C (room temperature) and 37°C (human body temperature).

The photo-stability of the quinazoline derivatives solutions was tested at different illumination conditions: a set of samples were kept in dark, one was exposed to ambient light in the room and a set of samples were exposed to the laser beam emitted as the fourth harmonic of a Nd:YAG laser fascicle (λ=266nm).

The photo-stability studies are needed to determine the maximum radiation dose (ambient light or laser radiation) to which a compound can be exposed without modifying its initial properties.

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P.31

UV treatment of water for drug pollutants removal

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Environmental pollution with organic or inorganic substances is a major global problem which leads to the need to develop ways to purify the contaminated water sources. Water is typically referred to as polluted when it is impaired by anthropogenic contaminants that influence their properties and makes it unsuitable for human use. Natural phenomena such as volcanoes eruptions, algae blooms, storms, and earthquakes could also induce modifications of water quality [1].

An increasing interest is shown in the use of nanoparticles to pollution reversal (remediation) mainly due to their enhanced surface and also to other specific changes in their physical, chemical and biological properties that are acquired due to the small size effects [2].

This study presents results regarding the possibility of using titanium dioxide nanoparticles (TiO_2) for photocatalytic water treatment, a well-known advanced oxidation process (AOP) for environmental remediation. AOP produces OH•, which presents stronger oxidation capabilities than regular oxidants and decomposes the organic compounds into relatively harmless compounds, such as CO_2, H_2O, or HCl.

As pollutant, several neuroleptic phenothiazines were selected. Previous results showed that their exposure to UV light for a certain period of time leads to a breakup of the molecule into several photoproducts. The addition of TiO_2 could enhance the effect of UV light and lower the time needed to destroy the molecule [3, 4].

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P.32

Hydroxyapatite thin films obtained by PLD and MAPLE activated by a top fibronectin layer: comparative study of physical, chemical and biological properties

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The aim of the study is to critically compare hydroxyapatite thin films deposited on Ti substrates by two different laser techniques: pulsed laser deposition (PLD) and matrix assisted pulsed laser evaporation (MAPLE). An enhanced chemical and biological activity is expected for the films deposited by MAPLE from nanopowders due to the extended surface area in contact with the reactive media.

The experiments were carried out in a reaction chamber using a KrF* excimer laser source (λ=248nm, $\tau_{(FWHM)}\approx$25ns). The films were grown on 12 mm diameter Ti disks which were previously cleaned in an ultrasonic bath with acetone, ethanol and deionized water. All films were post-deposition thermally treated in a flux of water vapors in order to improve morphology and crystallinity. Half of the samples were activated with a top layer of fibronectin (FN).

The selected samples were subjected to physico-chemical analysis. Specific coating surface morphologies were evidenced by optical, scanning electron and atomic force microscopy investigations. They were shown to depend on deposition technique and also on the post-deposition treatment. The crystalline structure of the coatings was monitored by X-ray diffraction before and after thermal treatment. To evaluate the biocompatibility of coatings, cellular adhesion, proliferation and differentiation tests were conducted.

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P.33

Micro-/nano-engineering surfaces using laser based methods for directing cell behavior at the cell–biomaterial interface *in vitro*

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Surface engineering is an important tool in understanding the mechanism of proteins and cells interactions with subjacent substrates aiming at obtaining a rational design of interfaces for different biomedical applications. Different laser based approaches (Matrix Assisted Pulsed Laser Evaporation-MAPLE, Laser Induced Forward Transfer-LIFT and direct laser ablation) are presented as strategies for designing controlled bio-interfaces by micro-/nano-engineering surfaces that address directing cell behavior at the cell–biomaterial interface *in vitro*.

MAPLE strategy involves modifying various surfaces with different polymers or bio-compounds for obtaining thin films having multiple functionalities - from protein repellent characteristics and anti-tumoral activities to *smart* coatings. LIFT was used for obtaining localized structures used as controlled restrictive cell adhesive areas. Direct ablation of polymers was used to create topographical cues for creating physical structures for controlling cell adhesive-repellence areas or for inducing cell guidance.

P.34

Time stability studies of Chlorpromazine and Thioridazine exposed to 266 nm laser beam

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Phenothiazine derivatives are known as neuroleptic drugs, used for the therapy of mental disorders, primarily in the treatment of schizophrenia. Chlorpromazine (CPZ) and Thioridazine (TZ) have common properties such as the sedative and hypotensive activities, TZ exhibiting less antiemetic activity than CPZ. CPZ is a medicine which has a very strong antiemetic effect and is also used for its antihistaminic effect [1,2].

In this paper, CPZ and TZ were prepared as solutions in ultrapure water at a concentration of 2 mg/mL and were irradiated utilizing the 4th harmonic (266 nm) of a Nd:YAG laser beam, the exposure time being 1, 15, 60, 120 and 240 minutes and an unirradiated sample being kept as control.

The knowledge about the time stability of irradiated medicine solutions play a crucial role when these samples are going to be used in different biomedical applications. Therefore within this study the time stability of CPZ and TZ solutions was reported by several evaluation methods: absorption spectrophotometry, Fourier transform infrared spectroscopy (FTIR), pH measurements and thin layer chromatography (TLC) analysis.

The time stability of solution was monitored immediately after exposure to laser radiation, after 1 and 2 hours and after one day up to a week. In the case of pH, measurements were made immediately after irradiation, after 1 and 2 hours, after one day and after 1 month.

CPZ and TZ solutions are remarkably stable after exposure to laser beam and may be used for applications within the above mentioned time intervals.

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P.35

Spectroscopic and DFT studies of a new hydantoin derivative molecular structure

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Hydantoin and its derivatives have received outstanding attention in recent years because of their remarkable pharmaceutical, biological, and industrial applications [1]. Particularly, the 2-thioxoimidazolidin-4-one derivatives find use in a wide variety of medical applications, most notably as antiandrogen, anticarcinogenic, antimutagenic, antithyroidal, antiviral, tuberculosis, antimicrobial (antifungal and antibacterial), as well as anti-HIV [2]. Extensive research studies are carried out in order to minimize the side effects of these potential therapeutic agents. For this purpose, newly synthesized hydantoin derivatives are proposed for spectroscopic characterization and molecular modeling.

In this work experimental and theoretical FTIR spectra of 5-(3-chlorobenzylidene)-2-thioxoimidazolidin-4-one, generically called SZ-2 were studied. Comparisons between the solid phase and the liquid phase molecular geometry optimization using Density Functional Theory (DFT) were also carried out. The UV absorption spectra of the compound in different solvents were examined.

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P.36

Minimal invasive control in paintings restoration and conservation by LIBS

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In the case of cultural heritage restoration and conservation, it has been proved that Laser Induced Breakdown Spectroscopy (LIBS) is an appropriate technique for pigment identification, for analysis of multilayered paintings, and for quantitative analysis of ancient materials.

LIBS, due to its advantages as minimally invasive method that provides real time monitoring and selectivity, is a suitable tool to analyze the sample composition and the time evolution of laser cleaning process.

Artworks cleaning is often mandatory for their preservation and lasers have proven to be one of the most valuable tools for this goal under many aspects. In the field of painting preservation and restoration, cleaning implies for many times the removal of aged varnish. Varnishes are transparent, hard thin films applied on painted surface with a protective (and aesthetic) purpose. They are organic natural resins or artificial compounds. Early varnishes - dammar, amber, mastic - are mainly natural triterpenoids while many modern ones are acrylic compounds.

Experiments involving LIBS to analyze the chemical composition of the removed material in paint cleaning were performed. Here, we report LIBS studies on mastic and dammar varnishes using visible (532 nm) and UV(266 nm) 5ns FWHM laser pulses. The studied varnish layers were on-purpose painted on glass supports or were part of complex morphologies comprising several mock-up samples consisting in dammar or mastic as final layer - gold foil, yellow ocre or cobalt blue egg tempera as painting layer - chalk or acrylic ground as a link to an wooden support. Laser fluences were in the range 0.6 - 4.4 J/cm^2. LIBS was used to monitor the laser induced stepwise selective removal of the layers and to analyze their composition through their specific markers.

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P.37

Analogy of Vancomycin experimental and model spectra

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Although it is a potent and versatile drug the use of Vancomycin is limited by the fact that it is quite toxic to the human body. In view of developing application procedures which include the use of Vancomycin, more information about the drug is required in order to develop new treatment procedures [1].

Generally, the use of computational methods is enabling a more precise characterization of molecules through the use of quantum chemistry applications such as Gaussian 09. These applications allow scientists to model absorption and emission spectra for different types of molecules considering the molecular size, the complexity of the theoretical approach and the available computational infrastructure.

In this study the aim is to compare the experimental FTIR spectra of Vancomycin to a model IR spectra obtained via a computational method that uses DFT (Density Functional Theory) and B3LYP functional level of theory with a 6-31G(d,p) double zeta basis set, which is known to give good results when dealing with organic molecules [2] and make a more precise assignment of the vibrational modes.

Also, it is a known fact that the wavenumbers of the IR model spectra are either underestimated or overestimated and therefore, a quadratic scaling factor applicable to the basis set used in this study has been previously calculated [3] in order to allow a correlation of the vibrational modes in the experimental and model spectra.

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List of participants

Name	Presentation number	Page number
Achim Alexandru	O.05	20
Achim Cristina	O.01	16
Alexandru Tatiana	O.11; P.27; P.28	26; 60; 61
Andrei Ionut Relu	O.17	32
Anghel Iulia	P.08	41
Baleanu Andrei	P.02	35
Banu Nicoleta	P.10	43
Boni Andra Georgia	O.04	19
Boni Mihai	O.03; P.03; P.04	18; 36; 37
Botea Mihaela	P.14	47
Brajnicov Simona	P.15	48
Bratu Ana Maria	P.29	62
Chériaux Gilles	I.12	13
Dascalu Traian	I.06	7
Dinache Andra	O.08; P.30	23; 63
Dinescu Maria	I.03	4
Dumitras Dan	I.11	12
Dumitrescu Nicoleta	P.16	49
Gheorghe Lucian	I.05	6
Hapenciuc Claudiu	P.17	50
Matei Consuela	O.15	30
Mihai Laura	P.06	39
Mihailescu (Serban) Natalia	P.18	51
Mihailescu Ion	I.09	10
Miroiu Marimona	P.19	52
Mitu Maria	P.11	44
Nastasa Viorel	O.12; P.31	27; 64
Neagu Liviu	I.13	14
Negut Irina	P.20	53

Nita Cristina	P.21	54
Oane Mihai	P.12	45
Pascu Mihail Lucian	I.08	9
Pavel Nicolaie	I.07	8
Petris Adrian	I.01; P.01; P.05	2; 34; 38
Petrus Mioara	O.14	29
Popescu Gabriel	I.02	3
Popescu-Pelin Gianina	P22; P23; P.32	55; 56; 65
Rusen Laurentiu	P.33	66
Salamu Gabriela	O.02; P.07	17; 40
Scurtu Adrian	P.13	46
Simion Sandel	O.07	22
Simon Agota	O.09; P.34	24; 67
Smarandache Adriana	O.13; P.35	28; 68
Staicu Angela	I.10; P.36	11; 69
Stefan Angela	P24	57
Stefan Nicolaie	P.25	58
Stoicu Alexandru	O.16; P.37	31; 70
Ungureanu Razvan	O.06	21
Visan Anita	O.10; P.26	25; 59
Voicu Flavius	P.09	42
Zamfirescu Marian	I.04	5