

**International Conference on Physics
of Optical Materilas and Devices**

BOOK OF ABSTRACTS

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 Dr. Bruno Viana**

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ICOM 2006

**International Conference on Physics
of Optical Materilas and Devices**

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**Herceg Novi, Montenegro
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FOREWORD

The 2006 International Conference on Physics of Optical Materials and Devices (ICOM) is the first conference jointly organized by the Institute of Nuclear Science “Vinča” of Serbia and the Laboratoire de Chimie de la Matière Condensée de Paris – ENSCP France.

The place in Herceg-Novi in Montenegro is of course dedicated to tourism but also to enjoyable and useful discussions between scientists through several conferences every year.

The ICOM meeting is devoted to a broad international forum on the science and technology of optical materials and devices, with a particular accent on wide gap materials in crystalline, glass and ceramic (nanocrystalline) forms. Point defects in insulators as well as rare earths and transition metals ions introduced as dopants in various optical materials are also considered. Their impacts on the optical properties are detailed in several contributions.

The conference will stress the value of a fundamental scientific understanding of optical materials and applications in lasers, scintillators, phosphors. The accent will be put on material elaboration and characterization.

The final scientific program of the ICOM 2006 conference comprises of 12 plenary lectures, 33 contributed lectures and about 60 posters.

We are grateful for sponsorships which have assisted us by providing some financial support. We are grateful to Prof. G. Boulon, editor, for the acceptance of some selected papers in the journal *Optical Materials*.

We wish to express our thanks to the members of the International committee for their suggestion of oral speakers and we are also grateful to the members of the local organising committee in Belgrade for their effort and time during preparation of the conference.

Chairpersons

Dr. Miroslav Dramićanin
Dr. Bruno Viana

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2D PHOTONIC CRYSTALS ON THE ARCHIMEDEAN LATTICES

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Here we present the results of our research of 2D Archimedean lattice photonic crystals. This involves the calculations of the band structures, band-gap maps, equifrequency contours and FDTD simulations of electromagnetic propagation through the structures. The band-gap dependence on the dielectric contrast is established both for dielectric rods in air and air-holes in dielectric geometries. A special emphasis is placed on possibilities of negative refraction and left-handedness in these structures.

LOCATION OF LANTHANIDE IMPURITY LEVELS IN III-V GaN AND AlN SEMICONDUCTORS

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Knowledge from lanthanide spectroscopy on wide band gap (6-10 eV) inorganic compounds is used to understand and predict optical and electronic properties of the lanthanides in the III-V semiconductors GaN and AlN. The location of the $4f^n$ ground state energy of each divalent and trivalent lanthanide ion relative to the valence and conduction bands in GaN and AlN is presented. We will relate the level location with the optical properties of lanthanide doped III-V compounds and demonstrate that the quantum efficiency of luminescence from Pr^{3+} , Eu^{3+} , Tb^{3+} , and Yb^{3+} depends on level location. The possibility of electron and hole trapping by trivalent lanthanides is discussed. For example Eu^{3+} and Yb^{3+} are electron traps and Pr^{3+} and Tb^{3+} are hole traps. Implications for possible optoelectronic applications of lanthanide doped III-V compounds will be discussed.

STRUCTURE, OPTICAL AND MECHANICAL PROPERTIES OF GaSe_{1-x}S_x SINGLE CRYSTALS AT $0 \leq x \leq 0.4$

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The crystals of GaSe are among the superior mediums for frequency conversion in IR spectral range because of large birefringence 0.35, low optical losses $\alpha \sim 0.1 \text{ cm}^{-1}$ ($\lambda = 1.06 \text{ }\mu\text{m}$) and $\sim 0.01 \text{ cm}^{-1}$ (2-12 μm), broad transparence range 0.6-20 μm , great second order nonlinear coefficient $d_{22} \sim 70 \text{ pm/V}$, high optical damage threshold and good thermoconductivity 0.162 W/cm·K in the layer plane. Pure GaSe, however, possesses bad cleavage properties limiting the yield of optical quality crystals and resulting in giant spread in measured physical properties. Bad mechanical properties of pure GaSe principally limit practical applicability of the compound in applied nonlinear optics. Growing of GaSe crystals doped with sulfur is a promising way to improve the nonlinear, mechanical and thermal properties of the crystal and suit the requirements needed for nonlinear optical device fabrication. In this study the single crystals GaSe_{1-x}S_x, $0 \leq x \leq 0.4$ have been grown by vertical two-zone Bridgman method using previously synthesized polycrystalline matters as a starting charge. The GaSe_{1-x}S_x crystals have ϵ – stacking, are free of cracks and have a diameter up to 25 mm. Chemical composition of the crystals has been measured with EPMA by LEO 1430. Crystal structure variations were observed with TEM and RHEED methods. Mechanical properties of pure GaSe and GaSe highly doped with In or S were carried out with “Nanohardness Tester” (CSEM) by kinetic hardness method. Prominent variations of the microhardness have been carried out as a function of chemical composition of the solid solutions. A jump of microhardness of GaSe_{1-x}S_x crystal has been detected at $x \sim 0.2$ that may be a result of a crystal structure transition induced by doping. The potentials of GaSe_{1-x}S_x and Ga_{1-x}In_xSe solid solutions for nonlinear optical applications have been considered. In comparative experiment on CO₂ laser SHG and DFG of signal and idler waves of BBO OPO at identical experimental conditions the effectiveness of GaSe:S ($x \sim 0.1$) crystal is 1.45 times higher than in pure GaSe and GaSe:In crystals.

STRUCTURAL AND ELECTRONIC PROPERTIES OF THE KTiOAsO₄(001) SURFACE

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Potassium titanyl arsenate, KTiOAsO₄ (KTA), is an important material from KTiOPO₄ (KTP) family and was found to be very prospective for nonlinear and integrated optics. Fabrication of the high-quality KTA(001) surface is highly designed for optoelectronic applications. Fine mechanical polishing is usually employed for the surface preparation of oxide crystals. Therefore, understanding the effects of KTA top surface modification by interaction of polishing materials with crystal is a prerequisite in order to optimize the conditions for obtaining the high-quality surface. The present work was performed to study the effect of mechanical polishing of the KTA(001) surface upon its structural and electronic properties. A high-quality KTA crystal has been prepared by modified top seeded solution growth (TSSG) from the self-flux. The methods of reflection high energy electron diffraction (RHEED) and X-ray photoelectron spectroscopy (XPS) were used to study the surface crystal and electronic structures and its composition. From analysis of RHEED patterns the superstructure formation has been detected with the relations $a = a_0$, $b = 2b_0$ and $c = 2c_0$ were a_0 , b_0 and c_0 are the cell parameters of KTA bulk. Results of the XPS core-level and valence-band measurements will be presented and discussed in comparison with those obtained earlier for other crystals belonging to the KTP family. The relationship between crystal structure variations and chemical shifts of core-level binding energy of the constituting elements induced by element substitution or doping has been considered for a set of KTP family crystals including KTiOPO₄, KTiOAsO₄, TlTiOPO₄ and K_{0.77}Ti_{0.77}Sb_{0.23}OPO₄.

OPTICAL PROPERTIES OF THIN TEXTURED FILMS V₂O₅/Si DEPOSITED BY REACTIVE MAGNETRON SPUTTERING

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Vanadium pentoxide, V₂O₅, is the most stable oxide in V-O system and exhibits a semiconductor-metal transition at ~250°C. Physical properties of V₂O₅ films can be modified over wide range by chemical intercalation or thermal reduction in special gas mixture. Thin films of V₂O₅ can be prepared by a variety of techniques and can be readily integrated into microelectronic sensors circuitry. Reactive DC magnetron sputtering of vanadium metal target in Ar/O₂ low pressure gas mixture has been applied in this study for fabrication of thin V₂O₅ films on Si substrates. The phase composition of the films was examined with reflection high energy electron diffraction (RHEED) at 65 keV and the presence of V₂O₅ textured polycrystal with preferential orientation of [100] was found for the range of 35.4-48.9% O₂ partial pressure. Chemical composition of V₂O₅ was confirmed by energy dispersive X-ray spectrometry (EDS) and Rutherford backscattering spectrometry (RBS) measurements. Electronic structure of top surface oxide layer was tested with X-ray photoelectron spectroscopy (XPS). Optical characterization of the films was produced with laser ellipsometry ($\lambda = 0.6328 \mu\text{m}$) and reflection spectra measurements. For typical film a uniform refractive index profile has been found with $n = 2.67$, optical absorption $k = 0.0011$ and thickness $d = 165.0 \text{ nm}$. The parameters are very reproducible and weakly dependent on gas mixture composition within the range pointed above. There is no optical anisotropy of V₂O₅ film has been detected. The thickness of the transition layer at the interface V₂O₅/Si has been estimated to be ~20 nm. The wear resistance of the oxide films was tested with sand bombardment method and high mechanical stability of the samples has been confirmed.

SYSTEMATIZATION OF NONCENTROSYMMETRIC OXIDES WITH THREE-VALENCE RARE EARTH IONS APPLICABLE FOR SELF FREQUENCY DOUBLING (SFD) LASER CRYSTALS: STRUCTURE-PROPERTY RELATIONS

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The problem of creation of novel SFD laser crystals is, on the one hand, a problem of searching for new noncentrosymmetric (NCS) crystals having high second order nonlinear optical (NLO) susceptibility $\chi^{(2)}$ and, on the other hand, a problem of isomorphic substitution of active ions for constituent elements in the parent crystal lattice. Such three-valence ions of rare-earth elements (RE) as Pr^{3+} , Nd^{3+} , Er^{3+} , Yb^{3+} are usually an active component of laser media. Earlier the field of binary NCS oxide crystals has been defined on the plane of the shortest oxide chemical bond lengths $L(\text{E-O}) < 200 \text{ pm} < L(\text{M-O})$. It has been found that all the NCS oxides with measurable $\chi^{(2)}$ level are located inside a rosette of two partly crossing ellipses of “acentricity”. The $\chi^{(2)}$ of several NCS crystals positioned away the ellipses, however, are below the sensitivity of modern apparatus and can not be measured certainly. In this study the local areas into the ellipses have been defined for NCS oxides which includes laser active RE elements. The areas define the ranges of oxide chemical bond lengths most promising for high doping of NCS phases by the RE elements without drastic defect generation in crystal lattice. The areas specified for laser active RE elements are compared with these obtained for such three-valence elements as Y, La, Gd, Bi and Sc typically considered as suitable constituents for isovalent substitution by laser active RE^{3+} ions in oxide matrix.

SELLMEIR EQUATIONS FOR HgGa_2S_4 AND CdGa_2S_4

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Nonlinear HgGa_2S_4 and CdGa_2S_4 crystals are known from 1955 but for the first time its optical properties were reported in detail only after mid of 70th. Again, because of poor optical properties and low birefringence, the CdGa_2S_4 crystals were restricted for further applications. Excellent experimental results on frequency conversions in HgGa_2S_4 , in particular on the up-conversion of CO_2 laser emission with the efficiency up to 60%, were developed in 80th. Great attention to this crystal was attracted later after the experimental confirmation of high nonlinear optical properties of HgGa_2S_4 ($d_{36} = 37 \pm 4$ and $d_{31} = 14 \pm 2$ pm/V) in combination of 2 - 3 times higher damage threshold than that of ZnGeP_2 . As a result, the improvement of HgGa_2S_4 single crystal growth technology has been produced and design of solid solutions $\text{HgGa}_2\text{S}_4 \cdot \text{CdGa}_2\text{S}_4 \rightarrow \text{Hg}_{1-x}\text{Cd}_x\text{Ga}_2\text{S}_4$ has been considered because precise refractive index tuning is possible in such mixed crystals with an increase of frequency conversion efficiency. On the other hand available data on main physical properties of parent crystals and solid solutions are still in serious contradictions. For example, up to now four different colors were reported for HgGa_2S_4 single crystals: light green, from light to bright orange, dark red and black. Last two types are not stable and light green crystals are most stable. As a result several different sets of Sellmeier equations were published for HgGa_2S_4 and $\text{Hg}_{1-x}\text{Cd}_x\text{Ga}_2\text{S}_4$ crystals. The equations give $\sim 10^0$ differences in the internal phase matching angle for SHG of 5 - 8 μm range. In this work we represent our new experimental and estimated data on CO_2 laser SHG phase matching and efficiency in $\text{Hg}_{1-x}\text{Cd}_x\text{Ga}_2\text{S}_4$ and different colored HgGa_2S_4 crystals grown by Bridgman - Stockbarger method. The parameters of HgGa_2S_4 bulk crystals are compared with these of needle-type HgGa_2S_4 specimens grown by vapor transport method with iodine as a transport agent. These data are compared with our previous experimental results on frequency conversion and confirm a set of Sellmeier equations determined by Takaoka et. al. Small difference in phase matching angles observed occasionally can be explained by the difference in point defect concentration. Differences in estimated phase matching angles with use of different available Sellmeier equations in comparison with experimental data will be also presented.

LONG-TERM POST-IRRADIATION STORAGE EFFECT ON RADIATION COLOUR CENTRES IN BOROSILICATE GLASS

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Radiation effects in borosilicate glasses have been a subject of extensive studies due to their wide applications in optical engineering. The effect of post-irradiation storage on the optical properties of silicate glasses has been also discussed in view of the radiation defects transformation. However, quite a few studies have been devoted to the dynamics of the radiation-induced changes in the optical spectra of silicate glasses after long-term post-irradiation storage. Here we compare the optical spectra of borosilicate glass, measured shortly after irradiation with high-energy electrons, with those measured for the same samples after 15 years of storage at room temperature.

3-mm thick samples of alkali borosilicate ($\text{SiO}_2\text{-B}_2\text{O}_3\text{-Na}_2\text{O-K}_2\text{O}$) glass were irradiated with 5-, 8-, and 10-MeV electrons on a M-30 electron accelerator at the Institute of Electron Physics, Ukr. Nat. Acad. Sci. (Uzhhorod, Ukraine), the electron fluence Φ ranging from 10^{11} to 10^{14} cm^{-2} . Irradiation was performed at room temperature, the samples being cooled by evaporating liquid nitrogen. Optical absorption spectra of the irradiated samples in the range of 300 to 800 nm were measured using a LOMO MDR-23 monochromator within 2 h after irradiation as well as after 15 years of post-irradiation storage at room temperature.

The optical spectra of as-irradiated borosilicate glass for $\Phi \geq 10^{13}$ cm^{-2} are characterized by a considerable absorption increment in the whole visible range due to the H_3^+ , H_2^+ , and H_4^+ colour centres with absorption energy maxima at 2.0, 2.7, and 4.0 eV, respectively. The absolute value of the increment increases with the electron energy and fluence and reaches up to 20 cm^{-1} in the short-wavelength part of the investigated spectra for $\Phi = 10^{14}$ cm^{-2} of 10-MeV electrons. Meanwhile, while processing the spectra of the samples measured after 15 years of storage, we observed that for all of them the residual fraction of the radiation-induced absorption increment is described by a smooth near-exponential tail which reveals no maxima corresponding to the colour centres. Contrary, the difference between the absorption of the as-irradiated samples and the same samples after durable storage reveals the maxima whose energies and halfwidths are quite close to those corresponding to the H_3^+ , H_2^+ , and H_4^+ colour centres.

It is generally known that radiation-induced colour centres in silicate glasses partly decay at room temperature, but this relaxational process is considered to saturate within a relatively short period, after which the colour centres are basically stable. The obtained results show that long-term post-irradiation storage leads to the decay and/or transformation of the centres. In our opinion, the changes in the environment of the centres in the course of the durable storage of the glass due to thermal diffusion and ageing processes result partly in their decay (partial absorption recovery), partly in transformation into the system of levels forming the density-of-states tails (the featureless residual absorption).

FORMATION AND OPTICAL PROPERTIES OF $\text{Ca}_{10-x}\text{Me}_x(\text{PO}_4)_6\text{F}_2:\text{Eu}^{3+}$

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Despite of $\text{Me}_{10}(\text{ZO}_4)_6\text{X}_2$ (Me=Ca, Sr, Ba; Z=P, V; X=F, Cl, OH) apatite-like compounds doped with rare earth elements (REE) are widely studied there are a lot of publications dedicated to studies of formation and growth processes of rare-earth activated haloapatites using high-temperature and low-temperature methods. Solid solutions of apatites and mixed apatites ($\text{Me}_{10-x}^{\text{I}}\text{Me}_x^{\text{II}}(\text{PO}_4)_6\text{F}_2$) activated with rare earth ions, possesses promising luminescence properties. However, obtaining of apatites and mixed apatites ($\text{Me}_{10-x}^{\text{I}}\text{Me}_x^{\text{II}}(\text{PO}_4)_6\text{F}_2$) from aqueous and their luminescence properties are studied insufficient. Ability of apatites to isomorphic substitution by modificating ions allows one to strongly change their optical properties. Thus, the aim of this work is to study the influence of $\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2:\text{Eu}^{3+}$ (FAP:Eu³⁺) modifications on their structural and optical properties.

Monophase polycrystalline $\text{Ca}_{10-x}\text{Me}_x(\text{PO}_4)_6\text{F}_2:\text{Eu}^{3+}$ (Me=Pb, Mg) samples with Me concentration from 1 to 100 % have been grown by the precipitation from aqueous solutions method. The technological conditions of single phase $\text{Ca}_{10-x}\text{Me}_x(\text{PO}_4)_6\text{F}_2:\text{Eu}^{3+}$ compounds formation have been optimised by XRD analysis and are T=80 °C, pH=4.7. The concentration range of calcium ion substitution by Pb^{2+} and Mg^{2+} ions in calcium fluorapatite has been studied. It has been shown that calcium apatite crystallographic parameters increase according to Vegard rule. FAP crystallites consist of nanocrystalline blocks with size 23-43 nm. It has been revealed that magnesium ions have strong inhibiting effect on the morphology of FAP disperse particles.

It has been shown that as-grown FAP:Eu³⁺ samples do not emit. Thermal annealing in an air atmosphere in the T=500–850 °C range do not change FAP phase composition and leads to appearance of intense Eu³⁺ luminescence. The influence of FAP modifications on the luminescent properties of Eu³⁺ ions in the apatite matrix has been studied.

OPTICAL ABSORPTION COEFFICIENT MEASUREMENTS FOR METHYLENE BLUE SOLUTIONS BY MEANS OF PHOTOACOUSTIC TECHNIQUE

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In this work the Photoacoustic Technique in the rear configuration is shown to be useful for the measurement of the optical absorption coefficient for dye solutions. The absorbing sample's thickness is used as the only variable for this goal. The mathematical model involves the one-dimensional heat diffusion problem through a two layer system assuming the Beer-Lambert model for light absorption. This optical property, at a wave-length of 650 nm, was measured for solutions of methylene blue in distilled water at various concentrations.

COOPERATIVE QUENCHING KINETICS (COMPUTER SIMULATION AND ANALYTICAL SOLUTION)

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Cooperative energy transfer from a donor ion to two-particle acceptors is recently experimentally observed in many optically pumped rare-earth doped crystals and may appear in excitation quenching processes, as well as in down-conversion and sensitization energy transfers [1]. Kinetics of static cooperative quenching in crystals with arbitrary acceptor concentrations, averaged over an ensemble of randomly distributed particles, has a complex non-exponential form. The analytical solution of ensemble averaging for the two-particle transfer (from donor to acceptor) is well known from the works of Th. Forster (1949), M. Galanin (1953), B. Sveshnikov & V. Shirokov (1962), A. Blumen & J. Manz (1979). Computer simulation together with theoretical study of cooperative three-particle interaction (donor and two-particle cooperative acceptor energy transfer) is presented in this work. In 2004 T. T. Basiev suggested that the asymptotic behaviour of the donor fluorescence decay due to the quenching by cooperative two-particle acceptors should have the form $I(t) \sim \exp[-(wt)^{d/2s-d}]$. The data on computer simulation of the cooperative quenching for an ensemble of particles with different dimensions d , concentrations c , and multipolarity s are presented. The analytical solution for the cooperative quenching decay is studied in comparison with the results of computer simulation and is used for determination of the conditions necessary for realization of the predicted asymptotic law. It is shown that the analytical solution agrees well with the results of computer simulation in the entire time scale and corresponds to the asymptotic law, $I(t) \sim \exp[-(wt)^{d/2s-d}]$ at the long-time stage of the process. The power dependence of the cooperative quenching rate on the concentration was deduced to be $w \sim c^{2s/d}$. The discovered time dependence of cooperative quenching has both fundamental and practical importance for study of cooperative processes.

1. T. T. Basiev, I. T. Basieva, M. E. Doroshenko, V. V. Osiko, A. M. Prokhorov, K. K. Pukhov "Cooperative quenching: experiment, theory and Monte-Carlo computer simulation", Journ. of Lumin., 94-95, p. 349-354, 2001

Er³⁺-SENSITIZED Pr³⁺-DOPED SELENIDE GLASSES IN 1.6 μm AMPLIFICATION REGIONS: ON THE MODELLING CONSIDERATION

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Since the appearing of the erbium-doped fiber amplifier (EDFA) almost 20 years ago, research aimed at increasing the transmission capacity in the 1.5 μm optical communication band has progressed rapidly. By contrast, research on transmission systems in the 1.3 μm band has been limited because there are few commercially available 1.3 μm optical amplifiers. These types amplifiers are known as praseodymium-doped fiber amplifiers (PDFAs) and available for amplification of 1.3 μm signals in future communications systems. By considering energy level of trivalent rare-earth ions, praseodymium is used for doping to glasses hosts such as silica, sulfide and fluoride for 1.3 μm fiber amplifiers. However, selenide glasses are required as an alternative host material for the 1.6 μm amplification region.

One of the major issues based on the spectroscopic properties of rare-earth ions is to obtain a reasonable understanding on the amplification procedures under several modeling considerations. From this point of view, the energy level diagram of the selenide-based Er³⁺-sensitized Pr³⁺-doped fiber amplifier is modeled by means of the temperature-sensitive rate equations. Analytical expressions are obtained by solving the modified rate equations. A luminescence centered at about 1.6 μm is considered for the Pr³⁺: (³F₃, ³F₄) → ³H₄ transition. The 1.6 μm emission obtained from the Pr³⁺-doped selenide glass is also discussed, where Er³⁺ is pumped at 1480 nm. It is seen that a partial change in the signal gain slightly depends on the variation with the temperature of the distribution of Pr³⁺-ions in transitions ³F₃-³F₄. Numerical calculations are carried out for the temperature range from 20 to + 60 °C. It is also seen that the prediction of the model is in good agreement with experimental results.

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THE COOPERATIVE JAHN-TELLER EFFECT IN RARE EARTH DOUBLE TUNGSTATE.

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Possible low temperature phase transitions, in double tungstates of rare earth elements alpha-KY(WO₄)₂ type, were investigated by means of different experimental technique: spectroscopy measurements, specific heat and specific heat in magnetic field, magnetostriction and magnetization. The presented experimental results show to be available the spontaneous structural phase transitions (SPT). Authors proved, that the observable of the SPT as a result of the cooperative Jahn-Teller effect (CJTE). The article shows that the cooperative Jahn-Teller effect takes place in samples content 100% the Dy³⁺ or Ho³⁺ ions. The behaviour for different physical properties is presented. As a rule, the SPT of the cooperative Jahn-Teller type takes place in high symmetry compounds. This kind of phase transitions is not very common for rare earth compounds. Particularly SPT CJTE has never been observed in rare-earth low-dimensional materials.

LASER-INDUCED, Er³⁺ TRACE-SENSITIZED RED-TO-BLUE PHOTON-AVALANCHE UP-CONVERSION IN Tm³⁺: KY₃F₁₀

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In sensitized photon-avalanche absorption [1], the sensitizer ions do not absorb the incident light energy but recycle a part of the excitation energy of active ions to prepare the potential active ions to become it actually. In this new sensitization scheme (fig.5 of [1]), the Er³⁺ ions (labelled “sensitizers”) act as mediators, continuously transferring the excitation energy from the higher levels of excited Tm³⁺ ions to the ground-level of potential active Tm³⁺ ions which, in this way, are promoted to the metastable ³F₄ level, then after excited-state absorption (ESA), to the upper levels, thus achieving a feedback loop.

We report here the first results of a spectroscopic study of anti-Stokes emissions from a Tm³⁺-doped KY₃F₁₀ crystal demonstrating the sensitization effect of Er³⁺ ions, present as trace impurities, on the ESA (³F₄ → ¹G₄) lines of Tm³⁺. These results are similar to those of Tm³⁺: LiKYF₅ [1].

In addition to Er³⁺ traces, we have also detected Ho³⁺ traces in Tm³⁺: KY₃F₁₀. Contrary to the Er³⁺ ion, the Ho³⁺ ion does not increase the possibilities of resonant transfer with the Tm³⁺ ion. Furthermore, the reservoir ⁵I₇ level of the Ho³⁺ ion is below the reservoir ³F₄ level of the Tm³⁺ ion. Consequently, the Tm³⁺ → Ho³⁺ → Tm³⁺ transfers are much less probable than the Tm³⁺ → Er³⁺ → Tm³⁺ transfers. Under these conditions, sensitized photon-avalanche absorption involving both Tm³⁺ and Ho³⁺ ions should not take place, what signifies that the Tm³⁺ ions located in the immediate neighbourhood of Ho³⁺ ions should not be excited.

Green and blue emission spectra originating respectively from ⁴S_{3/2} level of the Er³⁺ ion, from ⁵S₂, ⁵F₄ levels of the Ho³⁺ ion and from ¹G₄ level of the Tm³⁺ ion were recorded under monochromatic excitation at different wavelengths in the red spectral range. Excitation spectra were also recorded for the most intense emission lines. All measurements were performed at low (77K) temperature. In accordance with what was planned, we can see that the avalanche wavelengths (corresponding to ³F₄ → ¹G₄) excite the green (⁴S_{3/2} → ⁴I_{15/2}) emission from Er³⁺ ions as well as the blue (¹G₄ → ³H₆) emission from Tm³⁺ ions, but not the green (⁵S₂, ⁵F₄ → ⁵I₈) emission from Ho³⁺ ions. We are forced to conclude that the majority of the Tm³⁺ ions excited by sensitized photon-avalanche absorption are exclusively located in the immediate neighbourhood of Er³⁺ ions.

Red-to-green up-conversion mechanism is, for Er³⁺, either a two-step absorption process or a photon-avalanche absorption process (fig.5 of [1]) depending on whether the excitation wavelength is tuned on the ⁴I_{13/2} → ⁴F_{5/2} or ³F₄ → ¹G₄ transitions. Green (⁴S_{3/2} → ⁴I_{15/2}) emission decay time measurements under monochromatic excitation at different wavelengths (belonging to one or the other of two preceding transitions) confirm our first result.

[1] J.P. Jouart, M. Bouffard, E. Boulma, M. Diaf, E.N. Vojtenko and N.M. Khaidukov, J. Phys.: Condens. Matter 17 (2005) 5137-5148

THE ELECTRICAL CONDUCTIVITY OF THE BECHGAARD SALTS UNDER HIGH PRESSURE

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Bechgaard salts have been synthesized in the eighties of the last century. It was quickly shown experimentally that their low temperature electrical conductivity can not be described by the theory of conductivity of standard metals; instead of it, the Hubbard model had to be used. In some parts of the (P-T) plane, the Bechgaard salts become superconducting. Although these materials are well studied experimentally, theoretical modeling of their electrical conductivity is extremely complicated. In spite of experiments being performed under high pressure, theoretical studies did not take into account the influence of external high pressure on their conductivity. The aim of this contribution is to present a theoretical determination of the influence of high external pressure on the electrical conductivity of the Bechgaard salts. The calculation is a consequence of an earlier study of the conductivity of these materials. To some extent the results will be compared to experiments.

TEMPERATURE RISE MONITORING THROUGH RED-TO-GREEN UP-CONVERSION IN $\text{Er}^{3+}:\text{Sr}_{0.3}\text{Cd}_{0.7}\text{F}_2$ CRYSTALS

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The study of heating effects generated by an optical excitation around 652 nm in erbium doped upconversion fluoride crystals was recently undertaken in our laboratory [1]. Although the multiphonon relaxation rates are lower in the fluorides than in the oxides, significant rises of the internal temperature were noticed in the fluorides under modest excitation powers. In order to experimentally determine the temperature inside the crystal as well as its variation as function of time, we chose to study the green emission originating from two very near multiplets ($^4\text{S}_{3/2}$ and $^2\text{H}_{11/2}$) of Er^{3+} ions. The results relative to an Er-doped fluorite-type mixed $\text{Sr}_{0.3}\text{Cd}_{0.7}\text{F}_2$ crystal will be presented.

Er-doped $\text{Sr}_{0.3}\text{Cd}_{0.7}\text{F}_2$ crystals have been grown in our laboratory many years ago [2] by the Bridgman technique. The two Stark levels of $^4\text{S}_{3/2}$ and the lowest Stark level of $^2\text{H}_{11/2}$ used in this study to determine the temperature have been previously determined [3]. The excited Er^{3+} ions act both as internal sources of heat and as probes of temperature. One part of the absorbed energy (about 50% of the incident power at 652 nm is absorbed by the Er ions on a thickness of 1 mm) is converted into heat, while the other one generates two infrared Stokes emissions (attributed to the transitions coming from metastable levels $^4\text{I}_{13/2}$ and $^4\text{I}_{11/2}$), one red Stokes emission (due to $^4\text{F}_{9/2} \rightarrow ^4\text{I}_{15/2}$) and one green anti-Stokes emission (due to $^2\text{H}_{11/2}, ^4\text{S}_{3/2} \rightarrow ^4\text{I}_{15/2}$).

In all experiments, the sample was at room temperature before any excitation. To minimize the reabsorption effects, the exciting beam passes through the sample's thickness very near the face at the exit of which we collect the green emission. It is noteworthy that, in this material, the emission line's position is independent of the excitation wavelength. The emission lines of $\text{Er}:\text{Sr}_{0.3}\text{Cd}_{0.7}\text{F}_2$ are broader than those of ordered crystals but, however, still narrow enough to prevent the overlaps and, consequently, to reduce the uncertainty on the determination of the temperature. Immediately after the excitation at 652 nm is on, both emission lines at 549.3 nm and 540.7 nm originating from $^4\text{S}_{3/2}(1)$ and $^4\text{S}_{3/2}(2)$ sublevels progressively decrease in intensity before reaching a stable value in about one minute, while the intensity of the emission line at 522.8 nm originating from $^2\text{H}_{11/2}(1)$ immediately reaches a constant value.

The intensity ratio of both emission lines, the one (549.3 nm) originating from $^4\text{S}_{3/2}(1)$, the other one (522.8 nm) from $^2\text{H}_{11/2}(1)$, has been recorded as a function of time. The Boltzmann's law has then been applied (with a gap of 748 cm^{-1}) to obtain the internal temperature time dependence. The intensity ratio of both emission lines, the one (540.7 nm) originating from $^4\text{S}_{3/2}(2)$, the other one (522.8 nm) from $^2\text{H}_{11/2}(1)$ and the application of the Boltzmann's law with a gap of 632 cm^{-1} leads, for the same absorbed power, nearly to the same dependence, that confirms the former result.

[1] Z. Chouahda, T. Duvaut, J. P. Jouart, M. Bouffard, J.F. Henry and M. Diaf, Journal of Physique IV-Proceedings (accepted)

[2] J. P. Jouart, C. Bissieux and G. Mary, J. Lum. 29 (1984) 261

[3] X. Zhang and J. P. Jouart, unpublished results

INVESTIGATION OF THE EUROPIUM BIQ O₂-CRYPTATE USING THE SPARKLE MODEL AND INTENSITY PARAMETERS

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The structure and emission spectrum of the europium bisquinoline [Eu(biqO₂)] are investigated in the frame of the sparkle model for lanthanide complexes (SMLC) and the simple overlap model (SOM). The simulated structure is compared to the X ray measurements found in related literature. It can be noted the satisfactory similarity between them, the differences are attributed to the fact that the simulation is performed in vacuum conditions. In this way *packing effects* are not considered in our calculations. A direct proof of this effect is that the metal to ligating ions mean distance is smaller in the X ray data than in the simulated structure. The presence of more than 1 peak in the ⁵D₀-⁷F₀ transition position and more than 3 peaks in the ⁵D₀-⁷F₁ transition positions, indicate more than one stabilized local environment for the Eu ion. Theoretical values of the intensity parameters were calculated using the SOM. The best set of theoretical parameters reproduces around 80% of the experimental values. This is an indication that the SMLC was able to fit the more stable polyhedron of coordination of the Eu ion. These predictions strongly indicate that the sparkle model is a very good tool for simulating the local environment of the europium ion, even involving large molecule as cryptates.

QUANTHOLOGRAPHIC IMPORTANCE OF THE UNIVERSAL TRANSMISSION SYSTEM OF THE BODY MERIDIANS, REFLEXOGENIC ZONES, AND REFLEXOGENIC POINTS

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In this paper biological activity of the acupuncture or *body meridians* (BMs), *reflexogenic zones* (RZs), and *reflexogenic points* (RPs) as a mirror of functional states of the organs and systems of the whole body is considered. The acupuncture, biological active or reflexogenic points are the sites of exchange energy of different frequency between organism and environment, especially of natural resonance electromagnetic ultralow and microwave frequencies. RZs and RPs as small 'windows' of the body, which are functioning at completely low threshold or even subthreshold resonance actions, can be used for diagnostic and therapeutic aims. Hereby we argue that morphogenesis of BMs, RZs and RPs is tightly linked with embryogenesis of tissues and organs in all species - related to the system of *gap junction channels* (GJCs) - which represents the most probable structural morphofunctional basis for universal holographic system of BMs, RZs and their RPs. As phylogenetically oldest universally present electrotonical-metabolic transmission system of the organism, participating in the wide spectrum of biological functions (regulating signal transmission, cellular organization, tissue homeostasis) GJCs are particularly abundant within acupuncture RPs and BMs, with especially important role in embryogenesis of BMs, RZs and RPs. GJCs are most common in animal embryos, where chemical communication between cells is essential for development and growth. The embryo contains information of the whole body. In the blastula and gastrula developmental stadia, cells are joined by GJCs. All three embryonic germ layers give rise to epithelia. During migration the epithelial cells forming the somites lose their epithelial shape and migrate in the direction of the notochord and the spinal cord to form the sclerotome (future vertebral column). The dorsal wall of the somite differentiates into the myotome (future muscles) and the dermatome (future dermis). Thus, epidermis is formed from ectoderm, vascular endothelium from mesoderm, and the lining of the gastrointestinal tract from endoderm. GJCs are highly developed in epithelia and they help the maintaining of the close proximity of epithelial cells to one another. The homogeneity of the neural plate, after it uncouples from overlying ectoderm, is partially gap junction coordinated. GJCs system is the biological information system of direct intercellular communication, based on electrical-metabolic synapses between two or more neighboring cells. This is embryologically the oldest system for transfer and exchange of information, including ions, different messengers (e.g., cAMP, and Ca^{2+}), sugars, amino acids, and other solutes with molecular weights up to 1600 daltons. GJCs system of transmission represents just the most probable structural, morphofunctional basis for universal holographic system of BMs, RZs and their RPs. According to their origin, from embryonal endoderm, which develops from epithelial tissues of internal organs, the BMs most likely have got their name according to the GJCs system exteroceptive representation of the corresponding internal organs.

FAR IR REFLECTANCE SPECTRA OF α' -Na_{1-x}V₂O₅ SINGLE CRYSTALS

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The polarized infrared reflectance spectra of α' -Na_{1-x}V₂O₅ ($0 \leq x \leq 0.15$) single crystals are presented. An abrupt change of the effective charge is found from the $\mathbf{E} \parallel \mathbf{b}$ polarization data mainly as a result of the sudden change of the LO_b B_{2u} phonon at the critical Na deficiency: $x \approx 0.03-0.04$ where the charge ordering and spin-Peierls effect disappear in Na_{1-x}V₂O₅. Similarly, in the $\mathbf{E} \parallel \mathbf{a}$ polarization the structure of the 1015 cm⁻¹ peak (due to the leak of the B_{1u} LO_c phonon) suddenly changes its parameters at the critical deficiency. These phonon anomalies give evidence for a strong electron-phonon interaction and shed a new light on the mechanism of the phase transition in α' -Na_{1-x}V₂O₅.

INVESTIGATIONS OF THERMAL PARAMETERS IN LIQUID CRYSTAL MIXTURES USING PHOTOACOUSTIC TECHNIQUE

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The past three decades have witnessed the emergence of photoacoustic and related photothermal techniques as effective analytic and research tools for the evaluation of transport and optical properties of materials with accuracy¹. In this work, we focus on the complete thermal characterisation of liquid crystal mixtures in smectic phase consisting of various relative volume fractions of cholesterol and 1 hexadecanol have been carried out for the first time using photoacoustic technique. The thermal diffusivity value of these liquid crystal mixtures by taking into account of the thermoelastic bending are evaluated using the open cell photoacoustic technique. Thermal diffusivity is an important thermophysical parameter which essentially determines the diffusion of heat through a sample and, physically the inverse of which is a measure of time required to establish the thermal equilibrium in system for which a transient temperature change has occurred². The thermal effusivity value, which is measure of thermal impedance of the material, is measured using the conventional photoacoustic technique. From the measured values of these transient thermophysical parameters, thermal conductivity and heat capacity of the sample under investigation are calculated. Analysis of the results shows that thermal diffusivity values are enhanced in mixture with increase in relative volume fraction of 1 hexadecanol in mixture while the thermal impedance of the mixture, thermal effusivity value, decreases with increase in volume fraction of 1 hexadecanol. The evaluated thermal conductivity and heat capacity values also follow the volume fraction relation. Results are interpreted in terms of enhanced Hydrogen bonding and consequent cohesive thermal energy transport with the increase in volume fraction of 1 hexadecanol.

1) Sajan D George, S. Saravanan, M. R. Aantharaman, S. Venketachalam, P. Radhakrishnan, V. P. N. Nampoore and C. P. G. Vallabhan *Phys. Rev. B*, 69, 235201 (2004)

2) Sajan D George, P. Radhakrishnan, V. P. N. Nampoore and C. P. G. Vallabhan, *Phys. Rev. B*, 68 (16), 165319 (2003)

ELECTRONIC POLARIZABILITY IN Fe-Sb-S-I GLASSES

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The introduction of iron atoms in eutectic system of three-component Sb-S-I glass show the limit of amorphousity lower than 3 at % of Fe content. The investigated glasses have a wide range of transparency in IR spectra up to 20 μ m. The changing of the values of optical band gap is noticed at the concentration of about 1 at % of Fe. Up to this concentration, the energy band gap decreased with increased Fe content (from 1.83 eV to 1.56 eV), while at higher concentration the values of the energy gap are slightly increased. The magnetic properties show the similar behavior: at the low concentration, proportional to Fe atom content, dominated paramagnetism arise from high spin Fe²⁺ (d⁶) atoms. At the concentration upward 1 at % of Fe, the paramagnetic properties are mostly independent on impurity concentration. Up to the concentration of 1 at % Fe, DC conductivity is of semiconductor type with the activation energy about half of the value of the optical band gap, which is characteristics of the p-type conductivity of such materials. The mechanism of AC conductivity is of hopping type by bipolarons between defect centers near Fermi level ($\Delta E \approx 10^{-2}$ eV). At the higher Fe concentration DC and AC conductivity is of metallic type. In this work we present the results of investigation of dispersion characteristics of refractive index at room temperature and related calculated parameters of the Fe_x[(Sb₂S₃)_{0.75}(SbI₃)_{0.25}]_{1-x} system, for x=0, 0.1, 0.5, 0.8 and 1 at % of Fe. The Sellmeier dispersion formula was used to describe the dispersion characteristics of the medium. The oscillator force and resonance frequencies were determined. It is noticed that resonant frequency are practically independent on iron content in investigated glasses ($\omega_0 = 9.07 \cdot 10^{14}$ Hz). We established analytic form of the oscillator force via iron content. The electronic polarizability was also determined by using Lorentz-Lorentz relation. At given wavelength of incident light the electronic polarizability decrease with increasing the density of glasses. These materials possess positive values of Grüneisen constant.

THE GALVANOLUMINESCENCE SPECTRA OF BARRIER OXIDE FILMS ON ALUMINIUM FORMED IN AMMONIUM TARTRATE

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This paper presents the results of the most recent investigations of the galvanoluminescence (GL) spectra measurements of barrier oxide films formed by aluminum anodization in ammonium tartrate. The spectra were recorded for different values of the temperature of electrolyte and anodization current density. For the first time we have showed that there are strong galvanoluminescence bands range from 400 nm to 700 nm and the shape of the spectra depend of anodic conditions. For spectra recording we used an ICCD based detection system intended for dynamic (time resolved) GL measurements in a wide range of wavelengths.

TEMPORAL CHARACTERISTICS OF PICOSECOND STIMULATED RAMAN SCATTERING IN OXIDE CRYSTALS

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In the presented work our interest concerns with experimental possibility of stimulated Raman scattering (SRS) pulse shortening under picosecond laser pumping of oxide crystals. We experimentally investigate a connection of SRS pulse width with optical dephasing time of crystals in frame of known theory for the transient and stationary SRS. We chose crystals with variation up to two orders in magnitude optical dephasing time (T_2) for Raman active vibrations of frequency ν_R : $\text{Ba}(\text{NO}_3)_2$ ($T_2=26.5\text{ps}$, $\nu_R=1047\text{cm}^{-1}$), BaWO_4 (6.6ps, 925.6cm^{-1}), SrWO_4 (3.9ps, 921cm^{-1}), CaWO_4 (1.5ps, 911cm^{-1}), PbWO_4 (2.3ps, 904.7cm^{-1}), $\text{KGd}(\text{WO}_4)_2$ (1.96ps, 901cm^{-1}), PbMoO_4 (1.3ps, 871cm^{-1}), LiNbO_3 (0.38ps, 256cm^{-1}). Passively mode-locked YLiF_4 : Nd crystalline laser, which at 1047nm wavelength generates pulses of $T_p=22\text{ps}$ width, was used as the source for SRS excitation. For all the crystals we measured SRS stokes T_s pulse width and then analyzed the T_s dependence on optical dephasing time T_2 . The corresponding to the theory tendency of shortening stokes pulse width at the increase T_p/T_2 ratio was observed. At T_p/T_2 ratio rise SRS pulse width is shortened relatively pump pulse width from less than two times for $\text{Ba}(\text{NO}_3)_2$ crystal ($T_s=13.8\text{ps}$) to approximately five times for LiNbO_3 crystal ($T_s=4\text{ps}$). Our analysis showed that the measured dependence of the Stokes pulse width on dephasing time is described in frame of the SRS theory [1].

1. R. L. Carman, F. Shimizu, N. Bloembergen, *et al.* Phys. Rev. A 2, 60 (1970)

SIZE EFFECT IN OPERATION OF DOUBLE FIBER DISPLACEMENT SENSORS

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In this article the result of displacement measurements for two different optical fiber sensors are reported. For a better comparison the same double-fibers in two different arrangements are experimented and the results are compared in this paper. In one arrangement, the protective sleeve is removed and two fibers are placed together with a smaller center-to-center distance. Since the core and cladding size are the same for the two cases, thus the effect of the center-to-center distance for double fiber designs is precisely investigated in this study. The reflected output power as a function of the axial distance is recorded for such sensors. A theoretical model is also developed, which depends on the center-to-center distance for the sensor performance and experimental results are compared with the theoretical computations. The output respond includes the active part with an increasing reflection power with distance and a dead region parts in which the respond curve shows a conventional decay of the reflected power as a function of distance. The overall behavior of the reported sensors is very similar to that of the theoretical one, but the larger size arrangement shows a wider bandwidth in term of output respond.

PERFORMANCE OF A DOUBLE-FIBER INTENSITY MODULATED SENSOR

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Recently there has been a great deal of interest in the development of optical fiber sensors. The interferometric optical fiber sensors are more accurate while the intensity modulation devices are less complicated and therefore have a lower cost of production. Different reports on the design, characterization, operation, and possible applications of such devices have been given. Physical, chemical, and biological effects have been used to develop a variety of optical switches and sensors for monitoring different sensing parameters. The optical fibers sensors are effectively used as the light switches or for liquid level sensing. It is also possible to use these devices for determination of impurities in any other solutions. A typical design for liquid level testing has been the use of fiber guidance with inverted tip to provide internal reflection at the tip of the fiber. The fiber optic probe has been used for measuring refractive index or different liquids. Since transmitted or reflected light in a fiber is a function of the refractive index of the probe and the refractive index of the liquid thus the index of refraction of the surrounding can be measured. Using this concept, researchers have been able to measure the index of refraction of liquids. In general intrinsic and extrinsic methods have been implemented for construction of such devices. Intensity and phase modulation have been used for the operation of optical fiber sensors. Design and operation of a double fiber sensor is presented in this report. The dominant loss mechanism is found to be the evanescent loss and based on this phenomenon the optical fiber sensor is designed. Construction and the experimental arrangement for the proposed double fiber sensor are discussed in this study. Dry and wet output signals for the water liquid are presented and a comparison of the average signal differences is reported. The precision of measured values, reproducibility of the results, and the stability of sensing operation as a function of time are also reported.

THE INFLUENCE OF ANNEALING TEMPERATURE OF ALUMINIUM SURFACE ON GALVANOLUMINESCENCE SPECTRA IN VARIOUS ELECTROLYTES

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Our previous researches showed that aluminum surface pretreatment affects galvanoluminescence (GL) spectra obtained during aluminum anodization in various electrolytes. Thermal pretreatment of aluminum samples showed as related to flaws generation on the aluminum surface. In this article we have presented very new results of annealing temperature influence on a shape of GL spectrum recorded by specially constructed ICCD camera based spectrographic system.

BIOPOLYMER HOLOGRAPHIC DIFFRACTION GRATINGS

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The holographic diffraction gratings have many applications, for example in integrated optics, spectroscopy, acousto-optic devices, and holographic optical elements. Surface-relief gratings are of significant interest due to their applications in the mass production of holographic optical elements by using embossing technique. The photoresists are the most widely used recording media for relief hologram production. In our case, surface relief diffraction gratings are holographically recorded in dextran sensitized with ammonium dichromate (DCD). Dextran is biopolymer with branching polysaccharide structure. It was found in our previous experiments that the dextran sensitized with ammonium dichromate has good holographic properties such as high diffraction efficiency, high resolution, simple fabrication, low noise; it can be used in real-time. In our work, surface-relief diffraction gratings were formed by the interference of two equal power coherent beams. DCD was exposed with single-frequency 400 mW diode pumped Nd-YAG laser, at 532 nm. He-Ne laser operating at 632.8 nm was used for real-time monitoring of diffraction efficiency. Exposure of DCD film was considered complete when the real-time maximum diffraction efficiency was achieved. The exposed plates were chemically processed (developed) with a mixture of isopropanol and water and then immersed in the pure isopropanol. The diffraction grating profiles were analyzed by atomic force microscopy (AFM). It was found that different surface profiles can be obtained. Gratings with spatial frequencies of 330 lines/mm were made. Existence of higher harmonics in Fourier Transform of non-sinusoidal profiles shows that DCD is capable of recording spatial frequencies up to 1320 lines/mm (four times fundamental frequency). The measured maximum relief depth of the DCD grating is 402 nm. Compared with those of pullulan (biopolymer with linear polysaccharide structure), higher relief depths of DCD gratings were achieved.

UPCONVERSION AND EXCITONIC/HOST EXCITATION IN Er:KPB₂Cl₅ CRYSTALS

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The low phonon energy Er³⁺-doped crystals with ions are of great interest for lasers with upconversion pumping by InGaAs laser diodes ($\lambda=960-980$ nm). The Er-doped potassium-lead double chloride crystals Er³⁺KPb₂Cl₅ (Er:KPC) are promising new material emitting in a wide spectral region from UV up to mid IR. Crystals have high chemical resistance and low hygroscopicity; good mechanical properties, and can be grown in a quite large size with high optical quality for applications in solid-state lasers. They are transparent in wide spectral region from 330 nm up to 20 μ m, incorporate erbium ions in concentrations up to 3 mol.%. Intense absorption band useful for laser diode pumping (~ 980 nm), high radiative probabilities, narrow phonon spectrum (maximum phonon energy is ~ 203 cm⁻¹) and, therefore, low multiphonon relaxation rates make the Er:KPC crystals promising for using as laser crystals. Laser action of the Er:KPC crystals was achieved in mid-IR at 4.6 μ m [1].

We report on the results of the study of energy transfer and dynamics of Er³⁺ levels population in new low phonon energy potassium-lead chloride crystals Er³⁺:KPb₂Cl₅ under direct UV and IR laser diode impurity excitation as well as under indirect excitonic or crystalline-matrix excitation.

It was shown that UV selective direct excitation of Er ions lead to population of low-lying energy levels via cascade schemes. Fast efficient energy transfer from the exciton/host to low-energy excited Er levels takes place under excitation into excitonic or host absorption bands. Upconversion IR continuous-wave or pulsed excitation causes population of the upper energy levels via both excited state absorption (2 or 3 photon processes) and upconversion nonradiative energy transfer (ETU) arising due to nonlinear coupling of long-living excited levels. Experimental concentration and pump power dependencies of the steady-state VIS luminescence intensity were investigated for Er doped KPC crystals using LD pumping at 975 or/and 808 nm. Dynamics of upconversion luminescence was studied using short pulse laser excitation at 980 nm. The efficiency of upconversion of excitation energy is demonstrated. The possibility of laser action with Er:KPC crystals in UV-VIS or mid-IR is discussed.

[1] S.R. Bowman, S.K. Searles, N.W. Jenkins, S.B. et al. *Technical Digest of conference of Lasers and Electro-Optics 2001, May 8-10, Baltimore, Maryland, USA, CLEO (2001)*, CFD2, 557-558 (2001).

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EMISSION OF AMINE- AND AMIDE-CROSS-LINKED ALKYLENE/SILOXANE HYBRIDS

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The drive to miniaturization that occurred during the last two decades has been rapidly pushing industry into the atomic and nanometer scale. The development of new synthesis strategies for advanced materials with enhanced properties and affording an effective control at the nanometer level is therefore required. The birth of “soft” inorganic chemistry processes, in particular the sol-gel via, allows the chemical design of pure and well-controlled multifunctional organic/inorganic hybrid materials. The resulting synergies open up exciting directions in materials science research and related technologies with implications in the processing of novel multifunctional advanced materials with innovative performances. Moreover, the ability to tailor materials properties over broad length scales suggests that research on hybrids can significantly impact diverse fields, such as nanophotonics, magnetism, catalysis, smart coatings, sensors, biomedical and ceramic/polymer composite applications [1, 2].

Increasing attention has been focused in the last few years on the photonic features of stable and efficient siloxane-based organic/inorganic hybrid matrices incorporating amine or amide functionalities, such as those obtained from 3-aminopropyltrimethoxysilane (APTES) with carboxylic acids and urea (*di-ureasils*) and amide-based (*amidosils*) cross-linked xerogels, due to their intrinsic and efficient room-temperature emission with significant quantum yields (20-35 %) [3, 4]. These materials can be prepared through hydrolysis and condensation of the corresponding organic-inorganic hybrid precursors [4, 5] or, alternatively, via carboxylic acid solvolysis process [6]. Preliminary results demonstrated that the emission quantum yields of the hybrids prepared through acetic or valeric acid solvolysis are 27-35 % higher than those calculated for the analogues synthesised via the conventional sol-gel technique [3].

The aim of this work is to discuss the photoluminescence (PL) properties of a series of *di-ureasils*, and *amidosils* and to determine the influence of the nature of the carboxylic acid on the local structure, PL properties and quantum yield of the solvolysis-derived organic/inorganic hybrids. Samples with polymer chain of different molecular weights and with cross-linkages in one or in the two sides of the polymer segments were investigated. Particular attention will be devoted to examples of hierarchically-structured organic-inorganic hybrids discussing the subtle relation between modifications in the local structure and alterations on their emission features.

[1] C. Sanchez, B. Lebeau, F. Chaput, J.-P. Boilot, *Adv. Mater.* **15**, 1969 (2003).

[2] C. Sanchez, B. Julian, P. Belleville, M. Popall, *J. Mat. Chem.* **15**, 3559 (2005).

[3] W. H. Green, K. P. Le, J. Grey, T.T. Au, M. J. Sailor *Science*, **276**, 1826 (1997).

[4] L.D.Carlos, R.A.Sá Ferreira, V.de Zea Bermudez, S.J.L.Ribeiro, *Adv. Funct. Mater.* **11**, 111 (2001).

[5] L.D.Carlos, R.A.Sá Ferreira, R.N.Pereira, M.Assunção, V.de Zea Bermudez, *J.Phys.Chem. B.* **108**, 14924 (2004).

[6] L.S.Fu, R.A.Sá Ferreira, N.J.O.Silva, L.D.Carlos, V.de Zea Bermudez, J.Rocha, *Chem.Mater.* **16**, 1507 (2004).

OPTICAL ABSORPTION COEFFICIENT MEASUREMENTS FOR PHENOLIC COMPOUNDS IN SOLUTION BY MEANS OF PHOTOACOUSTIC TECHNIQUE

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Photoacoustic Technique in the rear configuration is shown to be useful for the measurement of the optical absorption coefficient for dye solutions. The absorbing sample's thickness is used as the only variable for this goal. The mathematical model involves the one-dimensional heat diffusion problem through a two layer system assuming the Beer-Lambert model for light absorption. The optical absorption coefficient for phenolic compounds in solution was measured at two different wavelengths. Some phenolic compounds (like anthocyanins) have powerful antioxidant activity for which they are having increasing importance in many fields of medical science and industry. The corresponding samples were obtained from a typical plant from México called xoconoxtle for which its potential as yields of this kind of compounds is currently under study.

FORMATION OF PHOTOLUMINESCENT GERMANIUM NANOSTRUCTURE BY FEMTOSECOND LASER PROCESSING ON BULK GERMANIUM

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We present the formation of Ge nanostructures by fs-laser irradiation on bulk Ge crystal and the origin of its photoluminescence (PL) properties in visible region. High intensity of incident laser energy gives rise to make oxidized layer on the surface of Ge nanoparticle, of which size exhibits a rather large anisotropic behavior. Raman shift and PL spectral feature of the nanoparticle was measured as a function of fs-laser processing conditions such as laser fluences, the surrounding gas, and its pressure. It should be noted that the oxidation reaction of Ge nanoparticle plays an important role for the observed photoluminescence. This relation between oxidation and particle size is explained with time-resolved reflectivity change measured during ablation of Ge.

OMNIDIRECTIONAL REFLECTOR BASED ON ONE-DIMENSIONAL PHOTONIC CRYSTAL CONTAINING FREE CARRIERS IN THE PRESENCE OF EXTERNAL MAGNETIC FIELDS

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At Brewster's angle the reflection of a p-polarized light wave vanishes at a material interface. So at this angle of incidence conventional one-dimensional photonic crystals close up all their gaps for p-polarized light waves. If an external magnetic field is applied to material containing free carriers, it alters dielectric constants along perpendicular directions. This induces birefringence that may give rise to imaginary Brewster's angle. By 4×4 transfer matrix method we have performed some calculations of the reflection spectra of a one-dimensional photonic crystal with one constituent containing free carriers in the presence of external magnetic fields according to Drude model. When an external magnetic field is applied normal to its interfaces, an omnidirectional reflector is achieved within some frequency range near the plasma frequency. When the external magnetic field is applied in the plane of its interfaces, the Brewster's angle can be tuned. However, when frequency is very near the plasma frequency, the absorption will be significant. Our calculations showed that in the case of large reflectivity the absorption would be much weaker than that in the case of large transmissivity. That is to say, the absorption has a very limited influence on the omnidirectional reflection of the 1D photonic crystal.

HIGH PRESSURE OPTICAL STUDIES OF LMA:Mn²⁺, Nd³⁺ AND LMA:Mn²⁺

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The effect of pressure on line position and fluorescence lifetime for ${}^4T_1 \rightarrow {}^6A_1$ transition in LMA:Mn²⁺ and LMA:Mn²⁺, Nd³⁺ has been considered up to about 110 kbar. Energy transfer between Mn²⁺ and Nd³⁺ in LMA:Mn²⁺, Nd³⁺ has been considered also. We find that pressure induced shifting the line toward to longer wave length – red shift in both crystals with the same rate 0.182 nm kbar⁻¹. Fluorescence lifetime slowly linearly increase with pressure. Energy transfer efficiency decrease with a pressure. Induced red-shift and the change of τ can be explained by a simple model. A good agreement between theoretical and experimental values of λ and τ within the pressure interval in question has been achieved.

COUNTERPROPAGATING BEAMS IN ROTATIONALLY SYMMETRIC PHOTONIC LATTICES

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Several properties of counterpropagating mutually incoherent self-trapped beams in optically induced circular photonic lattices are investigated numerically. We consider a local isotropic dynamical model with Kerr-type saturable nonlinearity. Different incident beam structures are considered, as well as various kinds of lattice defects. We observe spontaneous symmetry breaking of the head-on propagating Gaussian beams. In the case of vortices, we find beam filamentation and a strong pinning of filaments to the lattice sites. We see discrete diffraction, leading to the formation of discrete counterpropagating vector solitons.

CHOLESTERIC LIQUID CRYSTALS DOPED WITH PROVITAMIN d AS SENSOR MATERIAL FOR DOSIMETRY OF BIOLOGICALLY RELEVANT UV RADIATION

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Monitoring of biologically active UV radiation is one of the challenging problems of biophysics and medical physics. In conventional solid-state UV detectors and dosimeters, physical mechanisms of the measured response of the sensor material are substantially different from those occurring in biological tissues, and fundamental problems arise in matching the UV sensitivity spectrum of a sensor material to the erythema action spectrum or other biologically relevant spectral characteristics. As one of the ways, specially designed filters are used to select biologically relevant regions of the UV radiation spectrum, which also does not fully ensure an adequate response of the instrument used. The idea of our approach is to use cholesteric liquid crystals (CLC) doped with UV sensitive dopant of biological origin - provitamin D (provitamin D₂, provitamin D₃) as a basic sensor material. Helical pitch of CLC (i.e., easily measurable maximum selective reflection wavelength – λ_{\max}) can be made highly sensitive to changes in concentration of specific dopants [1]. Under UV irradiation, provitamin D is basically transformed (not accounting for side reactions) to vitamin D. As provitamin D and vitamin D have opposite senses of helical twisting power, the photochemical reaction can be easily monitored by recording the corresponding changes in λ_{\max} [2]. We developed a CLC matrix based on a nematic-cholesteric mixture ensuring appropriate UV transparency and stability and possessing λ_{\max} in visible region. The matrix doped with 5-10% of provitamin D ensures λ_{\max} shift up to 100 nm under UV irradiation which could be visually observed as a change in color. Irradiation was carried out by a UV illuminator based on a DRT-240 lamp, calibrated accounting for the experimental geometry. The sensor response (λ_{\max} shift) vs. irradiation dose was obtained in different UV subranges, this dependence being linear within certain dose limits. Selective sensitivity of such sensor to biologically active UV was demonstrated. The observed effects of ProD and D on the phase state of cholesteric matrices allowed us to propose and realize a method of UV visualization based on the smectic A→cholesteric photoinduced phase transition. As the sensor process used is a biologically relevant UV-induced process, in biodosimeters developed under the present approach there will be no need to account for the actual spectral composition of UV radiation – the sensor material is a filter in itself, and the measured response will be a direct reflection of the biological activity of the monitored UV radiation.

1. G.S.Chilaya, L.N.Lisetski, *Mol.Cryst.Liq.Cryst.*, **140**, 243 (1986).

2. I.P.Terenetskaya, I.A.Gvozдовsky, *Mol.Cryst.Liq.Cryst.*, **365**, 551 (2001).

ZnO-s HEATHED SiO_x NANOWIRES

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Since the discovery of carbon nanotubes, much technological and scientific excitement has been raised by the discovery of various forms of nanostructures. Recently, coaxial nanocable-like one-dimensional (1D) structures comprising different kinds of materials have been successfully synthesized not only for making nanometer scale electronic devices with a variety of functions, but also for the protection of 1D structures from contamination. In this paper, for the first time, we have performed the coating of ZnO on SiO_x 1D nanostructures. We have used the atomic layer deposition method, with the feasibility of surface-controlled process. The structural properties of the product were characterized by X-ray diffraction, field emission scanning electron microscopy, transmission electron microscopy, and energy dispersive X-ray spectroscopy. Photoluminescence measurement was conducted at room temperature with the 325 nm line from a He-Cd laser.

UNDIRECTIONAL GROWTH OF 3-METHOXY 4-HYDROXY BENZALDEHYDE (MHBA) SINGLE CRYSTALS AT ROOM TEMPERATURE FOR SHG APPLICATIONS

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Reported large nonlinear optical coefficients such as $d_{22}=23.8d_{36}^{\text{KDP}}$, $d_{21}=13.5d_{36}^{\text{KDP}}$, $d_{23}=29.1d_{36}^{\text{KDP}}$, $d_{25}=12.8d_{36}^{\text{KDP}}$ of 3-methoxy 4-hydroxy benzaldehyde (MHBA) attract much research on its bulk crystal growth for device application. Further, the growth toward a phase-matched direction is very attractive for SHG application since no need of cutting and polishing. To fulfill this need, a novel unidirectional crystal growth method was utilized in order to grow MHBA single crystal at a given direction. The suitability of the employed method for NLO applications was already demonstrated by the growth of <110> benzophenone ingot having diameter of 60mm. In the present work, the unidirectional growth details of MHBA single crystal at room temperature and its characterization will be presented in detail.

THE PVA-PAA_N POLYMER COMPLEX AS THE OPTICAL SENSOR FOR WATER-SOLUBLE MOLECULES DETECTION

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The processes of the sorbtion of some soluble compounds from water solutions by polymer complex poly(vinylalcohol) with poly(acrylamide) grafted copolymers (PVA-PAA_N) were studied using spectrophotometry and steady-state fluorescence methods. It was showed the molecules of average benzene ring (for example, phenole) were effectively sorbed from water by the PVA-PAA_N films. Simultaneously, the processes of polymer films dissolving in water took place. The thermal annealing (with the help of special methods) PVA-PAA_N film gives a possibility to obtain non-dissolving polymer films which possess high sorbtion ability. Such films are proposed to be used as the sensors with optical response. The analytical model of the absorbtion process based on diffusive character of penetration of phenole molecules in PVA-PAA_N polymer film with the following spontaneous capturing by selftuning traps was proposed. The analytical results can be easy compare with experimental data obtained by spactrophotometry method. The comparison of theory and experiment gives the average value of resulting diffusion lenght of phenole molecule during «free» life-time $\langle l \rangle \sim 10^{-6}$ cm.

THE FIRST-PRINCIPLES STUDY OF OPTICAL PROPERTIES OF BGO AND BSO SCINTILLATORS

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The bismuth ortho-germanate $\text{Bi}_4\text{Ge}_3\text{O}_{12}$ (BGO) and bismuth ortho-silicate $\text{Bi}_4\text{Si}_3\text{O}_{12}$ (BSO) are technologically important materials owing to their remarkable characteristics such as fast luminescent decay constant, large light output and radiation hardness. Both are used as high-efficient scintillators in gamma ray spectroscopy and high energy physics, and widely applied in non-linear optical devices and nuclear medicine (x-ray and positron computer tomography).

The BGO and BSO crystallize in the same cubic structure, known as eulytite. Although they resemble in many aspects, the compounds exhibit differences in some of the key scintillation properties: BSO has faster response but smaller light output than BGO, for example. Thus the BSO is preferably used for some applications and BGO for others, imposing a question about the microscopic origin of their differences, which are closely connected with their electronic structures and optical properties.

The theoretical studies of BGO and BSO, however, face difficulties due to complexity of their crystal structure (38 atoms in primitive unit cell, absence of the inversion symmetry). This is the main reason why no theoretical calculations considering a full crystal structure has been reported so far.

In this work we present such calculations for the first time. It is the first-principles study of pure BGO and BSO crystals, performed by state-of-the-art, density-functional theory based, full potential linear augmented plane wave (FP-LAPW) method, as embodied in WIEN2k computer code. The electronic structures of both compounds were carefully calculated, analyzed and compared. Starting from these self-consistent results, we calculated the optical matrix elements for interband electronic transitions, and determined complex dielectric tensors for BGO and BSO. Then we calculated their optical constants, such as refractive index, extinction and absorption coefficients and reflectivity, as a function of the incident radiation energy. The results are compared with the available experimental data concerning the optical absorption spectra of the pure BGO and BSO. The origin of the spectral peaks is interpreted in terms of the calculated electronic structure, and differences between the optical properties of the BGO and BSO are discussed. Except explaining the basic electronic and optical properties of pure BGO and BSO, the present study provides a good starting point for a treatment of the optical effects of various impurities in these scintillators, planned for a close future.

ELECTRICAL AND OPTICAL PROPERTIES OF Ga-DOPED ZnO THIN FILMS DEPOSITED BY SPUTTERING WITH A ZnO BUFFER LAYER ON POLYMER SUBSTRATES

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Highly transparent conducting Ga-doped ZnO (GZO) thin films with good adherence and low resistivity have been prepared by r.f. magnetron sputtering with a thin ZnO buffer layer on polymer substrates. Dependences of the electrical resistivity and transmittance of the GZO films on the thickness of the ZnO buffer layer and the O₂/Ar gas flow ratio were investigated. By introducing a thin ZnO buffer layer, the overall sheet resistance of GZO films was remarkably reduced.

GROWTH AND CHARACTERIZATION OF DOPED Ga₂O₃ NANOSTRUCTURES

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One of the most exciting areas in materials science is the study of nanomaterials, due to their novel physical properties stemming from the reduced dimensions. Since monoclinic gallium oxide (β -Ga₂O₃) is chemically and thermally stable with a band gap of 4.8 eV, the β -Ga₂O₃ with low-dimensional nanostructure will likely provide an attractive promise for its practical application as well as for fabricating nanodevices with novel properties. Particularly, Ga₂O₃ has gained much attention as a new phosphor material for emissive display applications. In this study, we have fabricated the Ga₂O₃ nanostructures activated with metal elements, by means of the thermal evaporation technique. We have used a mixture of GaN and metal powders as a source material. We have investigated the structural and optical properties of doped nanostructures. We have discussed the role of dopants in changing the photoluminescence properties.

ELECTRONIC AND OPTICAL PROPERTIES OF SPODUMENE GEMSTONE: A THEORETICAL STUDY

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The spodumene is a natural silicate with formula $\text{LiAlSi}_2\text{O}_6$. It appears in large, nearly perfect crystals in many parts of the world. Its crystal structure belongs to a monoclinic system with the space group $C2/c$ (pyroxene family). The transparent varieties of beautiful coloration are considered as semi-precious gemstones: the colorless or yellow (triphane), the pink (kunzite), and the green (hiddenite). The color is due to light absorption by various impurities, mostly Mn, Fe and Cr. The process of irradiation causes changes in color, turning the spodumene an interesting material for a jewel industry. Besides, some of the spodumene varieties exhibit the striking luminescence, being used as efficient scintillators. All these properties make the spodumene an interesting optical material for various applications. But, although it has been subject of many experimental studies so far, it is still lacking a theoretical knowledge about its basic electronic and optical properties.

Here we present a theoretical study of these properties for the pure spodumene crystal, as a first and necessary step towards the future investigation of the impurity effects in the material. As a tool we used a state-of-the-art, full potential linear augmented plane wave (FP-LAPW) method, one of the most elaborate first-principles methods for electronic structure calculations, based on density-functional theory. We thoroughly analyzed the obtained electronic structure for the spodumene, identifying the characters of the most important bands around the fundamental band gap. On this basis we investigated the dipole matrix elements of the allowed interband electronic transitions, and calculated a complex dielectric tensor of the spodumene. We also calculated the optical constants which characterize a propagation of an electromagnetic wave through material: refractive index, extinction coefficient, optical conductivity and reflectivity, all as functions of the incident radiation wavelength. We discuss these results, compare with the available optical absorption experimental data, and interpret the origin of the spectral peaks on the basis of the calculated spodumene electronic structure.

OPTICAL PROPERTIES OF CHOLESTRIC LIQUID CRYSTALS AND THEIR MIXTURES

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Measurements of refractive indices (n_e , n_o) and birefringence (Δn) have been made in solid, cholesteric and isotropic phases of cholesteryl propionate, cholesteryl benzoate and their three homogeneous mixtures of concentration 0.25, 0.50 and 0.75 at varying temperature in the range of 80^oC to 185^oC. optical transmittance technique is used for the measurement of transition temperatures of all mixtures and all results clearly indicates that various transitions are of the first order. For accurate measurement of Δn , a modified wedge method was used. Using n_e and n_o , principal polarizability (α_e , α_o), internal field factor (γ_e , γ_o) and order parameter (S) have been evaluated, and their temperature dependence is discussed. The order parameter has been determined using the isotropic internal field model (Vuks approach) and the anisotropic internal field model (Neugebauer's approach), and both values agree up to average deviation of 0.7 %.

Keywords: Liquid crystal mixtures, birefringence, cholesteryl propionate, cholesteryl benzoate.

PRODUCTION AND RESEARCH OF OPTICAL PROPERTIES OF HETERONANOPARTICLES LIKE “CORE – SHELL” ON THE BASIS OF SILICIUM DIOXIDE

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Works on building new materials on a basis nanoparticles such as “core – shell”, capable selectively now are actively carried on to immerse light in visible or infrared range of a spectrum, which optical properties can be changed over a wide range. The compositions can find such nanostructures application at making materials for detection of IR-radiation, photoelectric devices, making of biological and chemical sensor controls [1, 2].

The object of the given work is to study the conditions of forming heteronanoparticles on the basis of siliceous dioxide in the shell made of metal gold with different ratio of core diameters and the shell, and the research of their optical absorption spectrum. Monodisperse spherical forms of SiO₂ nanoparticle with the sphere diameter ranging from 40 to 500 nm have been obtained. The dispersion of nanoparticles diameter values does not exceed 10 %. Heteronanoparticles on the basis of monodisperse spherical forms of nanoparticles SiO₂ with a wide dielectric cores dimensions (average diameter 40, 120, 350 and 500 nm) and different thickness of a conductive metal shell (separate metal clusters, 3, 5, 7, 10 nm) have been produced.

Optical absorption spectrums of produced heteronanoparticles have been investigated. The dimensional effects have been revealed in absorption spectra of the heteronanoparticles SiO₂/Au. It has been ascertained that the maximum position in absorption spectrums (plasmonic resonance) is determined by the ratio of thickness of internal dielectric (nanoparticle SiO₂) and external conductive (Au) shells. The increase of ratio value of the core diameter/thickness of shell in a heteronanoparticle SiO₂/Au leads to the displacement of the pick maximum of a plasmonic resonance in the infra-red area. When increasing the thickness of a metal shell, maximum in absorption spectrums displaces into the short-wave area in comparison with the pattern spectrum with the less thickness of the metal shell. Thus, varying the dimension of the dielectric core and thickness of heteronanoparticle metal layer like “core – shell” it possible to produce heteronanostructures with the given location of the absorption maximum in the wide spectrum range.

[1]. N.J. Halas , Optics and Photonics News., 26 (2002).

[2]. S. L. Westcott, S. J.Oldenburger, T. R.Lee, Langmuir, 14, 5396 (1998).

THE ANOMALOUS TEMPERATURE AND ELECTRIC FIELD DEPENDENCE OF BIREFRINGENCE IN PZNT SINGLE CRYSTALS

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Recently relaxor ferroelectric materials $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})_{1-x}\text{Ti}_x\text{O}_3\text{-PbO}_3$ (PZNT) have attracted great interest because of extremely large piezoelectric, electro-optic and photorefractive effects. This material is a good candidate for stress sensors, electro- and acousto-optic modulators. The outstanding properties of the relaxor-based piezocrystals are closely related to the morphotropic phase boundary (MPB) which separates the rhombohedral and tetragonal phases. Here we report a detailed investigation of birefringence in PZNT single crystals in the temperature range from 20C to 220C and electric field up to 1kV/mm. PZNT single crystals with x from 0.02 to 0.15 were grown by the flux solution method. Structures of the crystals, their dielectric constants and piezoelectric measurements also will be presented. The samples was poled along the [001] direction with an applied field of 1kV during cooling from 200C to room temperature for 2 h. The domain structure were observed using the (001) plates under a polarization microscope. The birefringence and linear electro-optic coefficients of poled single crystals (size $2\times 3\times 3$ mm, along pseudo-cubic axes) were characterized using PCSA ellipsometer with the quarter-wave compensator (wavelength 632.8 nm). The development of an automated PCSA ellipsometer with magneto-optical modulators is also described. Refractive indices were mesuered by the same ellipsometer on reflection. Phase diagram has been constructed around the morphotropic phase boundary from measurements of phase shift and orientation information of birefringence. The phase boundaries between cubic, rhombohedral and tetragonal phases were observed in close agreement with phase diagrams suggested by published dielectric and diffraction experiments. A small, but the distinct temperature hysteresis of the birefringence was related to the nucleation and growth of one phase into another phase. The linear electro-optic coefficients of single crystals over a broad composition range were investigated. The large values of (r_{33} - r_{13}) and r_{51} near the MPB were observed and the crystal orientation effects of the coefficients were also analyzed.

TWO-MODE MODULATION OF INFRARED LIGHT BY SMALL PARTICLES-LIQUID CRYSTAL COMPOSITE

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It is known that optical properties of small particles depend on physical parameters of surrounding medium. On the other hand, if it takes a liquid crystal (LC) as a medium then his optical parameters are easily changed by electric field.

In this report the possibility using the Al_2O_3 small particles-nematic liquid crystal MBBA (4 – methoxybenzylidene - 4' - butylaniline) composite is studied for modulation of infrared light.

The fraction Al_2O_3 with sizes of 2-5 μm dispersed in LC and homogenized in isotropic phase for up to three weeks. The cell consisting of two parallel transparent plates made of AgCl with the conductive SnO_2 coat and LC in-between. The initial configuration of MBBA is homeotropic. The director of the MBBA molecules is changed by electric field of 3.6 V. Experiments are carried out at 25° C.

There is only the narrow band with a maximum at 3810 cm^{-1} (2.60 μm) is observed in transmission spectra of composite without electric field. At application of electric field the maximum of transmission shifts to the frequency of 1680 cm^{-1} (5.95 μm). Maximal magnitude of transmission and the band half-width depend on the concentration of Al_2O_3 in MBBA and the cell thickness.

Experimental results are explained by Christiansen' s effect in the composite at a change of the LC refractive index along the light beam. On the base of obtained results the first experimental modulator for infrared light is constructed. A use of other components of the composite for another pairs of transmission frequencies is discussed.

QUANTUM-CUTTING MECHANISM IN BLUE AND GREEN EMITTING RARE-EARTH DOPED MATERIALS

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Because the energy of VUV photons is more than twice the one of visible photons, quantum cutting appears to be a promising process in rare-earth doped materials in order to obtain efficient phosphors for mercury free lighting devices as well as for plasma display panels.

Some years ago, such a process has been observed in the case of red emitting phosphors [1]. We have focused our attention on blue and green emitting rare earth doped materials. In order to get very efficient materials, it is not only necessary to get the highest possible quantum efficiency, but also to use materials characterized by a strong absorption in the vacuum ultra violet (VUV) energy range. Fluoride matrices doped with trivalent Dy/Tb couples of ions are selected as green emitters and fluoride or phosphate matrices doped with Tm³⁺ ions as blue emitters. The nature of matrices is selected because of, on one hand, their wide band gap corresponding to a high transparency in VUV range and on the other hand, their low energy of phonons which avoids or at least reduces non radiative relaxations. We have calculated the position of the 5d bands of Tb³⁺, Dy³⁺ and Tm³⁺ respectively in several matrices and we have selected those which should lead to the more efficient quantum cutting process. Their energetic position depends on the crystal field undergone by the rare earth ions and can be localized in order to induce efficient cross relaxation processes towards f levels, leading to quantum efficiencies higher than one. These d bands are responsible of parity allowed transitions inducing very strong absorptions, what is favourable for high fluorescence efficiencies.

Samples are synthesized by solid-state reaction at high temperature and sol-gel technique. The purity of obtained compounds is checked by X-rays diffraction and EDX-MEB analysis. VUV spectra of emission, excitation and diffused reflection are presented, and energy transfers between the dopant ions are studied by analysing VUV emission lifetimes of spin-forbidden d-f transitions.

1. R.T. Wegh, H. Donker, K.D. Oskam and A. Meijerink *J. Lum*, 82(2), (1999), 93-104

RELATIONSHIP BETWEEN STRUCTURE AND PROPERTIES IN RARE-EARTH-DOPED HAFNIUM AND SILICON OXIDES: MODELING AND SPECTROSCOPIC MEASUREMENTS

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The SiO₂-HfO₂ binary system is recognized as a useful candidate for Erbium-doped waveguides amplifiers fabrication. Recently, it was demonstrated that Er³⁺-activated 70SiO₂-30HfO₂ planar waveguides with valuable optical and structural properties can be prepared by sol-gel technique with dip-coating processing[1-3]. The important role played by Hafnium in the silica network was evidenced by the particular spectroscopic properties presented by Er³⁺-ions in the silica-hafnia planar waveguides [1-4]. In this work we present preliminary results on HfO₂-SiO₂ massive xerogels doped with Eu³⁺ ions, with the aim to go inside the role of Hafnium on the rare earth ions local environment. Spectroscopic measurements of the Eu³⁺ photoluminescence emission are given. Numerical simulations by the Molecular Dynamics method have been performed showing clearly a phase separation and crystallization for the HfO₂ richer samples. Moreover it is found than the rare earth doping ions stay preferentially in hafnium rich domains, thus explaining why the rare earth spectroscopic properties are strongly modified [1-4].

[1] R.R. Gonçalves, G. Carturan, L. Zampedri, M. Ferrari, M. Montagna, A. Chiasera, G.C. Righini, S. Pelli, S.J.L. Ribeiro, and Y. Messaddeq, "Sol-gel Er-doped SiO₂-HfO₂ planar waveguides: a viable system for 1.5 μm application", *Appl. Phys. Lett.* **81** (2002) pp. 28-30.

[2] R.R. Gonçalves, G. Carturan, L. Zampedri, M. Ferrari, M. Montagna, G.C. Righini, S. Pelli, S.J.L. Ribeiro, Y. Messaddeq, "Erbium-activated HfO₂-based waveguides for photonics", *Opt. Mater.* **25** (2004) pp. 131-139.

[3] L. Zampedri, G.C. Righini, H. Portales, S. Pelli, G. Nunzi Conti, M. Montagna, M. Mattarelli, R.R. Gonçalves, M. Ferrari, A. Chiasera, C. Armellini, "Sol-Gel-Derived Er-activated SiO₂-HfO₂ Planar Waveguides for 1.5 μm application.", *J. Non-Cryst. Solids* **345&346** (2004) pp. 580-584.

[4] N.D. Afify, R. Grisenti, G. Dalba, C. Armellini, M. Ferrari, S. Larcheri, F. Rocca, and A. Kuzmin, "Short-range order around Er³⁺ in silica waveguides containing Aluminium, Titanium and Hafnium", *Opt. Mater.* **28** (2006) pp. 864-867.

MICROLENS FABRICATION ON TOTHEMA SENSITIZED GELATIN

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Gelatin is very versatile material. It is used in many industrial, technological and scientific areas, as well as in everyday life. In optics, it is mainly used in holography - doped with chromium ions and organic dyes, gelatin represents almost ideal high resolution photosensitive material. Additionally, it can be used as material for production of microoptical components. In a search for high resolution, cheap and nonpoisonous photosensitive material, we found that gelatin can be doped with tothema and eosin, with excellent results. Tothema is a trade mark name of drinkable solution used in medicine for curing deficit of iron in human organism. According to manufacturer (Laboratoire Innotech International, France), one 10 ml ampoule contains 50 mg of iron gluconate, 1.33 mg of manganese gluconate, 0.7 mg of copper gluconate and 20 mg of sodium benzoate. Eosin is an organic dye with absorption maximum in a green part of the spectrum (it has medical uses too). Photosensitive material was prepared by dissolving gelatin in water and adding small amounts of tothema and eosin. Liquid was poured on a leveled glass plates and left to gel and dry overnight. Layers were 100 microns thick, with absorption maximum around 500 nm. If irradiated with unfocused second harmonic Nd YAG laser light (532 nm wavelength, power between 60 and 120 mW), concave microlenses were readily produced (in approximately 10-20 s). Depending on exposure time, lens depth can be 80 μm at maximum, while aperture is 800 to 1000 μm . With proper focusing, we could significantly reduce lens aperture. Lens formation can be observed in real-time by detecting diffraction picture. It represents a series of, high contrast, circular fringes, rapidly growing through the lens formation process. By analyzing diffraction picture, using Hankel transform, we found that the lens profile is gaussian. In order to test the reproducibility of the process, we produced lens array ($6 \times 6 = 36$ lenslets), with almost no variation of the lens profile across the array. Imaging properties of lenslets, were analyzed by ray tracing.

BUFFER-GAS INFLUENCE ON MULTIPHOTON ABSORPTION IN DIFFERENT GAS MIXTURES: LOW PRESSURE STUDIES

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Buffer - gas influence on multiphoton absorption and dissociation in different mixtures was investigated using the special photoacoustic gas cell design adopted for low pressure studies, and simple method based on the empirical and theoretical vibrational energy distribution together with generalized coupled two – level model. Energy transfer efficiency was analyzed within the frame of pulsed photoacoustic spectroscopy technique. Buffer – gas pressure effects are induced to enhance absorption and relaxation characteristics of irradiated absorbing molecules (SF_6 and C_2H_4). Functional behavior of mean number of absorbed photons per one molecule $\langle n \rangle_{\text{total}}$ as a function of buffer – gas pressure ($p_{\text{buff.}}$) is presented in order to confirm or predict some physical and chemical processes which can occur during the strong laser field – molecule interaction. Limitation of proposed model was analyzed depending both on gas pressure and laser fluence influence.

OPTICAL PROPERTIES OF $\text{Ge}_x\text{Sb}_{20-x}\text{Te}_{80}$ THIN FILMS AND THEIR CHANGES BY LIGHT ILLUMINATION

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Development of information technology demands new optical recording materials and good knowledge of their optical properties. Among such materials are the ternary compounds of Ge-Sb-Te chalcogenide glasses. They possess controllable phase transformation from amorphous to crystal state, which makes them suitable for optical data storage. Amorphous thin films with stoichiometric composition lying on the GeTe-Sb₂Te₃ pseudobinary line of the Ge-Sb-Te system, have found application as media in optical recording devices. Films with non-stoichiometric Ge-Sb-Te compositions are also of practical interest, and their optical and structural properties have recently become subject of intensive studies. Recently, we also started to investigate chalcogenide films with $\sim 1 \mu\text{m}$ thickness and non-stoichiometric $\text{Ge}_x\text{Sb}_{20-x}\text{Te}_{80}$ ($x=15, 17, 19$) composition. Here we present results on the study of the influence of illumination on the optical properties of these films. A one-hour illumination of the films was performed with a 500 W HBO mercury lamp and the changes in the optical parameters are traced by spectroscopic ellipsometry (SE) measurements. It has been established that illumination of the films leads to a decrease of the refractive index, n , in the whole spectral region studied and to an increase of the extinction coefficient, k , in the range of 600-800 nm. For as-deposited films, the optical bandgap energy E_g values are below 1 eV. Illumination results in a sharp decrease of the E_g values indicating structural change in the films. This change is unstable and shows a slow recovery of the film structure with time. This is expressed in the increasing value of the optical parameters n and E_g toward their initial value but they remain lower even after 144 h stay of the films at atmospheric conditions. The structural change is the strongest in films with $\text{Ge}_{17}\text{Sb}_3\text{Te}_{80}$ composition.

CHARACTERIZATION OF Ho³⁺ PAIRS IN LiYF₄ AND LiLuF₄ BY HIGH-RESOLUTION SPECTROSCOPY

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The scheelite crystals LiR_{1-x}Ho_xF₄ (R=Y,Lu) are used as concentrated multi-frequency laser materials. They are studied also as model magnetic systems exhibiting interesting low-temperature magnetic properties. Information on the ion-ion interaction mechanisms and on the crystal-field perturbations in these mixed systems is of a primary importance for both mentioned research fields. In this study, we extract such information from the analysis of optical and sub-millimeter EPR spectra of Ho³⁺ pairs. High resolution (up to 0.007 cm⁻¹) polarized spectra of LiY_{1-x}Ho_xF₄ (x=0.001, 0.01, and 0.2) and LiLu_{1-x}Ho_xF₄ (x=0.001, 0.01) crystals at low temperatures (5-30 K) were registered in the region of ⁵I₈→⁵I₇, ⁵I₆ optical transitions of Ho³⁺. EPR spectra corresponding to transitions between the ground electronic doublet and the first excited singlet were taken at 4.2 K in the frequency range 140-285 GHz. The spectra demonstrated well-resolved hyperfine structure. Weak satellites shifted up to 0.5 cm⁻¹ from the main lines were observed and assigned to the Ho³⁺ pairs on the basis of the concentration dependence of their intensities and estimations of the line shifts due to magnetic dipole-dipole interaction. To compare, the Nd³⁺-Nd³⁺ satellites in LiYF₄ are shifted to several wave numbers from the main line [1]. Rare earth ions substitute for Y³⁺ and Lu³⁺. A comparison of satellite shifts in LiYF₄ and LiLuF₄ (where the mismatch between the ionic radii of the host cation and the Ho³⁺ ion is much larger) presented direct evidence for local lattice distortions induced by Ho³⁺ ions. The spectra were modeled taking into account changes of crystal field in pairs relative to the single ion centers and magnetic ion-ion interactions. Satisfactory agreement with experiment has been achieved.

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1. O. Guillot-Noel, V. Mehta, B. Viana, D. Gourier, M. Boukhris, and S. Jandl, Phys. Rev. B, 61 (2000) 15338

THE EFFECT OF ANHARMONISITY ON MULTIPHONON RELAXATION OF EXCITED RARE-EARTH IONS IN IONIC CRYSTALS

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Multiphonon relaxation processes of Rare Earth (RE) excited states have been studied since the early 70's and several models were established. The Electron-Vibration Coupling (EVC) is assumed to be linear with respect to the relative ligand Rare-Earth (RE) displacements (linear EVC) then the following two major mechanisms lead to MultiPhonon Relaxation (MPR) of the RE excited states:

1)The conventional (linear) mechanism of multiphonon relaxation based on difference in the equilibrium positions of the normal lattice coordinates in initial (α) and terminal (α') electronic states. In this frame, the lattice vibrations are taken to be harmonic. Because of super weak EVC for trivalent RE ions this mechanism less effective than nonlinear mechanism of MPR.

2)The second mechanism takes into account the higher-order lattice anharmonicity of the ionic motions but neglects the changes in a lattice occurring due to the $\alpha \rightarrow \alpha'$ transition. The theory of MPR processes in ionic matrices based on this mechanism has been developed in Ref [1]. The equation was obtained, which connects the probability of the multiphonon transitions with the infrared (IR) multiphonon spectrum of the matrices.

Here we present the first numerical estimations of the MPR rates of RE excited states in fluorite type crystals (CaF_2 , SrF_2 , and BaF_2) in the framework of the theory based on the abovementioned second mechanism. These crystals were chosen due to several criteria: their IR multiphonon absorption coefficients are known, we carefully measured the multiphonon relaxation rates of RE excited states in these crystals, and the MPR rates of RE excited states in these crystals have been calculated in the framework of the theory based on nonlinear mechanism of MPR. Three types of linear EVC (dipole-dipole, even multipole-dipole, and linear "exchange" EVC) were taken into account in the calculations. These calculations have revealed that the joint action of the linear EVC and the higher-order lattice anharmonicity can give a contribution to the multiphonon relaxation rates comparable to that given by the nonlinear mechanism. In all crystals the main contribution will be given by even multipole-dipole and linear "exchange" EVC, irrespective of the magnitude of the IR multiphonon absorption coefficients.

[1] K.K. Pukhov, F. Pellé, and J. Heber, *Molecular Physics*, **101**, 1001, 2003.

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PULSED PHOTOACOUSTIC GAS CELL DESIGN FOR LOW PRESSURE STUDIES

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The photoacoustic spectroscopy is based on the sensitive detection of acoustic waves launched by the absorption of pulsed or modulated laser radiation via the transient localized heating and expansion in an investigated gas sample. This effect is caused by the transformation of at least part of the excitation energy into kinetic (translational) energy by energy exchange processes. The designing of the photoacoustic cell is really critical to get a very good signal to noise ratio. All theoretical and experimental studies predict that for a constant light absorption, the amplitude of the photoacoustic signal reaching the microphone depends on the size of the cell and in general increases as cell dimensions are reduced. For constant laser energy and beam – cell geometry, amplitude of photoacoustic signal also depends on sample pressure. Such effect is obvious in the 1 – 100 mbar region, where collisionally induced processes are dominant. Functional amplitude vs. pressure behavior is not a simple one, and must be established for any type of gas samples. Here we would like to stress our attention on low gas pressure region (less than 100 mbar), where some collisionally induced relaxation processes can be monitored analyzing photoacoustic signal shape and amplitude behavior as a pressure dependent quantities.

POSSIBILITIES FOR TUNING ELECTRONIC AND OPTICAL PROPERTIES OF OLIGOPHENYLENES BY SELECTED CHEMICAL INFLUENCES

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Using molecular mechanics, semi-empirical quantum mechanic, and ab-initio Hartree-Fock (HF) calculations, we investigated changes induced by doping, addition of side-chains and hetero-oligomers formation on P2P to P6P oligophenylenes electronic and optical properties. The results are compared to existing experimental data and to results of similar calculations, and the possible implications for the oligophenylenes-based materials applications have been discussed.

SPIN-DEPENDENT ELECTRON TRANSPORT IN NONMAGNETIC SEMICONDUCTOR NANOSTRUCTURES

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In this paper we investigate the effects of spin-orbit coupling mechanisms on electronic transport in multilayer semiconductor structures and explore their prospective applications to spin-manipulation devices. A model is presented for estimating the influence of combined Rashba spin-orbit interactions (induced by the structural asymmetry) and Dresselhaus spin-orbit coupling (caused by the bulk inversion asymmetry) on the spin-polarization status of the tunneling electrons. The proposed structures are expected to enable spin separation without exploiting the magnetic properties of constituent materials, and should therefore be realizable by conventional nonmagnetic semiconductors only. The degree of spin-polarization may eventually be enhanced by careful tailoring of the structural parameters.

DIFFERENCES BETWEEN OPTICAL CHARACTERISTICS OF MONO- AND BI-MOLECULAR ULTRATHIN FILMS

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We have investigated optical properties of molecular crystals in space-bound conditions, i.e. those characteristics of ultra thin crystalline films. The Frenkel's excitons define micro (nano) scopic behavior of the system. Bi-molecular is the term for the cubic crystalline system with complex cell, compound of two different sublattices. Dispersion laws of excitons in perturbed mono- or bi-molecular films are found using the method of Green's functions. Space boundaries and disturbing of energetic parameters on boundaries are considered as perturbations. The sharp and discrete energy levels are obtained, which is expectable as well as narrowing of energy-zones as a consequence of adequate treatment of dimensional quantization, or changing characteristics of molecules itself. Optical behavior of these systems was investigated through the calculations of dielectric permittivity, which is one of the macroscopic value, but demonstrating noticeable quantum effects. In these ultra thin systems we obtained selective absorptions. Energy range of absorption is very narrow, almost discrete, which is very different from bulk. Also, we have investigated the difference of absorption selections, zone width and shifting effects between observed mono- and bi-molecular ultra thin crystalline films.

SPATIOTEMPORAL INSTABILITIES OF COUNTERPROPAGATING BEAMS IN NEMATIC LIQUID CRYSTALS

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We investigate behavior of counterpropagating self-trapped beam structures in nematic liquid crystal. A time-dependent model for the beam propagation and the director reorientation in nematic liquid crystal is numerically treated in (2+1)D. We display the formation of stable solitons in a narrow threshold region of control parameters. Spatiotemporal instabilities are observed as the input intensity, propagation distance and the birefringence are increased. We demonstrate the splitup transition, breathing, filamentation of solitons, and other dynamical effects.

EFFECT OF Si NANOPARTICLES EMBEDDED IN SiO_x FILMS ON THEIR OPTICAL PROPERTIES STUDIED BY SPECTROSCOPIC ELLIPSOMETRY AND PHOTOLUMINESCENCE SPECTROSCOPY

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In the recent years great interest has been paid in the synthesis and properties of Si nanocrystals embedded in SiO_x matrix due to their intensive visible-light emission at room temperature. Photoluminescence (PL) observed in such structures is strongly dependent on the size and density of nanocrystalline Si (nc-Si) inclusions, which in their turn are dependent on the post-deposition annealing conditions. At thermal annealing of silicon oxides the prime attention has been paid to the observation and characterization of the Si inclusions. Spectral ellipsometry (SE), a powerful nondestructive tool for detection of thermally stimulated changes in the oxide structure and composition, gives important additional information about the formation of nano-sized Si inclusions. In this paper results on the study of the effect of Si nanoparticles embedded in evaporated SiO_x films on the optical properties are presented. The Si inclusions were formed in the oxide matrix by thermal annealing in argon atmosphere at 700 and 1000 °C. Information about the optical constants and film composition was obtained by spectroscopic ellipsometry (SE), as for data analysis Bruggeman effective-medium theory was applied. The photoluminescence properties of the SiO_x films in dependence of annealing conditions were considered. It has been shown that annealing at 700 °C leads to coagulation of Si atoms into amorphous clusters, while at 1000 °C the Si clusters start to crystallize and form nano-sized crystallites. All the films possess photoluminescence properties. The PL emission from the films annealed at 700 °C is blue-shifted and 5-10 times more intense in comparison with the films annealed at 1000 °C. This behavior is correlated with the films structures - amorphous Si nanoclusters yields higher PL intensity than Si nanoclusters crystallized at 1000 °C. The photoluminescence can be interpreted in terms of the electron-hole pair recombination in amorphous Si nano-inclusions and at the nc-Si/SiO₂ interface.

DEVELOPMENT OF A SIMPLE CATHODOLUMINESCENCE APPARATUS USING A CARBON FIELD EMITTER

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We have developed a new and simple apparatus to investigate cathodoluminescence (CL) of various phosphors. The salient feature is using a carbon film with high field emission efficiency as an electron field emitter. If the luminescence from very narrow region isn't needed, the established CL system which is coupled with scanning electron microscope (SEM) is no longer indispensable. This apparatus will provide enough information about CL properties of samples. For checking this apparatus, CL spectra of the typical phosphor ZnS single crystal and the transparent p type semiconductor (LaO)CuS. This oxysulfide is known to have an exciton luminescence in the photoluminescence (PL) spectrum even at room temperature. First, ZnS shows a bright and broad luminescence band centered at 540 nm. The intensity increases with increasing the applied voltage between a cathode and an anode. The CL spectra of ZnS are in good agreement with the results reported by many researchers. In case of (LaO)CuS, the spectrum consists of two peaks; one is an emission band from excitons and the other is a broad band from deep donor-acceptor pair in the band gap. The exciton peak is located at 385 nm with relatively narrow half maximum full-width. The intensity of CL spectra from (LaO)CuS also increases with the applied voltage. The CL spectra from (LaO)CuS correspond well with our previous PL spectra. When comparing the luminescent intensity against both samples, the intensity of (LaO)CuS is about ten times smaller than that of ZnS.

We have succeeded in the development of the simple CL apparatus. We believe that this new measurement system can relieve us of very expensive and torturously complicated current apparatus which is widely used.

EXCITATION OF GUIDED WAVES IN MATERIALS WITH NEGATIVE REFRACTION

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We investigate, both analytically and numerically, electromagnetic beam transmission through layered structures that include materials with negative refraction. Excitation of leaky guided modes leads to the formation of anomalous lateral shifts in both reflected and transmitted beams with single or double peak structures. We demonstrate that zero reflection (i.e. high transparency) of the slab waveguide with negative refraction can be achieved, when high reflectivity is normally expected.

NEW LOW PHONON RE:MPb₂Hal₅ (M=K, Rb; Hal=Cl, Br) MATERIALS FOR MID-IR LASERS AND OPTICAL CONVERTERS

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The mid-IR solid state lasers operating in 3–10 μm spectral range are of great importance because of the overwhelming variety of fundamental and practical applications such as next generation of imaging devices, near-infrared quantum counting devices, remote sensing, molecular and solid state spectroscopy etc. At present optical parametric oscillator systems are typically used to cover this spectral range. These systems incorporate both nonlinear media and pump laser sources, leading to some complexity in the optical system. Another, simpler approach to solve these problems is direct mid-IR laser operation in solid-state media. In this case in order to achieve acceptable quantum efficiency from a given energy level it is necessary to avoid luminescence quenching via multiphonon relaxation on small energy gap. Thus, crystals with low maximal phonon energy are required.

Currently large attention attract the RE-doped low phonon energy halide hosts, which have extremely low non-radiative relaxation rates and have been demonstrated to be very advantageous for direct diode-pumped solid state lasers operating at 3 – 9 μm .

We report on physical and optical properties of new laser crystals based on RE³⁺-doped alkali-lead halide hosts MPb₂Hal₅ (M=K, Rb; Hal=Cl, Br), which are suitable for diode-pumped IR, VIS and UV lasers. Crystals were grown using the Bridgman technique, the most of them were grown for the first time. The estimations of multiphonon non-radiative relaxation rates, the optical spectra, Judd-Ofelt intensity parameters, calculated radiative transition probabilities, lifetimes and branching ratios are summarized. The results of the study of upconversion processes and host-RE impurity energy transfer are reported. The dynamics of RE energy levels population under different ways of excitation is investigated using room and low-temperature time-resolved spectroscopy under selective excitation into RE ions or into crystalline-host. The possibility of creation of population inversion on mid-IR luminescent transitions is considered. It is shown, that all excited levels of RE³⁺ ions separated by energy gap of $\Delta E > 1400 \text{ cm}^{-1}$ in chlorides and of $\Delta E > 1000 \text{ cm}^{-1}$ in bromides are radiative, including ⁴I_{9/2} (Er), ⁵I₅ (Ho), and ⁴F_{5/2} (Nd) levels, which are considerably quenched in oxides and fluorides. The distinctions in phonon spectra for MPb₂Br₅ and KPb₂Cl₅ hosts lead to differences in luminescent properties of RE³⁺:MPb₂Br₅ and RE³⁺:KPb₂Cl₅ crystals.

The combination of high intensity of luminescent transitions and long lifetime of rare-earth radiative levels together with efficient up-conversion processes permit us to conclude that the MPb₂Hal₅:RE³⁺ crystals may be considered as new luminescent materials promising for UV-VIS and mid-IR LD pumped lasers as well as for UV-VIS and mid-IR -VIS optical converters.

PHOTOPHYSICS OF ORGANOMETALLIC COMPOUNDS IN ORGANIC LIGHT EMITTING DIODES

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Display based on organic light emitting diode (OLED) is an application of electroluminescence (EL) generated from the emitting organic molecules. Phosphorescent molecules are more interested as the emitting materials than the fluorescent ones because the harvesting of triplets is expected to increase the EL quantum efficiency. Organometallic compounds with Ir³⁺ and Pt²⁺ are currently known as good phosphorescent OLED materials. Especially the Ir³⁺-compounds are promising because of high quantum efficiency and wide color tenability due to selection of ligand molecule. Of various Ir³⁺-compounds, the absorption, photoluminescence (PL), life time of PL, transient time-resolved PL and their temperature dependences have been studied experimentally in detail using solid thin films of tris(2-phenylpyridine) iridium [Ir(ppy)₃]. We have a success in explaining the optical properties of Ir(ppy)₃ quantitatively by the calculation which is taken into account that (1) the emitting triplet state T₁ consists of three zero-field splitting substates, (2) non-radiative relaxation occurs among these substates, (3) energy transfer between the Ir(ppy)₃ guest molecule and endothermic and exothermic host molecules, and (4) energy diffusion from the T₁ state of the excited host molecules into neighboring unexcited host molecules by tunneling and thermal activation processes. From this result, we can explain the mechanism of the EL in phosphorescent OLED devices, which is generated by the recombination of electrons and holes injected by the applied voltage. Discussion is given on the difference of electronic processes among various phosphorescent organometallic compounds.

[1] T. Tsuboi, N. Aljaroudi, *Phys. Rev. B* **72** (2005) 125109-1.

[2] T. Tsuboi, N. Aljaroudi, *Jpn. J. Appl. Phys.* **44** (2005) 591.

[3] N. Aljaroudi, T. Tsuboi, *Inter. J. Computational Sci. Eng.* (2006) in press.

PHOTOINDUCED SPIN-DISORDER IN $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ FILM

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Doped manganites with a perovskite structure have attracted much attention because of their colossal magnetoresistance (CMR) effect. In this system, the generic features of the magnetic and transport properties are well understood in the framework of the double-exchange mechanism, which includes the transfer of the e_g electrons (transfer integral t) and the strong Hund's rule coupling ($J \sim 3$ eV) between the local t_{2g} spins and the e_g electrons. Photo-excitation of the e_g electrons in the Mn3d state is expected to influence the spin system via the strong exchange coupling J . Liu *et al.* [1] found a photoinduced demagnetization a narrow bandwidth $\text{La}_{0.7}\text{Ca}_{0.3}\text{MnO}_3$ film in a ferromagnetic metallic (FM) phase at 5 K. In order to clarify the physics of the photoinduced demagnetization, we investigate the photoinduced effects on the transmission and resistivity of a wide bandwidth $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ film ($T_c = 350$ K) in the various excitation photon energies E_{exc} and temperatures by means of time-resolved pump-probe method.

Below 300 K ($<T_c \sim 350$ K), we have observed a negative transmission change ($\Delta T/T$) under photo-irradiation ($E_{\text{exc}} = 3.20$ eV) at $E_{\text{probe}} \sim 2.54$ eV. The $\Delta T/T$ signal at 2.54 eV is a monitor of the spin correlation $\langle S_i \cdot S_{i+1} \rangle$ because the absorption coefficient $\alpha(\omega)$ at 2.54 eV depends on the magnetization M as $1 - (M/M_s)^2$, where M_s is the saturation magnetization [2]. Thus, the negative $\Delta T/T$ signal indicates a photoinduced spin-disorder in the FM phase. With approaching to T_c , the $\Delta T/T$ -value signal significantly reduces. We further have found a positive resistivity change $\Delta R/R$ under photo-irradiation. The enhancement of R is expected because the effective transfer integral t [$= t_0 \cos(\theta/2)$, where t_0 and θ are the bare transfer integral and the relative angle between the neighboring t_{2g} -spins, respectively] is significantly reduced in the spin-disorder state. With increasing temperature beyond T_c , the $\Delta R/R$ signal almost disappears. Such a behavior is reasonable because the spin system is *a priori* disordered in the paramagnetic phase ($>T_c$). In addition, the photo-induced signal is observed even at room temperature ($<T_c \sim 350$ K) in a $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ film, which is indispensable to practical application such as photo-switching device.

[1] X. J. Liu, *et al.* Phys. Rev. B **63** (2001) 115105

[2] Y. Moritomo, *et al.* Phys. Rev. B **56** (1997) 5088.

THERMAL DIFFUSIVITY OF FILM/SUBSTRATE STRUCTURES CHARACTERIZED BY TRANSIENT THERMAL GRATING METHOD

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A transient thermal grating method is introduced to characterize the thermal diffusivity of absorbing films deposited on a transparent substrates in experiment and theory. In the experiment, the transient thermal grating is excited by a nanosecond Nd:YAG laser, in which the exciting laser beam is separated into two beams and then cross-superposed on the sample in different angles, then the optical interference stripes produce a thermal grating on the surface of the sample. The probing light is a He-Ne laser beam, which is incident on the thermal grating with a tilt angle, and then the probing beam is reflectively diffracted by the thermal grating. The diffraction signals are measured at different grating fringe spaces by a photomultiplier. According to transiently dielectric constant variations and thermoelastic deformations of the thin film caused by the thermal gratings, an optical diffraction theory based on the Kirchhoff's equation is presented. Then the thermal diffusivity of the film can be characterized by fitting the theoretical calculation of time-depended diffraction signals to the experimental measurement data with a least-squares algorithm. The validity of the method is proved by the application to an absorbing ZnO film with oxygen deficiencies deposited on a transparent glass substrate.

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A MULTI-POINT LASER PUMP METHOD USED TO CHARACTERIZE THERMAL PROPERTIES OF WEAK REFLECTION FILM/SUBSTRATE MATERIALS

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Photothermal detection techniques are versatile and sensitive methods for characterizing thermal properties of materials. In this study, a new multi-point pump method is presented, which is used to characterize the thermal properties of weak reflecting film/substrate structures. In the experimental setup, a Ar⁺ laser is used as a pump beam, which is modulated by an acousto-optic (A-O) modulator, and then coupled to an optical multimode fiber. A convex lens is used to focus the output light of the optical fiber on the surface of the sample. Owing to the effect of the multimode of the optical fiber, the output light from the optical fiber can be simply regarded as a multi-point light source. Then a two-dimensional (2-D) thermal grating on the surface of the bilayered sample is induced. A He-Ne laser is used as a probe beam, which is focused on the thermal grating with the incident angle about 80 degrees, and then reflectively diffracted laser beams are produced by the thermal gratings at the surface of the film and also in air neighboring the surface. A photodiode is used to detect the reflected 0-order (central) laser beam and the output AC signal is amplified and displayed by a lock-in amplifier. In the experiments, several diamond films with different thicknesses deposited on the Si substrates are used as the samples and the 0-order light intensities change with the modulation frequencies are measured by the photodiode. On the other hand, a new 2-D optical diffraction theory model based on the TTG method is presented and used to analyze the output signals of the photodiode, then the theoretical calculations of the diffraction signals can be obtained. Using a least-squares algorithm to fit the calculated results to the signals detected at different frequencies, the thermal diffusivities of the diamond films are obtained.

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PHOTOINDUCED RECONSTRUCTION OF ELECTRONIC STRUCTURE IN HALF-METAL CrO₂

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Photoinduced phenomena such as photoinduced phase transition (PIPT) currently attract considerable interest from the viewpoint of fundamental physics and technological application to new devices in which electronic, magnetic and optical properties are controlled by light. For example, the Fe-based spin crossover complex shows a photoinduced change of the spin state from a high-spin (HS) to low-spin (LS) states as well as that from LS to HS states. Accompanying the spin change, the electronic structure is found to change due to the strong cooperation between the spin and electron freedoms. [1]

CrO₂ is considered to be a candidate material to investigate photoinduced phenomena. CrO₂ is well known as a half metallic ferromagnet ($T_c = 390$ K) in which the itinerant electrons are totally polarized. Saturation moment is $\sim 2 \mu_B$ per a Cr site, indicating that the itinerant electrons are nearly spin polarized in the ferromagnetic state. Recently, Yoshii *et al.* [2] observed a significant change of absorption spectra in CrO₂ film after photo-excitation at pump energy at 3.2 eV, which corresponds to the electron transfer from O2p state to Cr3d e_g level. They have ascribed the photoinduced change of the absorption spectra to the photoinduced spin-disorder via the strong correlation between the itinerant e_g electrons and local t_{2g} spins. However, there is little theoretical work to be taken out to clarify the photoinduced change of the electronic structure in the half-metallic compounds.

In present work, we have compared the electronic structure for CrO₂ between the ground state and the photo-excited state by using the local-spin-density approximation plus U (LSDA+ U) method. In the photo-excited state, it is considered that one electron is photo-excited from O2p state to the itinerant Cr3d spin down state, i.e., O2p⁵ and Cr3d³ states. We have found significant changes on the electronic structure for CrO₂ as well as the magnetic moment of Cr ions under photo-irradiation. The photo-excitation induces the disappearance of the energy gap between the localized t_{2g} to the itinerant t_{2g} states, which indicates the collapse of the half-metallic state. [3] Our calculated results also show that the photo-excitation can disorder the alignment of the localized t_{2g} spins due to the photo-excited down-spin e_g electrons via the strong on-site exchange coupling J in the ferromagnetic phase and hence suppression of the magnetization, which is in agreement with the previous experimental investigation. [2]

[1] X. J. Liu, *et al. Phys. Rev. B* **67**, 012102 (2003)

[2] T. Yoshii, *et al. J. Lumin.* **108**, 225 (2004)

[3] R. Yamamoto, *et al. Phys. Rev. B* **61**, R5062 (2000)

THE PHOTOCHEMICALLY SAFE TWO-PHOTON EXCITED DYE PROBES AS THE LUMINESCENT SENSORS FOR BIOLOGICAL OBJECTS DETECTION AND IMAGING

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The series of monomers and dimers of new styryl dyes were designed and synthesized. The optical absorption, fluorescence and phosphorescence spectra (using both single-photon (SPE) and single-photon (TPE) excitations) of these dyes and the correspondent DNA+dye systems were studied. The optical absorption spectra of the samples of the dyes and the DNA+dye systems were measured under the irradiation of these samples by visible light. It was shown the dyes are rather photostable when bound to DNA, while for the free dyes the photostability is much lower. The majority of the new dyes is photochemically safe. SPE luminescence experiments showed that the studied dyes increased the fluorescence intensity in the DNA presence to 2-3 orders of magnitude. TPE experiments revealed the studied dyes in the DNA presence are efficiently excited via TPE; they have the high value of the two-photon absorption cross-section. Thus such dyes are proposed to be used as the sensors with optical response of biological objects (as the DNA) inasmuch as they can help to obtain three-dimensional image of the biological object and be excited in visual red and near infrared spectral region where the biological objects are transparent. This work was supported by STCU (Project No U3104k).

THE SYNTHETIC AND BIOLOGICAL MULTIFUNCTIONAL COMPOUNDS WITH THE PHOTO-INDUCED PROCESSES OF ONE-WAY DIRECT EXCITATIONS ENERGY TRANSFER

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The results of the design, synthesis and spectral investigations of the special multifunctional compounds containing several (up to 12) π -electron systems were described and analyzed. Also the scanning tunneling microscope and volt-ampere characteristics investigations for the compound that consists of two π -electron systems were made. The investigations results of a few synthetic natural-nucleotides-containing compounds are compared with the results obtained on the deoxyribonucleic acid (DNA). The predicted processes of the photo-induced direct triplet electronic excitations transfer existence in all the specially designed and synthesized functional compounds under selective photon excitation were established. This fact gives the possibility to propose these compounds to be used for nanotechnology devices constructing. Some problems appeared on the way of such systems creation are discussed. The theoretical calculations of the electronic excitation passing through the functional macromolecule (that consists of 12 links and that is close to real macromolecule) were done. These calculations take into account the reverse exciton currents and the multipath excitation energy migration. This work was supported in part by STCU (Project No U3104k) and Ministry of Education and Science of Ukraine (Projects No C7/255-2001 and M/230-2004).

THE POLYMER SENSORS WITH OPTICAL RESPONSE. MAIN IDEAS AND MODELS

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The variants of the polymer macromolecules use as the sensors with optical response are discussed. The possibility of the use of the processes of electronic excitation energy migration and capturing for impurity molecules detection and identification were studied. The ability of π -electron systems of macromolecules links to form the exciplexes or other type complexes was examined. The main aim of this paper is to describe: (1) The general approaches to the creation of new polymer sensors with optical response. (2) The polymer sensors on acids small concentrations detection. It was shown the smallest concentration of NO_2 that can be detected is $C < 0.1$ ppm. In this case the effect of excitations capturing by chemically modified macromolecule links is observed in both matrix macromolecule luminescence and chemically modified links luminescence. (3) The polymer sensors on molecular oxygen detection (sensitivity ~ 0.01 ppm). The effect of excitations capturing by molecular oxygen is so strong that majority of polymers do not phosphoresce at normal conditions (phosphorescence appears only at the value of pressure 1-10 millimeter of mercury). (4) The polymer sensors on ionizing irradiation detection. An interaction between the ionizing irradiation and polymers leads to excitation of the chromophores electronic states in polymers. The chemical reaction in specially embedded centers causes the changes in polymer film optical density that can be spectrophotometrically detected. The sensitivity is 20 mP. (5) The polymer sensors on H^+ and OH^- detection. Under influence of these ions the partial regrouping of the π -electron systems takes place. This regrouping causes the occurring of new long-wave absorption spectra bands that do not overlap with the initial absorption spectra. (6) The polymer sensors on water-soluble molecules detection. The polymers of this type sorb some soluble compounds from water solutions. It was showed the molecules of average benzene ring were effectively sorbed from water by such type polymer films.

OBTAINING OF "CORE-SHELL" PARTICLES SiO_2/CdS , SiO_2/PbS AND INVESTIGATION OF THEIR OPTICAL PROPERTIES

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The main problem in area nanotechnology of optical materials is development of methods of extraction nanoparticles from solutions and their structurization with retention nanodimensional optical properties for creation of materials with the assigned characteristics. In this connection the purpose of our research was studying conditions of formation «core-shell» heteronanostructures SiO_2/CdS , SiO_2/PbS with various diameter of a dielectric core and a density of its filling by nanoparticles PbS, CdS. Studying of influence of composition of a semiconductor shell and the size of a core on optical properties of heteronanostructures. Heteronanoparticles with a core of silica particles and an external semiconductor shell of nanocrystals PbS, CdS have been obtained by the method of colloid synthesis. Polyacrylic acid used as the stabilizer of nanoparticles PbS, CdS in a solution. Monodisperse silica nanoparticles of the spherical shape have been received by hydrolysis of tetraethylorthosilicate. For reception heteronanostructures, a surface of silica nanoparticles has been modified using bifunctional organic molecules 3-aminopropyltriethoxysilane. Silica particles serve as mobile support. Semiconductor nanocrystals, which uniformly dispersed on surfaces silica nanoparticles, preserve their optical properties. Moreover, we can control optical properties of nanocrystals changing structure of heteronanoparticles. Such heteronanostructures expands opportunities of their use for creation new optical materials. Phase and element composition of nanocrystals CdS, PbS, making an external shell of heteronanostructures SiO_2/CdS , SiO_2/PbS has been investigated. Optical properties of received heteronanostructures have been researched. The presence of quantum confinement effects in optical absorption spectra has been established. Influence of the size of a dielectric core (40 nm, 120 nm, 350 nm) and a different density of its filling by semiconductors on optical properties has been shown. It is revealed, that intensity and position of exciton peak in absorption spectra of heteronanostructures depends on density of filling by semiconductor nanoparticles and does not depend on the size of a core.

THREE-DIMENSIONAL LASER-INDUCED THERMAL ANALYSIS IN DIAMOND/ZnSe SYSTEM

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The number of IR materials, in particular for the 8–12 μm spectral range, is very limited. ZnSe has a good transmittance property in the IR region, and hence a potential application in IR windows, especially for high-power IR lasers such as CO₂ laser at 10.6 μm and airborne IR sensor systems operating within the 8–12 μm atmospheric window. However, the mechanical, thermal and chemical properties of ZnSe are not enough to withstand severe environmental conditions such as abrasion, chemical attack or aerodynamic load. In order to improve the limits of ZnSe, one possible way is to use diamond thin film as the protective coating on ZnSe due to the excellent mechanical and thermal properties even if its worse transmission ($0.03\text{--}0.05\text{ cm}^{-1}$ at 10.6 μm) by a two orders of magnitude than that (0.0005 cm^{-1}) of ZnSe. Thus, the laser-induced thermal analysis becomes important in diamond/ZnSe system. However, the accurate thermal analysis in diamond/ZnSe system is difficult because of high thermal conductivity, a much lower thermal expansion coefficient and small thickness for diamond thin film. On the other hand, finite element method (FEM) is widely used in thermal analysis due to its flexibility in modeling complex structures and its preponderance to get full field numerical solution. [1-2]

In present work, we have made a three-dimensional (3D) laser-induced thermal analysis in diamond/ZnSe system by means of FEM. Under irradiation of a strong cw CO₂ laser (500 kW/cm^2 at 10.6 μm), our calculated results indicate that the steady-state temperature in the diamond surface steeply reaches 1036 K after 0.443 s if thicknesses of diamond and ZnSe are 100 μm and 2 mm, respectively. The steady-state temperature field in diamond/ZnSe system is also investigated. The absorbed heat in diamond film is found to significantly affect ZnSe. We further consider the influence of the thermal convection due to air on the temperature field in the diamond/ZnSe system. The calculated results indicate that the steady-state temperature on diamond surface has approximately reciprocal relation with the thermal convection coefficient. Based on the thermal analysis, we have simulated the stress field in the diamond/ZnSe system. Due to the large difference for the thermal expansion coefficient between diamond and ZnSe, the thermal stress in the interface between diamond and ZnSe becomes very large under laser-irradiation. We further discuss the influence of laser power, thickness of diamond film and thermal convection on the stress field.

- [1] H. Relyea, M. White, J.J. McGraph, *Diamond Relat. Mater.* **7** (1998) 1207-1212
[2] X. B. Mi, H. D. Gao, S. Y. Zhang, *Int. J. Heat Mass Trans.* **47** (2004) 2481-2485

THREE-DIMENSIONAL THERMOELASTIC ANALYSES OF TRANSPARENT FILMS/SI STRUCTURES IRRADIATED BY A PULSED LASER BEAM

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Based on a three-dimensional (3-D) thermoelastic theoretical model, the temperature fields and thermoelastic displacement distributions of bilayered structures induced by a Gaussian laser beam irradiation are studied, in which the bilayered structures consist of transparent films (ZnO or diamond films) deposited on opaque substrates (silicon substrates). Since the Gaussian laser beam is absorbed by the surface of the substrate, a Gaussian thermal source is located at the interface of the bilayered structure. Due to the 3-D thermoelastic theoretical model is very complicated, and then a finite element method (FEM) is used to get the theoretical (numerical) results of the temperature fields and thermoelastic displacement distributions in the bilayered structures. Meanwhile, the influences of the thermal and elastic properties of the thin films and substrates on the temperature fields and thermoelastic displacement distributions of the structures are calculated. The results show that the temperature fields and thermoelastic displacement distributions are strongly dependent on the thermal and elastic properties of the thin films. Therefore, the thermal and/or elastic properties of the thin films, which are always difficult to be characterized, can be characterized by detecting the temperature fields and thermoelastic displacement distributions using laser photothermal and/or laser ultrasonic methods.

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THERMAL STABILITY AND RELAXATION OF AMORPHOUS DIAMOND FILMS DEPOSITED BY FILTERED CATHODIC VACUUM ARC TECHNOLOGY

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Amorphous diamond (a-D) films prepared at a substrate bias of 20, 80, and 2000 V by the filtered cathodic vacuum arc (FCVA) technology on a single-crystal silicon substrate have been annealed at the different temperature under 1100 °C respectively in air and in vacuum. The thermal stability and relaxation processes in the films are comparatively investigated by visible Raman spectroscopy. The mechanical properties are characterized by XP-type nanoindenter. All the films are stable under 400 °C in air and under 500 °C in vacuum because they do show hardly changes of the microstructure and the hardness. The comparisons of the Raman spectra have clarified that the films deposited at the lower impinging energy are provided with the better stability. This is very important for practical high-temperature applications requiring a-D films deposited at the different bias.

EFFECTS OF KrF AND ArF EXCIMER LASER IRRADIATION ON THE RESISTIVITY OF ITO THIN FILMS

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350 nm amorphous (a)-indium-tin oxide (ITO) thin films deposited on glass or on polymer Ultem by PVD were irradiated at ambient temperature with KrF (248 nm) or ArF (193 nm) excimer laser. The effects of excimer laser irradiation on the resistivity of the ITO thin films were studied as function of laser energy density and number of pulses. The resistivity of the ITO films decreased as the number of pulses increased and depends strongly on the laser wavelength. It was found, that the maximal conductivity on glass was about one order of magnitude lower compare to Ultem. However, the laser irradiation energy density was about 1.5 higher.

SOLID-STATE LUMINESCENCE TECHNIQUES APPLIED FOR THE OPTICAL EXAMINATION OF ARCHAEOLOGICAL GLASS BEADS

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An archaeological glass bead collection recently excavated at the city of Thebes, Greece and considered as unique in terms of typological variety and time span –from Archaic to Hellenistic period- was examined with the application of Thermoluminescence (TL) and Optically Stimulated Luminescence (OSL).

X-rays Fluorescence and Scanning Electron Microscopy were also performed to obtain information on the elemental and structural composition of the material.

The beads are variously colored from transparent to opaque and the coloration was obtained with the use of metal oxides in variable ratios. The alkali metal and metal oxide concentrations and also the impurities present or added to the glass network are likely to act as electron traps and recombination centers.

TL sensitivity was examined by comparing the glow curves of the natural and laboratory irradiated aliquots from each sample. Additionally, both continuous waved and linearly modulated OSL spectra of the samples were recorded in order to examine the kinetic mechanisms of the material.

The results of the study provide additional information mainly for the characterization of the studied collection and also aim to probe the chronological suitability of archaeological glasses with the application of innovative luminescence techniques.

THE OPTICAL PROPERTIES OF THE Ni₅La AND Ni₅Ce THIN LAYERS

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By vaporizing the binary compounds Ni₅La, and Ni₅Ce with laser light impulses, thin layers of the above compounds were prepared on glass and quartz substrates. The thickness of the metallic strata ranges within the limits of 150 Å – 1200 Å. The reflection and transmission spectra were increased in the visible and UV domains of the spectrum which led to finding out the spectral dependences of the adsorption coefficient. By analyzing the spectral dependence of the absorption coefficient in the domain of the basic band borderline, the nature of the optical transitions and the width of the forbidden optical band were established for the examined the metallic strata. Using the Kramers-Kronig formalism in the reflection spectra, the dispersion of the optical constants n , k , dR/dE , ε_1 , and ε_2 is determined in the domain 1.3 eV - 6.0 eV.

THE DETERMINATION OF THE OPTICAL CONSTANTSS OF THE THIN FILMS IN THE CASE OF XANTHATS ADSORPTION

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The paper present the determinations of some kinetic parameters that characterize the kinetics of the adsorption phenomenon of some organic xanthate molecule on the surface of some natural semiconductor mineral (galena, sphalerit) in order to understand the inward mechanism of this phenomenon. Among the methods of inquiry that allow kinetics determination in situ the optical ones were chosen relying on the change of the relative reflection of the liquid-mineral semiconductor interface, and permitting continuous inquires without disturbing the inward development of the processes .Into the computation, we took into the consideration the physical values which feature the roughness of the solid surface, the diffusion into liquid media and the energetic non-homegeneities of the surface. The $R_s/R_p = f(\theta)$ characteristic helps us to establish the thickness of the adsorbed layer, as well as to determine the optical parameters of the thin film. Using the Kramers-Kronig formalism and with the aid of optical reflection spectra UV-VIS, we could calculate the following optical functions for the adsorption layers: the optical adsorption coefficient α ; the refraction index n ; the adsorption index k ; the real part ϵ_1 of the dielectric constant; the imaginary part ϵ_2 of the dielectric constant; the functions of the characteristic losses of the electrons $-\text{Im}\epsilon^{-1}$ and $-\text{Im}(1+\epsilon)^{-1}$; the effective dielectric constant ϵ_{ef} ; the function $\epsilon_2 E^2$.

THE STUDY OF THE LAYERS AT THE HETEROFUNCTION INTERFACE CdTe-Cd_xMn_{1-x} (x = 0.8)

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The paper presents the study of the layer at the heterojunction interface CdTe-Cd_xMn_{1-x} (x = 0.8) by optical measurements. The heterojunctions were grown on a Cd_{0.7}Mn_{0.3}Te monocrystalline under layer by condensing cadmium telluride in the saturated vapours phase. The depth of the studied layers could be varied within large limits by varying the exposure and temperature of the under layer. We studied the photoluminescence spectra when selectively exciting the Cd_{0.7}Mn_{0.3}Te and CdTe layers as well as the one at the heterojunction interface. The photoluminescence spectrum at the interface contains a surplus band localised in the red domain in relation to the exciton line of the ternary compound CdMnTe.

THE OPTICAL PROPERTIES OF THE $\text{Cd}_x\text{Mn}_{1-x}\text{Te}$ THIN LAYERS

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The paper tackles the results of the research of the borderline of the basic adsorption band as well as the optical functions of the solid strata in the CdTe-MnTe row. The spectral dependence of the absorption coefficient in the basic absorption band domain was calculated from the reflection and transmission spectra. The high reflection spectra at the surface of the $\text{Cd}_x\text{Mn}_{1-x}\text{Te}$ thin layers ($0.45 \leq x \leq 1$) in the domain 6.2 eV, 1.2 eV are also analyzed at room temperature; they enable the calculation of the spectral dependence of the optical constants in this spectral domain. The particularities characteristic to the reflection spectra and the optical constants are compared to the spectra obtained from monocrystals and identified to the optical transitions in the spots of high symmetry in the Brillouin area of these crystals.

SYNTHESIS, STRUCTURAL CHARACTERIZATION AND OPTICAL SPECTROSCOPY OF NANOCRYSTALLINE GADOLINIUM GALLIUM GARNET ACTIVATED WITH LANTHANIDE IONS

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Gadolinium gallium garnet (GGG) is an important material, suitable as a host for luminescent trivalent lanthanide ions (Ln^{3+}). As a nanocrystalline powder, it has shown to give rise to intense luminescence (both Stokes and anti-Stokes), when doped with Er^{3+} , Ho^{3+} , Pr^{3+} or Tm^{3+} and suitably codoped with Yb^{3+} [1-4]. These nanocrystalline powders are promising for applications in the field of phosphors and in biomedicine. In the present communication, we will present several preparation methods of nanosized $\text{GGG}:\text{Ln}^{3+}$, and we will show how the physical properties of the obtained powders are affected by the synthetic route. In addition, we will present an overview of the optical spectroscopy of these materials, with particular attention to the differences in the optical spectra induced by the various preparation methods. Moreover, the local structure at the impurity ions in the nanopowders will be approached by the analysis of EXAFS data obtained using synchrotron radiation at different temperatures. The results will be compared with the ones relative to the corresponding bulk materials, and with predictions derived from computational simulations [5].

[1] F. Vetrone, J.-C. Boyer, J.A. Capobianco, A. Speghini, M. Bettinelli, *J. Phys. Chem. B* 107 (2003) 10747.

[2] J. C. Boyer, F. Vetrone, J.A. Capobianco, A. Speghini, M. Bettinelli, *Chem. Phys. Lett.* 390 (2004) 403.

[3] R. Naccache, F. Vetrone, J.C. Boyer, J.A. Capobianco, A. Speghini, M. Bettinelli, *J. Nanosci. Nanotechnol.* 4 (2004) 1031.

[4] F. Pandozzi, F. Vetrone, J.-C. Boyer, R. Naccache, J.A. Capobianco, A. Speghini, M. Bettinelli, *J. Phys. Chem. B* 109 (2005) 17400.

[5] F. Maglia, V. Buscaglia, S. Gennari, P. Ghigna, M. Dapiaggi, A. Speghini, M. Bettinelli, *J. Phys. Chem. B* 110 (2006) 6561.

RECENT DEVELOPMENTS IN LIGAND FIELD THEORY FOR LANTHANIDE COMPOUNDS ON THE BASIS OF THE CONCEPTS OF OVERLAP POLARIZABILITY AND IONIC SPECIFIC VALENCE

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Ligand field effects in compounds of d and f ions are of paramount importance in determining their optical and magnetic properties. It has been, since several decades, the subject of intense investigation, covering aspects ranging from complex molecular orbital theory to the simplest crude electrostatic model. Due to the difficulties in describing these effects from first-principles, a common practice has been to represent the interaction between the central ion and its chemical environment by a phenomenological one-particle hamiltonian $\sum B_q^k C_q^{(k)}$ (in Wybourne's notation) in which the $C_q^{(k)}$ are Racah tensor operators and the B_q^k are treated as phenomenological parameters – the so-called ligand field parameters. However, the rationalization of the ligand field in terms of reliable non phenomenological models is highly desirable, not only to the understanding of the chemical bond characteristics in d and f ions compounds not following their primary valences, but also to allow the prediction of ligand field splitting – for example, in opaque materials – and the prediction of the odd components of the ligand field hamiltonian required to relax Laporte's rule in the case of intraconfigurational transitions.

In a recent attempt to get deeper insights on covalency in lanthanide compounds, we have introduced the concepts of chemical bond overlap polarizability and ionic specific valence [1]. Several consequences of these concepts have been explored, among which the definition of a quantitative covalent fraction scale [2] and a description of the ligand field in terms of a contact potential that may be treated non phenomenologically when the charge factors, appearing in the Simple Overlap Model, are identified with the ligating atoms ionic specific valences. As far as each pair lanthanide ion-ligating atom is considered as a diatomic-like molecule, these charge factors are a simple function of the chemical bond force constant, internuclear distance and LUMO-HOMO energy difference. In this lecture we will present and discuss the results obtained for representative lanthanide compounds.

[1] O.L.Malta, H.J.Batista, L.D.Carlos, Chem. Phys. 282, 21 (2002).

[2] L.D.Carlos, O.L.Malta, R.Q.Albuquerque, Chem. Phys. Letters 415, 238 (2005).

PHOTOACOUSTIC DETERMINATION OF THE 1.8 μm LUMINESCENCE QUANTUM EFFICIENCY OF Tm^{3+} IONS IN LiNbO_3 CRYSTALS

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The determination of absolute quantum efficiencies of ions in solids is not always straightforward, although the combination of luminescence and photothermal techniques, and the complementary information that they provide, has allowed sufficiently accurate methods within the last years. Photoacoustic, photocalorimetric, photopyroelectric and thermal lens techniques have been used to access luminescent quantum efficiencies in solids [1-4]. In the particular case of the 1.8 μm Tm^{3+} laser, it has been recently emphasized the need of determining the fluorescence quantum efficiency by direct excitation to the lower Tm^{3+} levels, avoiding the complications of energy transfer between Tm^{3+} ions [5]. In this work, we present the determination of the absolute luminescence quantum efficiency of the 1.8 μm upper laser level by the comparison of simultaneous photoacoustic and luminescence signals by direct excitation of the two lower Tm^{3+} excited state levels, which provide the most straightforward procedure for quantum efficiency determination. The experimental set-up allows the simultaneous detection of photoacoustic and luminescence signals under pulsed optical excitation, performed by using an Optical Parametric Oscillator (MOPO Quanta-Ray) with 0.1 nm spectral resolution. The output luminescence from the sample, collected by a system of lenses, was spectrally selected at 1.8 μm by a monochromator and then detected with a cooled InAs photodiode and averaged by an EGG lock-in amplifier. The photoacoustic signal was detected by a PZT transducer attached to the sample and averaged using a digital oscilloscope. Both signals, photoacoustic and luminescent, were collected simultaneously and the digital outputs finally stored in a PC. The experimental conditions are kept constant throughout the experiment in order to maintain the proportionality of the signals with the absorbed pump power. Following the excitation – luminescence cycle, both photoacoustic (PAS) and luminescence (LUM) signals are directly proportional to the number of absorbed photons, so that when PAS is represented vs. LUM, the experimental points are expected to exhibit a linear dependence. Comparing the slopes obtained at different excitations [$\lambda_{\text{LOW}} = 1750$ nm (${}^3\text{H}_6 \rightarrow {}^3\text{F}_4$ transition) and $\lambda_{\text{HIGH}} = 1220$ nm (${}^3\text{H}_6 \rightarrow {}^3\text{H}_5$ transition)] the luminescence quantum efficiency can be obtained ($\Phi({}^3\text{F}_4) = 95 \pm 5$ (%)). This result is compared with other spectroscopic estimations based in Judd-Ofelt calculations and life-time measurements. The high value of the luminescent quantum efficiency opens prospects for improving the performance of reported waveguide lasers through adequate modelling and fabrication optimization.

[1] C.K.N. Patel and A.C. Tam. *Rev. Mod. Physics* **53**, 517 (1981).

[2] A. C. Tam *Rev. Mod. Physics* **58**, 381 (1986).

[3] H. Vargas and L.C. M. Miranda, *Physics Report* **161**, 43 (1988).

[4] E. Rodriguez, J.O. Tocho and F. Cussó, *Phys. Rev.* **B47**, 14049 (1993).

[5] S.L. Oliveira, S.M. Lima, T. Catunda, L.A.O. Nunes, J.H. Rohling, A.C. Bento and M.L. Baesso, *Appl. Phys. Lett* **84**, 359 (2004).

DUAL-POLARIZATION-PUMP CW LASER OPERATION IN $\text{Nd}^{3+}:\text{LiNbO}_3$ CHANNEL WAVEGUIDES FABRICATED BY REVERSE PROTON EXCHANGE

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Optical waveguide fabrication in lithium niobate is accomplished nowadays by a variety of techniques which in many cases include one or several diffusion processes, such as metal indiffusion, proton exchange (PE) and reverse proton exchange (RPE) [1-3]. Unlike the standard PE ones, the RPE waveguides are composed of two superimposed guiding layers supporting both TE and TM polarised modes. For a Z-cut crystal, this fabrication process gives rise to a local increase in the ordinary refractive index at the surface (TE-mode layer) and to a local increase in the extraordinary refractive index a few microns beneath the surface (TM-mode layer). The latter is a buried waveguide that allows an improved coupling to/from optical fibres owing to its more symmetric transverse profile, better confinement and lower scattering losses. This work reports continuous-wave laser action at 1084.5 nm at room temperature in $\text{LiNbO}_3:\text{Nd}^{3+}$ channel waveguide by RPE. The sample was pumped at $\lambda=808.3$ nm in either σ or π -polarized configurations, being the laser emission π -polarized at all power levels. The laser characteristics, including the launched pump power at threshold and the slope efficiency of a 10-micron wide channel waveguide are reported. $\text{LiNbO}_3:\text{Nd}^{3+}$ crystal was grown along the z-axis by the Czochralski method, being the initial melt doped with 1% mol of Nd^{3+} ions related to Nb^{5+} ions. Z-cut substrates were obtained from the crystal boule, and polished to a flat surface up to optical grade, in order to perform channel waveguide fabrication. The channels were patterned using ultraviolet photolithographic techniques to define the regions where the exchange takes place. To perform the waveguide fabrication, the sealed ampoule technique was used [4], giving rise to the formation of waveguides that support both TE and TM propagation at 1.08 μm . Laser action around 1.08 μm at room temperature in these channel waveguides was successfully demonstrated in both σ and π -polarized configurations, with slope efficiencies around 1 %, independent of the pumping scheme while lasing thresholds were sensitive to the pumping scheme, as a consequence of the difference in pump and signal mode overlap. In both cases, the laser emissions were stable, without any reduction in the output power even under continuous pump operation at maximum power at room temperature, indicating high resistance to photorefractive damage.

[1] E. Lallier, J.P. Pocholle, M. Papuchon, C. Grezes-Besset, E. Pelletier, M. De Micheli, M.J. Li, Q. He and D.B. Ostrowsky, *Electron. Lett.* **25**, 1491 (1989).

[2] H. Suche, I. Baumann, D. Hiller and W. Sohler, *Electron. Lett.* **29**, 1111 (1993).

[3] A. Di Lallo, C. Conti, A. Cino and G. Assanto, *IEEE Photon. Technol. Lett.* **13**, 323 (2001).

[4] G. Bonelli, A. Di Lallo, S. Riva Sanseverino, A. Parisi, A. Bussacca and A.C. Cino, 5th Symposium of European Vacuum Coaters, Anzio Sept. 20th-Oct. 2nd (2002).

GROWTH AND OPTICAL CHARACTERIZATION OF Tm³⁺-DOPED LiNbO₃

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Tm³⁺-activated materials have a renewed interest due to their broad infrared luminescence emissions potentially attractive for the development of photonic devices with application in different fields such as optical amplification, surgery and remote sensing. When rare-earth ions are incorporated to LiNbO₃ it is possible to combine the optical characteristics of the rare-earth ions with the electrooptic, acoustooptic and nonlinear properties of LiNbO₃ [1-4]. An additional advantage of this host is the availability of well developed techniques to fabricate low-loss channel waveguides which have lead to engineer monolithic integrated devices [5-7]. Although LiNbO₃ doped with rare-earth ions has been extensively studied for several lanthanide ions, the incorporation of Tm³⁺ to LiNbO₃ has not been described in depth. In particular, the growth of highly concentrated samples, preserving the optical quality and crystal homogeneity required for photonic applications, becomes necessary. In this work, thulium doped LiNbO₃ single crystals have been grown by the Czochralski technique from melts with variable thulium concentrations (0.05, 0.35, 0.5, 0.65, 1.25, 2.0 and 3.0 mol %). Optical absorption spectroscopy together with X-Ray Fluorescence measurements have been used to calibrate the incorporation of Tm³⁺ ions to the crystal lattice. These measurements confirm the congruent character of the crystals as well as the trivalent valence state of the lanthanide ions. The incorporation of Tm³⁺ ions to the crystals follows a linear regime, close to the ideal case, for melt concentrations up to 2.0 mol %. From the optical absorption measurements and the calibrated rare earth concentration, absolute absorption cross sections of the different optical transitions of Tm³⁺ ions in the visible – near infrared range have been obtained. Finally, the segregation coefficient relating the thulium crystal concentration with melt concentration has been determined. As it was previously mentioned, the incorporation of the rare earth ions to LiNbO₃ lattice increases linearly with melt concentration up to about 2.0 mol%. Above this concentration the solubility is reduced, saturating at about 3 mol% , while simultaneously the optical quality of the boules also deteriorates.

[1] L.F. Johnson and A.A. Ballman, *J. Appl. Phys.* **40**, 297 (1969).

[2] R.C. Stoneman and L. Esterowitz, *IEEE J. Sel. Top. Quantum Electron.* **1**, 78 (1995).

[3] S. Agger, J.H. Povlsen and P. Varming, *Opt. Lett.* **29**, 1503 (2004).

[4] D. Jaque, J. Capmany, J.A. Sanz García, A. Brenier, G. Boulon and J. García-Solé, *Opt. Mat.* **13**, 147 (1999)

[5] M. Fujimura, A. Shiratsuki, T. Suhara and H. Nishihara, *Jpn. J. Appl. Phys.* **37**, L659 (1998).

[6] B.K. Das, H. Suche and W. Sohler, *Appl. Phys. B* **73**, 439 (2001).

[7] E. Cantelar, J.A. Sanz-García, G. Lifante, F. Cussó and P.L. Pernas, *Appl. Phys. Lett.* **86**, 161119 (2005).

TEMPERATURE DEPENDENCE OF THE $\text{Bi}_{12}\text{GeO}_{20}$ OPTICAL ACTIVITY

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This paper presents measurement of the $\text{Bi}_{12}\text{GeO}_{20}$ optical activity temperature dependence. Measurement was performed by orthogonal polarization detection and temperature was measured with a thermovision camera. Since the $\text{Bi}_{12}\text{GeO}_{20}$ crystal used possess Faraday rotation and optical activity, analysis of electromagnetic wave propagation through crystals that posses Faraday rotation as well as optical activity is presented. Compensation of the temperature dependence for current and magnetic field sensors that use Faraday rotation is proposed.

CREATION OF COPPER NANOPARTICLES BY LASER ABLATION IN OIL

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Unusual characteristics of nanoparticles are attracting interests in a variety of technical fields including optical engineering and material science. Laser ablation in liquid has an advantage over other particle-fabrication techniques in simplicity and efficiency of the process. Aqueous solutions are usually used in the liquid-phase laser ablation, but nanoparticles of some materials cannot exist stably in those solutions because of oxidation or aggregation. In this work, we conducted laser ablation in silicone oil to create copper nanoparticles, which had been difficult to create in aqueous solutions. Silicone oil is useful as the liquid for ablation and suspension, since it is chemically stable and its physical properties, e.g., density and viscosity, can be controlled suitably by changing its molecular weight. In addition, solid compounds of a polymer and nanoparticles can be fabricated easily by curing silicone. In our experiments, a copper plate was put in silicone oil (8 ml), and optical pulses (energy: 0.2 J, duration: 5 ns) of the frequency-doubled Nd:YAG laser (wavelength: 532 nm) were irradiated on the plate (beam diameter: 6 mm). The transparent oil turned to a brown suspension after the irradiation of 6000 pulses. The transmission spectrum of the suspension exhibited the $1/\lambda^4$ -dependence (λ : wavelength) in the visible spectral range, indicating that the particle size is much smaller than the light wavelengths. Spherical particles of ~20 nm in diameter were observed by using a transmission electron microscope. By contrast, large particles or aggregating particles were observed for the sample that was created by ablation in water. Corresponding to this observation, large particles precipitated in the water sample, when it was preserved for a few days after the ablation process. At the same time, the transmission spectrum of the water sample changed daily which seemed to be caused by oxidation. However, the transmission spectra of the oil samples exhibited little change even after the 30-day preservation. Some silicone samples containing copper nanoparticles solidified successfully by addition of the curing agent.

PULSED PHOTOTHERMAL SPECTROSCOPY OF SOLIDS

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Generalized model of pulsed photothermal responses is presented, including the thermal memory effects. The analysis is restricted to the case for which nonradiative relaxation processes occur instantaneously on the time scale of the measurement. The focus is on optically opaque solids. The influence of sample properties on impulse responses is discussed for both adiabatic and isothermal conditions on the back surface. Those results are compared with previous models.

NANOPHOTONIC GOLDEN LIGHT OF 0D QUASISTRUCTURE AND ITS BIOMEDICAL APPLICATIONS

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It has been shown experimentally that under influence of light, samples, which consists of multilayer dielectric structures of the Fibonacci type (1D quasicrystal), generate mode beating and pulse stretching with strongly suppressed group velocity for frequencies close to a Fibonacci band gap (Phys Rev Lett., 90(5):055501-1,2003) Theoretical consideration of this phenomena based on transfer matrix theory leads to conclusion of Fibonacci band-edge resonance existence. In our experiments we observed similar resonance phenomena using two Fibonacci type structures (0D quasicrystals); one nano-molecular crystal and other biomolecule. Considered Fibonacci type biomolecule, participate in synaptic activities, including wave brain modulation. According to Fibonacci band-edge resonance phenomena we observed change of EEG signals when human brain trough eyes were exposed to “golden light” influence generated by external 0D quasicrystal. We strongly believe that nanomaterials with Fibonacci type structures (golden mean properties) may be used for building new type of biomedical devices.

SYSTEMS OF LiCl NANOPARTICLES INSERTED IN MATRICES OF ISOTACTIC POLYPROPYLENE

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Structural, opto-electrical behavior of a system with isotactic polypropylene as polymer base and inserted nanoparticles of a LiCl was investigated. The analyses were pointed to influences of different percentage of LiCl particles on an iPP structures with different degree of crystallinity, and consequentially properties of those systems. Experimental methods, like wide angle X-ray scattering, differential scanning calorimetry, far and middle range infrared spectroscopy, dielectric spectroscopy and ultraviolet-visible spectroscopy were used.

STRUCTURAL AND OPTICAL CHARACTERIZATION OF $\text{Ba}_{0.8}\text{Sr}_{0.2}\text{TiO}_3$ FILMS DEPOSITED BY PLD ON VARIOUS SUBSTRATE USING MICRO-RAMAN AND SPECTRAL REFLECTOMETRY METHODS

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Structural and optical properties of $\text{Ba}_{0.8}\text{Sr}_{0.2}\text{TiO}_3$ (BST) ferroelectric thin films, deposited by PLD technique on Si/SiO₂/Ti/Pt, Si/SrRuO₃ and Si substrates, were performed by micro Raman, Atomic force microscopy (AFM), scanning electron microscopy (SEM) and optical reflectometry measurements.

Temperature dependence (10 - 800 K) of the micro-Raman scattering was done using RENISHAW spectrometer. AFM measurements were performed by Stand Alone SMENA microscope from NT-MDT Co. in contact mode using conventional Si tips to characterize the surface morphology. In addition Carl Zeiss brand model EVO 50 XVP SEM measurements, with energy dispersive detector for x-rays (EDX) and with an option of electron beam lithography (EBL), was realized.

A miniature "Ocean Optics" CCD spectrometer, model PC 1000, designed as a plug-in PC ISA slot with fiber optics input was used for the reflectivity measurements under normal light incidence geometry in the spectral range of 250 - 930 nm. A multilayer fitting model including interface layer, voids and surface roughness was employed to describe complex refractive coefficient of the samples. The optimal values of optical constants, described by Lorentz oscillator, and thickness d for each sample layer were found by Monte Carlo optimisation procedure of multilayer model. The effective medium approximation (EMA) theory was used to estimate surface inhomogeneities, i.e., roughness and porosity. Dependence of the Raman spectrum, refractive and extinction coefficients, optical band gap energy and surface roughness on film structure was analyzed.

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PREPARATION AND OPTICAL CHARACTERIZATION OF RARE EARTH DOPED NANOPARTICLES

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Rare-earth doped nanoparticles have drawn a lot of interest in the last few years for several potential applications: optoelectronics, transparent ceramics, nanosensors and medical diagnostics. In some cases, the material properties differ from those of conventional materials elaborated by solid state reaction and the particles size leads to specific applications.

In the present work, we have also investigated dense rare earth doped mixed oxides ($\text{SrZrO}_3\text{:Ce}$ and $\text{SrHfO}_3\text{:Ce}$), which could be well adapted to scintillation (medical imaging). The phase transformations and the very high melting points of these materials (respectively 2646°C and 2730°C for SrZrO_3 and SrHfO_3) lead us to study their synthesis as nanoparticles. We have also prepared Y_2O_3 doped with several RE^{3+} ($\text{RE} = \text{Eu}, \text{Er}$ and Yb) which can be used as nanosensors. Eu^{3+} ions are being used as local probe.

The combustion method appeared these last years to be a very appropriate method to obtain pure and homogeneous nanoparticles. With this synthesis method we could obtain particles of very small dimensions (10 to 100nm) without impurities, at temperatures less than 1000°C for both families of compounds. The shape of the emission spectra are compared in bulk and nanostructured compounds. This reveals that no confinement effect occurs with RE^{3+} , and that surface effects are not predominant.

For Eu^{3+} , we have investigated the position of the ${}^5\text{D}_0 \rightarrow {}^7\text{F}_0$ emission at about 580 nm in the different systems as well as lifetimes and intensity parameters. We also have characterized the optical properties under UV irradiation of the cerium ion in the perovskite matrixes.

MAGNETIC SUSCEPTIBILITY AND ORDERING OF Yb AND Er IN PHOSPHORS Yb,Er:Lu₂O₃

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The rare earth doped oxides are considered to be convenient materials for optical applications, especially as the luminescent host matrices. Particularly, lanthanide ions doped diamagnetic matrices (Y₂O₃, Lu₂O₃, La₂O₃ and Sc₂O₃) have shown very good luminescence properties, due to its low cut-off phonon frequency. In this work we present results on synthesis, crystal structure refinements and crystal field levels determination in Yb and Er substituted Lu₂O₃. The ceramic sintering procedure is used to prepare (Lu_{0.9}Yb_{0.1})₂O₃ and (Lu_{0.9}Er_{0.1})₂O₃ mixed sesquioxides. Starting oxides Lu₂O₃ and Yb₂O₃ (Er₂O₃) were mixed in appropriate stoichiometric ratio, pressed in pellets, pre-sintered at 950 °C for 24 hours and sintered at 1350 °C for 12 hours. Crystal structure of prepared samples was checked by XRD. It was shown the formation of single phase oxides, with the C-type (bixbyte) structure (space group Ia3). Crystal structure was refined by the Rietveld method using computer program Fullprof. The important structural parameter which determines the magnetic, conducting and optical properties, cation ordering within C₂ (8a) and C_{3i} (24d) sites, was found by refinement of their respective occupation numbers. It was observed that Er and Yb occupy both of the cation sites in C-type of structure. Magnetic susceptibility was measured using an MPMS XL-5 SQUID magnetometer. Due to the high degree of dilution the susceptibility data can be regarded mostly as a result of the crystal field influence. Thus, to analyze the susceptibility in the whole 2-300 K temperature region was necessary to account for the crystal field influence at low temperature, while at the high temperature region the Hund's formula gives very good agreement with experimental data. The result was determination of the mean energy gap between ground and some of the excited crystal field levels (E_i), and their effective magnetic numbers M_{ieff} (denotes linear combinations of the free ion magnetic quantum numbers M_J).

COHERENT SPECTROSCOPY AND CRYSTAL FIELD ANALYSIS OF Pr³⁺:LaW₃O₁₂

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Rare earth doped crystals are well known as efficient light emitting materials and have found important applications in lasers, display technology and scintillation. Recently, these materials have also been considered promising systems in a new research field: quantum information (QI). In this area, the unique properties of quantum systems are used to manipulate data in a non-classical way [1]. Applications of QI include quantum cryptography, which is now commercially available [2], as well as quantum computing (QC) and quantum storage (QS). The latter aims at storing the quantum state of a photon in order to build repeaters. Such devices are the key to quantum cryptography over long distances. On the other hand, a quantum computer is theoretically able to perform some calculations (e.g. prime number factorizing) orders of magnitude faster than a classical computer [1].

Although promising results in QS and QC were obtained in gases or liquids, a solid state system would be much closer to real-world applications. Rare earth ions doped crystals (REIC) are known to exhibit favorable properties in this respect since coherence lifetimes of optical and hyperfine transitions can be very long. This explains that several teams have proposed and partially demonstrated QC and QS schemes in REIC [3, 4]. These results prove the intrinsic interest of rare earth doped crystals for these new applications but significant improvements are still necessary to demonstrate QC and QS at a more advanced level. An especially important property for QS and QC is the minimization of the inhomogeneous linewidth. Since Pr³⁺ and La³⁺ ionic radii are very close, we expect La³⁺ based compounds to exhibit smaller inhomogeneous linewidths than other Pr³⁺ doped crystals currently studied like Y₂SiO₅. This is the motivation for our investigation of a new crystal, Pr³⁺:LaW₃O₁₂. This material was grown using the Czochralski technique and samples a few millimetres thick were extracted from a good quality boule and used for the optical experiments.

We determined the hyperfine structures of the ³H₄ and ¹D₂ levels using hole burning spectroscopy and ³H₄-¹D₂ transition coherence lifetime by photon echo technique. At low excitation power, we found a coherence lifetime of 12 μs, corresponding to a homogeneous linewidth of 27 kHz. These experiments were performed at liquid helium temperature. On the other hand, Pr³⁺ crystal field parameters were determined by a fit to low temperature absorption and emission data which showed a good agreement. This allowed us to compute the influence of an external magnetic field on the hyperfine levels. These data can be used for example to find orientations for which the transitions are insensitive to magnetic field fluctuations.

[1] I.Chuang, M.Nielsen, Quantum Computation and Quantum Information (Cambridge Univ. Press, Cambridge, 2000)

[2] <http://www.idquantique.com/>

[3] J. J. Longdell, M. J. Sellars, and N. B. Manson: Phys. Rev. Lett. Vol. 93 (2004) 130503; N. Ohlsson, R. Krishna Mohan and S. Kröll: Opt. Com. Vol. 201 (2002) 71

[4] J.J.Longdell, E.Fraval, M.J.Sellars, and N.B.Manson: Phys.Rev.Lett. Vol.95 (2005) 063601

ROOM-TEMPERATURE EXCITONIC LASING IN ZnO TETRAPOD-LIKE CRYSTALLITES

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Room-temperature low-threshold (0.55 mJ/cm^2) lasing in UV region was observed in ZnO powders with tetrapod-like shape of crystallites. Zinc oxide powders were prepared by a high-temperature pyrolysis of organic salts of zinc. The powder samples were optically pumped with a frequency-tripled Q-switched Nd:YAG laser ($\lambda=355 \text{ nm}$, 4 ns pulse duration). The lasing spectra were recorded using a MS-300 spectrometer (with the spectral resolution 0.1 nm) equipped with CCD array. The tetrapods consisted of four branches growing from one centre, each branch (leg) grew in [0001] direction and was about 200-500 nm in diameter and up to 25 μm . Such shape provided low-threshold lasing due to formation of effective feedback in material under study. Each leg served as optical microcavity of waveguide type. The room-temperature excitonic lasing spectra were characterized by clear mode structures, the full width of lasing lines at half maximum being equal to $\sim 0.2 \text{ nm}$ and with intermode spacing $\sim 0.57 \text{ nm}$. Increase in pumping energy resulted in the changing group of bands corresponding to different microcavities in powder medium. Low-threshold of stimulated emission indicated high optical qualities of synthesized material as active media for UV lasers. This work was supported by Russian Foundation for Basic Researches, Grant N 06-02-17230, and State Contract № 02.434.11.2017.

Yb:CaGdAlO₄ AN INFRARED SOLID STATE LASER

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Due to an unique combination of high thermal conductivity value and very low quantum defect, the CaGdAlO₄:Yb host could be interesting to obtain high power laser emission with reduced problems linked to thermal loading. Very recently, the broad emission plateau between 987 nm up to 1060 nm has permitted to obtain laser pulses of 47 femtoseconds, which represents the shortest pulses ever obtained in an Yb doped bulk laser material [1].

Furthermore, we have also succeeded to tune emission wavelength closer to the absorption wavelengths leading to quantum defect less than 0.8 % [2].

At the conference, we will develop the spectroscopic optical properties of the CaLGO host in regard to these properties, looking at several ytterbium concentrations. The analysis of the local surrounding around ytterbium cations under high resolution spectroscopy gives insights to understand the unique properties of this new laser host.

[1] 47-fs diode-pumped Yb³⁺:CaGdAlO₄ laser ; Y. Zaouter, J. Didierjean, F. Balembois, G. Lucas-Laclin, F. Druon, P. Georges, J. Petit, P. Goldner, B. Viana *Optics Letters*, Vol. 31 Issue 1 Page 119 (2006)

[2] Laser emission with low quantum defect in Yb:CaGdAlO₄

J. Petit, P. Goldner, B. Viana, *Optics Letters* 30, Issue 11, Page 1345 (2005)

THEORETICAL ANALYSIS OF SECOND HARMONIC PHOTOTHERMAL EFFECTS IN SOLIDS

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Second and higher harmonics of thermal wave arise in solids when heat generates and propagates through the material with nonlinear properties. When thermophysical parameters of materials depend on temperature (the case of special interest in photothermal spectroscopy), heat conduction has a pronounced nonlinear character. At that time, harmonically modulated heat sources as usually applied in the photothermal techniques induce thermal waves in the material at the fundamental thermal-wave angular frequency (first harmonic), as well as thermal waves at those integer multiplications of the modulated frequency (higher harmonics), which would be impossible in the linear case. In this work the influence of temperature dependent materials thermal properties on generation of second harmonic of thermal waves and photothermal effects is theoretically analyzed. For the case of semi-infinite solid we have solved nonlinear hyperbolic modified Fourier heat conduction equation (nonlinear parabolic for Fourier heat conduction problem), the equation that integrates an atypical relation between the heat flux and the temperature gradient, having as a result thermal waves. We assume the conduction of heat in solids excited by a harmonically modulated heat source, commonly encountered in photothermal experiments. We have applied stepwise successive approximation method in order to obtain analytical mathematical solution of a given problem. Then, we have used this solution to simulate influence of nonlinearities on a second harmonic thermal wave phase and amplitude for both the classic and the non Fourier heat conduction case. The solutions are found and analyzed for both the frequency and spatial distribution of the temperature field.

POLYMER COMPLEX SOLUTION SYNTHESIS OF $(Y_xGd_{1-x})_2O_3:Eu^{3+}$ NANOPOWDERS

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Yttrium-gadolinium-europium oxide phosphors are regarded promising for many important optical applications, for example in medical diagnostic X-ray systems and plasma displays. In this work, we investigated procedure for $(Y_xGd_{1-x})_2O_3:Eu^{3+}$ ($x = 0, 0.25, 0.5, 0.75$ and 1) nanopowder synthesis and its structural and emission properties. The samples were synthesized using polymer complex solution method (PCS) based on polyethylene glycol (PEG). Appropriate amounts of Y_2O_3 , Gd_2O_3 and Eu_2O_3 were dissolved in hot nitric acid. Solution was mixed with strong stirring to ensure the homogeneous mixture. Then PEG ($M_w = 200$) was added and the mixture was heated by water bath at $80\text{ }^\circ\text{C}$ until transparent gel appears. Finally, the gel was thermally treated in furnace for two hours at $800\text{ }^\circ\text{C}$ to obtain very fine powder sample. Structural and emission properties of nanopowders are investigated by x-ray diffraction, electron microscopy and photoluminescence measurements.

PHOTOCATALYTIC DEPOSITION OF NOBLE METALS ON NANOCRYSTALLINE TiO₂ FILMS

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Nanocrystalline TiO₂ films were prepared on glass supports by the dip coating technique using colloidal solutions consisting of 45 Å particles as a precursor in order to probe the feasibility of exploiting solid state photocatalytic reactions for efficient deposition of silver and gold. Photoirradiation of nanocrystalline TiO₂ films modified with the bidentate ligand (alanine) that covalently binds to the surface of TiO₂ and at the same time attach silver ions induced their reduction to metallic form. However, the reduction of golden ions was maintained by photoirradiation of unmodified TiO₂ films with metal ions being attached directly to the surface of TiO₂. Atomic force microscopy measurements revealed presence of gold and silver grains in the nanosize regime. Optical properties of the deposited metallic films were correlated with microscopy data. Conductivity of deposited noble metal films was measured in the temperature range from 45 to 295 K.

PHOTON ENERGY UP-CONVERSION IN COLLOIDAL TiO₂ NANORODS

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Nonaqueous reaction between titanium(IV) chloride and benzyl alcohol was used for the synthesis of highly crystalline TiO₂ nanorods. The X-ray diffraction measurements proved the exclusive presence of the anatase phase. The photoluminescence of anatase TiO₂ nanorods with several well resolved emission bands was observed, and quantum yield at room temperature was found to be 0.25%. Highly efficient photon energy up-conversion from colloidal TiO₂ nanorods was observed at very low excitation intensities. The energy of the up-converted photoluminescence spans the range of energies displayed by the normal photoluminescence emission of the TiO₂ nanorods. The explanation for the photon energy up-conversion involves mid-gap energy levels.

PHOTOLUMINESCENCE AND FAR-INFRARED SPECTROSCOPY OF PbS QUANTUM DOTS – POLYVINYL ALCOHOL NANOCOMPOSITE

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The nanocomposite consisting of PbS quantum dots with average diameter of 26 Å and polyvinyl alcohol were characterized using photoluminescence and far-infrared spectroscopy. Photoluminescence spectra of nanocomposite, measured in temperature range from 8 to 280 K, consists of broad peak which spans the energy range from 1.2 to 2.1 eV and can be connected with trap states inside the band gap. Far-infrared measurements are consistent with theoretical calculations that include mechanical boundary conditions at the quantum dot – host interface. Observed peak at 90 cm⁻¹ can be assigned to coupled modes with $l_p = 1$, while broad peak at 275 cm⁻¹ is above any lattice frequency and is close to sum of the frequencies of the $l_p = 0$ acoustic and $l_p = 0$ coupled optical mode of PbS quantum dots.

COMBINATORIAL APPROACH TO FUNDAMENTAL SCIENCE

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By now, combinatorial methods for discovery and optimization of new materials are well established in pharmaceutical industry and materials science. This is not the case with fundamental research, which traditionally uses serendipitous try-and-error approach. However, there have been some recent breakthroughs in several laboratories in the world, including our in Santa Barbara [JCP 121, 3745 (2004); APL 88, 121902 (2006)], in expending applications of combinatorial methods into fundamental science. We will present highlights from this research, which include combinatorial studies of the Förster energy transfer in binary and ternary mixtures and the studies of nucleation mechanism in thin solid films formed by physical vapor deposition.

MULTILEVEL NANOSTRUCTURE DESIGNING OF Y_2SiO_5 AND Gd_2SiO_5 POWDERS USING COMBINATION OF HYDROTHERMAL SYNTHESIS AND ULTRASONIC SPRAY PYROLYSIS

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The nanostructure design of Y_2SiO_5 and Gd_2SiO_5 powder particles is discussed. These particles were formed using combination of precursor hydrothermal synthesis and subsequent ultrasound spray pyrolysis. By the synthesis itself a morphology and/or structural design (particle design) and sub-structural designs (sub-particles design/sub-structural elements as the sols, the silicon chains) were defined. Particle mean size and size distribution specter of all materials were determined by the SEM analysis. The obtained results were compared with those derived from author's theoretical model. Distribution uniformity, the size and morphology of the sol particles were determined by the TEM microscopy and by the dynamic light scattering. The length of silicon chain inside the silicon sol particles was determined using the thermal analysis and infrared spectroscopy. The assembled results indicate the possibility of a rigorous particle structure designing of all obtained powders over a various hierarchical levels.

STRUCTURAL AND OPTICAL PROPERTIES OF $\text{CaTiO}_3:\text{Pr}^{3+}$ FILMS DEPOSITED BY CHEMICAL AND PHYSICAL METHODS.

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The orthorhombic perovskite CaTiO_3 doped with Pr^{3+} is known as a promising phosphor for low voltage field emission display capable to exhibit red cathodoluminescence with CIE coordinates close to those of “ideal red” [1, 2]. In the present work, nanostructured films of this phosphor were deposited on silica or ITO / silica substrates either by physical (radio frequency sputtering) or chemical methods (dip or spray coating). The structural and optical properties of the films were investigated and compared to those of a micron sized powder of same composition. Although the 4f – 4f spectral features are similar for the films and for the powder, a shortening of the fluorescence decay profile and a blue shift of the UV part of the excitation spectrum are evidenced when the particle size is decreased to the nanometer scale.

- [1]. S.S. Chadha, D.W. Smith, A. Vecht, C.S.Gibbons, 94 SID Digest 51 (1994) 1.
- [2]. S.M. Chung, S.H. Han, K.H. Song, E.S. Kim, Y.J. Kim, J. Lumin. 114 (2005) 227.

STUDIES ON BINARY MIXTURES OF BENT-CORE AND CALAMITIC COMPOUNDS

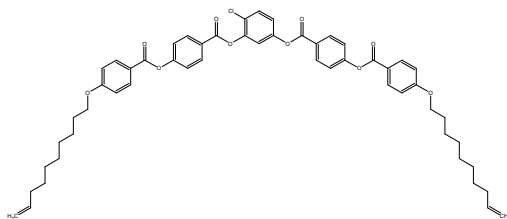
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Banana-shaped mesogens^[1] represent a new class of non-conventional thermotropic liquid crystals showing different mesomorphic properties than the classical liquid crystals formed by rod-like or disk-like molecules.

We have prepared a banana-shaped ester type liquid crystal, the 4-chloro-1,3-phenylene bis 4-[(9-decenyloxy)benzoyloxy]benzoate^[2] (**I**), which contains five aromatic rings, and exhibits a monotropic banana nematic mesophase.



I

Miscibility studies have been carried out on binary mixtures of this banana-shaped compound (**I**) and the rod-like compound, 4-n-octyloxy-phenyl-4'-n-hexyloxybenzoate^[3] (**II**), exhibiting an enantiotropic nematic phase. The phase diagrams of the binary mixtures were constructed using contact preparations. Selected mixtures were studied by DSC, textures observations and X-ray diffraction on non oriented samples. In spite of the differences between the shapes of the molecules **I** and **II** the binary mixtures preserve, or even broaden the nematic phase range. In some mixtures induction of the smectic A mesophase was also observed. The mixtures are going to be used to study the dependence of physical properties, such as flexoelectricity on the concentration of the bent-core component.

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[1] T. Niori et al., *J. Mater. Chem*, 6.1232 (1996)

[2] K. Fodor-Csorba et al., *Macromol. Chem. Phys.* 203, 1556-1563 (2002)

[3] D. Demus et al., *Flüssige Kristallen in Tabellen* (VEB Deutscher Verlag für Grundstoffindustrie, Leipzig), 1974

SOLITARY WAVES IN MATERIALS WITH NEGATIVE REFRACTION

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We investigate, both analytically and numerically, electromagnetic beam propagation through bulk material with negative dielectric susceptibility and magnetic permeability that depend on frequency. Possibility of nonlinear solitary waves formation is discussed by analyzing generalized nonlinear Schrodinger equation describing such media.

IS PERIODICITY A NECESSITY FOR PHOTONIC CRYSTALS?

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Recently strong experimental and theoretical interest in DEFORMED photonic bandgap structures as circular photonic crystals emerged. From the mathematical point of view, two algorithms will be discussed, which allow a) to deform photonic crystal lattices in a way to keep the bandgap, and b) to deform simultaneously the lattice and structure size variation for keeping a full band gap.

Adhering to some constraints the changes of transmission and stop band properties are negligible, compared to periodic structures, as calculated with finite difference time domain, plane wave expansion and local density of states techniques. It turns out that in systems with large gaps evanescent waves penetrate into the bulk only distances comparable to one lattice constant, therefore confinement of light can also be achieved WITHOUT long range order, which leads to the introduction of novel photonic bandgap designs and improved devices[1,2]

[1] “Arbitrary angle waveguiding applications of two-dimensional curvilinear-lattice photonic crystals“, J. Zarbakhsh, F. Hagemann, S. F.Mingaleev, K. Busch,-K, und K. Hingerl, Appl. Phys. Lett., 84, 4687, (2004)

[2] “Local density of states and modes in circular photonic crystal cavities“, J. Chaloupka, J. Zarbakhsh, K. Hingerl, Phys. Rev. B72, 085122, (2005)

THEORETICAL INVESTIGATION OF THE 7F_1 LEVEL SPLITTING IN A SERIES OF Eu^{3+} DOPED OXIDES MATRIXES

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The Simple Overlap Model (SOM) is applied to a series of oxide crystals (Gd_2O_3 , Y_2O_3 , Lu_2O_3 , In_2O_3 e Sc_2O_3) and a silicate glass ($\text{Na}_2\text{O}-2\text{SiO}_2$) doped with the Eu^{3+} ion. The SOM is implemented by means of computational procedures in order to give the theoretical crystal field parameters (B_q^k , $k=2, 4, 6$ and $|q|\leq k$). The $\rho(2\beta)^{k+1}$ factor is input as the shielding factor for all B_q^k expressions. The B_q^k predictions are used to calculate the crystal-field strength parameter N_V and then the maximum splitting ΔE of the 7F_1 manifold of the Eu^{3+} ion. It has been obtained another expression for α . This is an expansion factor in the ΔE expression. The theoretical predictions are compared to those of the Point Charge Electrostatic Model (PCEM) and to the phenomenological results. Good agreements have been found with respect to the linearity between ΔE and N_V using 2 as the charge factor, the valence of the oxygen ions. In the glass, as the mean M-L distances are bigger than in the crystals, as expected, N_V and ΔE are smaller. These results are satisfactorily compared to the experimental ones.

DEVELOPMENT OF SPECIFIC LASER SOURCES FOR RADIOFREQUENCY SIGNAL PROCESSING AND QUANTUM INFORMATION USING RARE EARTH DOPED CRYSTALS

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When they are cooled at cryogenic temperatures, some rare earth ions embedded in crystals exhibit very interesting characteristics, such as optical coherence lifetimes longer than a few tens of microseconds, hyperfine coherence lifetimes as long as milliseconds, and inhomogeneous broadenings of the order of a few GHz. Consequently, these crystals are now at the heart of very active fields of research, namely i) the optical processing of broadband radiofrequency (RF) signals and ii) their investigation as hardware for quantum computers and quantum memories.

In both types of applications, the potentialities of these rare earth doped crystals can be efficiently used only if the optical source used to coherently drive the ions exhibits proper characteristics. Indeed, in the case of the optical processing of RF signals, the laser source must be able to scan the whole bandwidth (several GHz) with a precision given by the desired resolution (better than 1 MHz) in a time smaller than the relevant lifetime (in the 10 μ s to 1 ms range). Besides, the coherent manipulation of the ions for quantum information processing requires the use of a laser source with a coherence time longer than the lifetime of the coherences of the excited transition, typically in the 10 μ s range. Moreover, some rare earths exhibit transitions at wavelengths far from usual laser diode wavelengths.

To address these problems, we have developed i) original methods to characterize the quantum and technical phase noises of rapidly chirped lasers; ii) unusual servo-locking schemes to control the phase noise of chirped laser sources; iii) ultra-low intensity noise laser sources used to carry the broadband radar signals; iv) single-frequency optical parametric oscillators to replace the cumbersome dye lasers in the domains where diode lasers are not available. We will present some recent results in these four fields together with their applications.

SYNCHRONOUS LUMINESCENCE SPECTROSCOPY OF MELANOMA

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Luminescence spectroscopy and imaging techniques are increasingly used for tumor detection. They are able to characterize various metabolic and pathological changes related to precancerous and cancerous growth. Luminescence has good capability to diagnose cancerous tissues due to its sensitivity to small changes in endogenous fluorophore concentrations and/or local environment present in tissues. Melanoma is one of the fastest growing cancers in the world. Failure to diagnose melanoma has serious implications for survival of patients and hence there is considerable interest in trying to produce a non-invasive method that would aid the clinician in the differential diagnosis of pigmented skin lesions. Such a method could obviate the need for surgical biopsies for the majority of benign lesions. Recently, a lot of research was focused on fixed-excitation luminescence spectroscopy of skin. However, fixed-excitation luminescence spectra tend to give insufficient contrast for tissue discrimination. A methodology that is capable of improving the specificity of the luminescence technique is the synchronous scanning method, often referred to SLS. In this work we present results of the *in vitro* SLS (constant wavelength mode) of human skin specimens obtained after clinical surgery. Normal and malignant tissue status is confirmed by histopathology and dermoscopy. Synchronous luminescence spectra were recorded at room temperature using a Perkin Elmer LS45 Fluorescence Spectrophotometer. A Xenon discharge lamp was used for illumination while a gated red-sensitive R928 photomultiplier operating up to 900 nm was used for detection. Data were recorded at a 200 nm/min scan rate and excitation wavelengths from 330 to 550 nm with 0.5 nm increments, averaging 4 scans to obtain the spectra. We analyzed SL spectra to find spectral regions where the most prominent differences exist between normal skin and melanoma. Statistical analysis is applied to investigate significance of observed differences and to predict relevance of SLS method in melanoma diagnostics.

OPTICAL PROPERTIES OF SILVER/SAGO-STARCH NANOCOMPOSITE

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Structure and optical properties of silver nanoparticles embedded in sago starch matrix were investigated. The UV-VIS absorption spectrum of the water solution of the nanocomposite material exhibited two overlapping SPR bands. Their positions strongly depended on concentration of the solution. The observed effect was interpreted in terms of the extended Mie theory for the "core-shell" nanoparticles. The obtained theoretical curves showed good agreement with experimental data. It was also shown that the calculations of particle diameter from optical and XRD measurements were in agreement with TEM observations.

STRUCTURAL CHARACTERIZATION OF EUROPIUM AND ERBIUM DOPED $\text{Li}_2\text{O}-\text{Al}_2\text{O}_3-\text{SiO}_2$ GLASS CERAMIC

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Particularly favorable properties of glass ceramics are developed on the basis of two key advantages of these materials: the variation of the chemical composition and of the microstructure. Therefore, detailed information, both structural and chemical is necessary to get insight in the novel glass ceramic materials of which two examples, obtained with sol-gel synthesis, are presented. The aim of this work was to provide a better understanding of the crystallization in the $\text{Li}_2\text{O}-\text{Al}_2\text{O}_3-\text{SiO}_2$ system when ZrO_2 is added in small quantity as a nucleating agent, and Eu_2O_3 or Er_2O_3 as luminescent dopants. The main interest was to observe the distribution of luminescent ions and to verify whether ZrO_2 crystallized in a rare-earth-stabilized cubic form, relevant to the luminescence behavior of glass-ceramics. TEM, HRTEM, and associated spectroscopy techniques (EDX, EELS, and EFTEM) are used as experimental methods. The 3-D reconstruction, done from HAADF-STEM imaging, proved to be a very valuable tool in determining the morphology of nanosize precipitates.

OPTICAL ABSORPTION DUE TO HIGH OVERTONE OF MOLECULAR FUNDAMENTAL VIBRATIONS IN PDMS MATERIALS APPLIED FOR DATA COMMUNICATION

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Solid poly(dimethylsiloxane) silicones (PDMS) have attractive characteristics as an inert, non-toxic, non-flammable and low-cost polymer showing high transparency combined with excellent tear strength. In the optical communication field, passive polymer multimode waveguides have been used for short-distance datacom optical applications, which require polymer materials of lowest intrinsic absorption losses within the spectral region of 600– 900 nm [1]. Especially, Pt-catalyzed polymerization can be carried out under low-temperature curing conditions without the formation of cross-linker by-products through hydrosilylation. The two component PDMS systems were supplied by Wacker Chemie GmbH. The cladding materials were standard commercial PDMS silicones (ELASTOSIL® RT 601), whereas the core polymer is a special development by Wacker Chemie.

A novel process for multi-mode optical waveguide device fabrication by casting polydimethylsiloxane (PDMS) has been developed at the University of Dortmund [2]. For spectral absorption band assignments, previous mid-infrared and Raman studies were taken into account. Vibrational C-H stretching overtone and combination bands dominate the near-infrared and long-wave visible spectral range. In the most important wavelength region for datacom application, i.e. the interval of 600 - 900 nm, the optical characterization and band assignment with absorption spectra recorded for the range are given for PDMS-materials that can be used for waveguide core and cladding applications. Furthermore, the theoretical multiphonon absorption loss in the region was computed in terms of the assigned band and compared with measured values from thick films. In addition, the refractive indices of the materials were measured as well and fitted with Sellmeier formula. Finally, optical propagation loss measurements of PDMS waveguide systems after different temperature treatment guided by future applications were performed at both wavelengths of 640 nm and 850 nm.

[1] N. Tanio and Y. Koike, *Polymer Journal* **32** (2000) 43.

[2] S. Kopetz, E. Rabe, W.J. Kang, A. Neyer, *Electronics Letters* **40** (2004) 668.

OPTICAL AND LIGHT SCATTERING PROPERTIES OF MONTMORILLONITE COMPOUNDS

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Montmorillonite clays have been known to have a layer structure suitable for different modifications and incorporation of the other compounds.

In this contribution pillared montmorillonite was used as substrate for different metallic oxides (Co and Ni) incorporation. The obtained forms of pillared montmorillonite were investigated by small angle X-ray technique, so call SAXS. Also in order to understand interaction of the metallic oxides and substrate an inelastic and quasioleastic light scattering phenomena were studied by Raman and Brillouin Scattering Technique. Quasioleastic measurements were also performed using 514.5 nm 2W argon-ion gas sample compartment of the light scattering goniometric system.

Time correlation measurements are used to calculate different parameters to determined scattering phenomena of measured materials.

**PREPARATION AND OPTICAL PROPERTIES OF CdS
NANOPARTICLES DISPERSED IN POLY
(2-(DIMETHYLAMINO)ETHYL-CO-METHACRYLATE
ACRYLIC ACID) CO-POLYMERS**

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CdS/poly(2-(dimethylamino)ethyl-co-methacrylate acrylic acid) nanocomposites were prepared and further characterized using structural and optical methods. Co-polymers were synthesized by radical polymerization of the co-monomers in different mol ratios (1-1, 2-1 and 1-2). It was shown that their physical properties, capping property and solubility in water strongly depend on ratios used. A blue shift of the onset of the optical absorption confirmed the presence of the nanostructured CdS within co-polymer matrixes. The size of the CdS nanoparticles estimated from the optical spectra using Brus equation agreed well to that obtained from TEM measurements.

CURRENT PROSPECTS OF INTERSUBBAND QUANTUM CASCADE LASER DESIGN AND MODELLING

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Engineering the thermal properties of quantum cascade lasers, particularly terahertz emitters, has become a central issue as we strive for higher temperature operation. With this aim we have developed a 2D calculation for the solution of the heat diffusion equation in a general waveguided device [1]. This has been linked with our electron transport model [2, 3] to produce an electro-thermal model of a quantum cascade laser [1]. We have applied this calculation to various device configurations, including antimonide-based mid-infrared lasers and GaAs-based mid-infrared and THz devices, and have investigated the effect of different device geometries and pumping conditions on the internal lattice temperature of the active region, which can be considerably higher than that of the heat sink. The model will also enable us to explain the influence of lattice temperature, doping and pumping conditions on electron heating in devices. A fully self-consistent Schrödinger–Poisson analysis, based on a scattering rate equation approach, was employed to simulate the above threshold electron transport in laser devices. V-shaped local field domain formation was observed, preventing resonant subband level alignment in the high pumping-current regime. The resulting saturation of the maximal current, together with an increase of the threshold current, limits the dynamic working range under higher doping. Experimental measurements are in good agreement with the theoretical predictions [4, 5]. The application of magnetic fields to quantum cascade lasers induces additional localisation in the plane of the quantum wells which can lead to reductions in non-radiative scattering and hence for particular values of magnetic field the device can have reduced threshold currents and operate at higher heat sink temperatures. We have developed the Boltzmann model of electron transport for the Landau level structure within the laser [6]. For the first time we can track the electron populations across all Landau levels in the active region and injectors as a function of both electric and magnetic field and give physical explanations for the rise and fall of the laser gain in terms of the internal dynamics of carriers.

[1] C.A.Evans, V.D.Jovanovic, D.Indjin, Z.Ikonic, and P.Harrison, IEEE J. Quantum Electron., in press.

[2] V.D.Jovanovic, S.Hofling, D.Indjin, N.Vukmirovic, Z.Ikonic, P.Harrison, J.P.Reithmaier, A.Frochel, J. Appl. Phys., J. Appl. Phys. **99**, 103106 (2006).

[3] J. Mc Tavish, D. Indjin, and P. Harrison, J. Appl. Phys. **99**,114505 (2006).

[4] S. Höfling, V. D. Jovanovic, D. Indjin, J. P. Reithmaier, A. Forchel, Z. Ikonic, N. Vukmirovic, P. Harrison, A. Mircetic, and V. Milanovic, Appl. Phys. Lett. **88**, 251109 (2006).

[5] V.D.Jovanovic, D.Indjin, N.Vukmirovic, Z.Ikonic, P.Harrison, E.H.Linfield, H.Page, X.Marcadet, C.Sirtori, C.Worrall, H.E.Beere, and D.A.Ritchie, Appl. Phys. Lett. **86**, 211117 (2005).

[6] I.Savic, Z.Ikonic, V.Milanovic, N.Vukmirovic, V.D.Jovanovic, D.Indjin, P.Harrison, Phys. Rev B, **73**, 075321 (2006).

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