PARAOPT–2001

INTERNATIONAL MEETING ON PARAMETRIC OPTICS

ABSTRACTS

SEPTEMBER 17-19, 2001

Institute of Phisical Optics
Lviv Ukraine

Organizing Committee

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2. Velukiy V.(Vice-Chairman)
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3. Bilyi O.
4. Andruschak A.
5. Dudok T.
6. Marsel L.
7. Trach I.
8. Kostyrko M.
9. Romanyuk H.

1-st day: September 17

9^{15} – Opening: O.G. Vlokh – director of the Institute of Physical Optics.

Chairman O.Vlokh

Plenary Lectures

9^{30} **Holographic Scattering and Thermal Fixing Experiments with $LiNbO_3$**

R. A. Rupp[1], L. Kovacs[2], G. Mandula[2], K. Lengyel[2], M. Ellabban[1], M. Fally[1]

[1]*Institute of Experimental Physics, University of Vienna, Vienna, Austria*

[2]*Crystal Physics Laboratory, Hungarian Academy of Sciences, Budapest, Hungary*

10^{15} **Raman scattering and dielectric spectroscopy investigations of phonon spectra and phase transitions in $CuInP_2(Se_xS_{1-x})_6$ and $Sn_2P_2(Se_xS_{1-x})_6$ ferroelectrics**

Vysochanskii Yu., Stephanovich V., Molnar O., Mytrovcij V., Mykajlo O., Yevych R., Gurzan M.

Institute for Solid State Physics and Chemistry, Uzhgorod University, Ukraine

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11^{00} Coffee break

Oral Session

11^{30} **Crystallooptical studies of propylammonium tetrachlorocuprate and tetrachloromanganate**

[1]Kushnir O.S., [2]Bolesta I.M., [1]Furgala Yu.M., [1]Lutsiv-Shumski L.P., [1]Shopa R.Y., [1]Sveleba S.A.

[1]*Nonlinear Optics Chair, Physics Department, L'viv Ivan Franko National University*

[2]*Radiophysics Chair, Physics Department, L'viv Ivan Franko National University*

11^{50} **Modification of optical properties of bacteriorhodopsin's base film structures**

Bandrovskaya I., Batori-Tartsi Z., Korposh O., Frolova N., Sharkany

Uzhgorod National University, Laboratory of Biotechnology, Uzhgorod, Ukraine

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12^{10} **Numerical-experimental approach for reconstruction of stress tensor distribution**

Berezhnyy I.V.

Institute of Physical Optics, Lviv, Ukraine

12^{30} **Photorefractive properties of $Sn_2P_2S_6$ ferroelectrics**

Grabar A.A., Kedyk I.V., Stoika I.M., Gurzan M.I. and Vysochanskii Yu.M.

Institute of Solid State Physics and Chemistry of Uzhgorod National University, Uzhgorod, Ukraine

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Lanch

14^{30} Poster Session (Coordinator A.Grabar)

The combined piezo-electrooptical effect in the $Ca_2Pb(C_2H_5CO_2)_6$ $K_2Cd_2(SO_4)_3$ and $LiTaO_3$ crystals

Mys O., Andrushchak A., Vlokh R.

Institute of Physical Optics, Lviv, Ukraine

Symmetry analysis of the photorefractive electrogyration and electrogyration study in the $LiNbO_3$ crystals

Vlokh R.O., Kostyrko M.E., Kruchkevych V.

Institute of Physical Optics, Lviv, Ukraine

Pressure behaviour of the birefringence near Lifshitz point in $Sn_2P_2S_6$ ferroelectric crystals.

Photoinduced magnetic linear dichroism in YIG:Co film.

[1]Miloslavskaya O.V., [1]Kharchenko Yu.M., [1]Kharchenko M.F., [2]Stupakiewich A., [2]Maziewski A.

[1]*B. Verkin Institute for Low Temperature Physics and Engineering of the Academy of Sciences of Ukraine, Kharkiv, Ukraine.*

[2]*Laboratory of Magnetism, University of Bialystok, Bialystok, Poland*

Photochromic and Photorefractive Properties of $YAlO_3$-Mn

[1]Zhydachevskii Ya., [1]Matkovskii A., [2]Sugak D., [3]Suchocki A., [3]Durygin A., [4]Vlokh R., [5]Loutts G.

[1]*National University L'viv Polytechnic, Lviv, Ukraine*

[2]*Institute of Materials, SRC «Carat», Lviv, Ukraine*

[3]*Institute of Physics, Polish Academy of Sciences, Warsaw, Poland*

[4]*Institute of Physical Optics, Lviv, Ukraine*

[5]*Center for Materials Research, Norfolk State University, Norfolk, Virginia, USA*

Absorption edge of $Sn(Pb)_2P_2S(Se)_6$ crystals under hydrostatic pressure

Slivka A.G., Gerzanich E.I., Guranich P.P., Shusta V.S., Kedyulich V.M., Kabal R.

Uzhgorod National University, Uzhgorod, Ukraine

Optical and photoelectric properties of non-crystalline antimony chalcogenides

Rubish V.M.

Uzhgorod National University, Uzhgorod, Ukraine

Structural transformations and optical transmission spectra of Sb_xSe_{1-x} films

Rubish V.M., Shtets P.P., Rubish V.V., Malesh V.I.

Uzhgorod National University, Uzhgorod, Ukraine

Effect of light irradiation on the optical properties of $Ca_3Ga_2Ge_3O_{12}$:Mn garnet

[1]Eremenko V.V., [1]Gnatchenko S.L., [1]Kachur I.S., [1]Piryatinskaya V.G., [2]Kosmyna M.B., [2]Nazarenko B.P., [2]Puzikov V.M.

[1]*Institute for Low Temperature Physics and Engineering, National Academy of Sciences of Ukraine, Kharkiv, Ukraine*

[2]*Scientific-Research Department of Optical and Constructional Crystals, STC "Institute for Single Crystals", National Academy of Sciences of Ukraine, Kharkov, Ukraine*

Long-lived photoinduced changes of optical properties of calcium-manganese-germanium garnet

[1]Eremenko V.V., [1]Gnatchenko S.L., [1]Kachur I.S., [1]Piryatinskaya V.G., [1]Ratner A.M., [1]Shapiro V.V., [2]Fally M., [2]Rupp R.A.

[1]*Institute for Low Temperature Physics and Engineering,National Academy of Sciences of Ukraine, Kharkov, Ukraine*

[2]*Institute of Experimental Physics, Vienna University, Vienna, Austria*

The indicative surfaces of induced optical effect for biaxial crystals. An example of piezooptical effect for Cs_2HgCl_4 crystals

Kaidan M., Zadorozhna A., Andrushchak A., Kityk A.

Institute of Physical Optics, Lviv, Ukraine

2-nd day: September 18

Chairman Yu. Vysochanskii

Plenary Lectures

9^{30} **Optical vortices in fiber-optical waveguides**

Alexander V. Volyar

National Tavrida V.Vernadsky University, Physical Department, Crimea, Ukraine

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10^{15} **High accuracy polarimetry and its application to studying of phase transitions**

Shopa Y.

Ivan Franko L'viv National University, Ukraine

11^{00} Coffee break

Oral Session

11^{30} **The standard error of concurrent determination hemoglobin derivatives the optical density ratio's method**

Bilyi O.I., Velykiy M., Dudok K.

Ivan Franko National University, Department of Biochemistry, Lviv, Ukraine

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11^{50} **Non-reciprocal acoustooptic effects in gyrotropic cubic crystals with electroinduced anisotropy**

Kurilkina S.N., Shuba M.V.

Department of Optics, Gomel State University, Gomel, Belarus

12^{10} **The effect of low molecular weight metabolites on the optical qualities of complexes of nitric oxide and protein polimers**

Korobov V.

Ivan Franko National University, Department of Biochemistry, Lviv, Ukraine

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Lanch

14^{30} Poster Session (Coordinator R. Vlokh)

Vibration spectra of an anion in $SN_2P_2S_6$ type crystals

[1]Rizak V.M., [2]Rizak I. M., [1]Maslyuk V.V

[1]*Uzhhorod National University, Uzhhorod, Ukraine*

[2]*Dnipropetrovsk National University, Dnipropetrovsk, Ukraine*

Birefringence of barium metaborate crystals in temperature range 80 – 330 K

[1]Adamiv V.T., [1]Burak Ya.V., [2]Sveleba S.A.

[1]*Institute of Physical Optics, Lviv, Ukraine*

[2]*Physics Department, L'viv Ivan Franko National University*

The skin retraction effect in the clinical surgical and therapeutic practice

Anatoly M. Dyadyura, Alexander V. Volyar

National Tavrida V.Vernadsky University, Physical Department, Crimea, Ukraine

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Optical and dilatative properties of diglycine nitrate crystals

[1]Andriyevsky B., [2]Czapla Z., [1]Kardash V., [2]Dacko S., [1]Dumka Yu., [1]Kurlyak V.

[1]*The Ivan Franko National University of Lviv, Ukraine*

[2]*Institute of Experimental Physics, Wroclaw University, Poland*

Spectra of fundamental dichroism of $K_2Ca(SO_4)_2 \cdot H_2O$ crystals reconstructed by the birefringence dispersion in the range of transparency

[1]Andriyevsky B., [2]Romanyuk G., [2]Brezvin R.

[1]*The Ivan Franko National University of Lviv, Ukraine*

[2]*Institute of Physical Optics, Ukraine*

Calculation of refractive indices for complicated crystals

Andriyevsky B., Kardash V., Romanyuk M.

The Ivan Franko National University of Lviv, Ukraine

Refractometric parameters of vitreous alloys of Mg-As-Se system in the infra-red range

Shpak I.I., Gadmashy Z.P., Shtets P.P.

Uzhhorod National University, Uzhhorod, Ukraine

Electron – stimulated changes in optical – refractometricproperties of glassy semiconductors of As-S(Se)-Ag(Hg)

Shpak I.I., Sokoliuk I.V., Stefanovich V.A., **Gadmashy Z**.P., Semak D.G., Rubish V.V.

Uzhhorod National University, Uzhhorod, Ukraine

Raman scattering spectrum of the blood albumin with alcohol content

[1]Vlokh R., [2]Vlokh I., [2]Moroz O., [1]Vatsynovska L., [1]Trach I.

[1]*Institute of Physical Optics, Lviv, Ukraine*

[2]*Medical University, Lviv, Ukraine*

Growth and optical microscopy observation of the lysozyme crystals

Vlokh R., Marsel L., Teslyuk I., Vlokh O.G.

Institute of the Physical Optics, L'viv, Ukraine

Optical and ultrasound investigations of phase transitions near triple point on temperature-pressure diagram of $Sn_2P_2S_6$ ferroelectric

[1]Khoma M., [2]Vlokh R., [2]Kityk A., [2]Zadorozhna A., [2]Martynyuk-Lototska I., [1]Grabar A., [1]Vysochanskii Yu.

[1]*Institute for Solid State Physics and Chemistry, Uzhgorod University, Uzhgorod, Ukraine*

[2]*Institute of Physical Optics, Lviv, Ukraine*

Optical analysis of middle-molecular_weight molecules of blood of individuals suffering from myocardial ischemia

Korobov V., Boltsta I., Dika A., Fedorovich A., Savitsky V., Galunsky A.

Ivan Franko National University, Department of Biochemistry, Lviv, Ukraine

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Determination of magnetic point symmetry of the magneto-electric $LiCoPO_4$ crystal by magneto-optic and SQUID-magnetometry techniques

[1]Kharchenko Yu., [1]Miloslavskaya O., [1]Kharchenko M., [2]Baran M., [2]Szymczak R., [3]Schmid H.

[1]*B. Verkin Institute for Low Temperature Physics and Engineering of the Academy of Sciences of Ukraine, Kharkiv, Ukraine*

[2]*Institute of Physics, Polish Academy of Sciences, Warsaw, Poland*

[3]*Department of Inorganic, Analytical and Applied Chemistry, University of Geneva, Geneva, Schwitzerland*

3–rd day: September 19

Chairman A. Volyar

Plenary Lectures

9^{30} **The perspective of the development of the relaxed (relaxation) optics.**
Petro P.Trokhimchuck
Department of the theoretical and mathematical physics, Lesya Ukrayinka's Volyn state university, Lutsk, Ukraine

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10^{15} **Optical techniques for characterization of distorted liquid crystals**
Nastishin Yu. A.
Institute of Physical Optics, L'viv, Ukraine

11^{00} **Crystallooptics of the circularly-polarized waves**
Vlokh R.
Institute of Physical Optics, Lviv, Ukraine

11^{40} Coffee break

Oral Session

12^{10} **Light beams focusing in periodically non-uniform crystalline medium**
Kurilkina S.N.
Department of Optics, Gomel State University, Gomel, Belarus

12^{30} **Vibration spectra of an anion in $Sn_2P_2S_6$ type crystals**
Vasyl Rizak
Uzhhorod National University, Uzhhorod, Ukraine

12^{50} **Charged domain walls in $Sn_2P_2S_6$**
Kaynts D.I., Horvat A.A., Grabar A.A. and Stoika I.M.
Institute of Solid State Physics and Chemistry of Uzhgorod National University, Uzhgorod, Ukraine

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13^{10} **A microscopic model for elastic, piezoelectric and dielectric properties of Rochelle type crystals**
Levitskii R.R., Zachek I.R., Verkholyak T.M., Moina A.P.
Institute for Condensed Matter Physics, Lviv, Ukraine

Lanch

14^{30} Poster Session (Coordinator O. Kushnir)

The studies of domain structure in ferroics by imaging polarimetry. The case of Rochelle salt and lead orthophosphate
Krupych O., Vlokh R., Kostyrko M.
Institute of Physical Optics, Lviv, Ukraine

Size effects in raman spectra of $Sn_2P_2S_6$ ferroelectrics
[1]Gomonnai A.V., [2]Vysochanskii Yu.M., [1]Azhniuk Yu.M., [2]Prits I.P., [1]Romanova L.G., [1]Solomon A.M.
[1]*Institute of Electron Physics of the Academy of Sciences of Ukraine, Uzhhorod, Ukraine*
[2] *Uzhhorod National University, Uzhhorod, Ukraine*

Multichannel acoustooptical spectrum analyzers with the time integration
Martynyuk-Lototska I.Yu., Vlokh R.O.
Institute of Physical Optics, Lviv, Ukraine

Optical investigations of phase transitions in $CuMP_2X_6$ (M=In,Cr; X=S, Se) layered crystals
Studenyak I.P., Mitrovcij V.V., Kovács Gy.Sh., Mykajlo O.A., Gurzan M.I., Vysochanskii Yu.M.
Institute of Solid State Physics and Chemistry, Uzhhorod National University, Uzhhorod, Ukraine

Optical absorption edge anomalies at superionic phase transition in Cu_6PSe_5Br crystals

Studenyak I.P., Kovács Gy.Sh., Panko V.V., Mitrovcij V.V., Mykajlo O.A., Stefanovich V.O.

Institute of Solid State Physics and Chemistry, Uzhhorod National University, Uzhhorod, Ukraine

The phase boundary and the domain structure in ferroelastic $K_2Mn_2(SO_4)_3$ crystals

[1]Vlokh R., [1]Vlokh O.V., [1]Skab I. and [2]Uesu Y.

[1]*Institute of Physical Optics, Lviv, Ukraine*

[2]*Department of Physics, Waseda University, Tokyo, Japan*

Cs_2HgCl_4 crystals as perspective acoustooptical material

Zadorozhna A.V., Kaidan M.V., Andrushchak A.S., Kityk A.V., Vlokh O.G.

Institute of Physical Optics, Lviv, Ukraine

Computer simulation of conoscopic papperns for distorted nematic cells ad their experimental observations

Nastishin Yu.A., Dovgyi O.B., Vlokh O.G.

Institute of Physical Optics, L'viv, Ukraine

Textural and conoscopic studies of chiral liquid crystals possessing cholesteric – smectic *A* or cholesteric – TGBA –smectic *A* phase transitions

[1,2]Nastishin Yu.A., [2]Kleman M., [1]Dovgyi O.B.

[1]*Institute of Physical Optics, L'viv, Ukraine*

[2]*Laboratoire de Mineralogie – Cristallographie, Paris, France*

On the piezooptical properties of multidomain KDP crystals

[1]Romanjuk M.M., [2]Stadnyk V.Yo., [3] Romanjuk G.M., [3]Brezvin R.S.

[1]*National University "Lviv politechnika", Lviv, Ukraine*

[2]*Lviv Ivan Franko National University, Lviv, Ukraine*

[3]*Institute of Physical Optics, Lviv, Ukraine*

Refractometry of incomensurate phase in $LiRbSO_4$ crystals

V.Yo.Stadnyk, M.O.Romanyuk, L.T.Karplyuk, V.Yu. Kurlyak

Lviv Ivan Franko National University, Lviv, Ukraine

Effect of unaxial influence pressures on the location and shape of the fundamental absorption edge of Rochelle salt crystals

Stadnyk V.Yo., Romanyuk M.O., Vachulovych V.F., Prytula O.O.

Lviv Ivan Franko National University, L'viv , Ukraine

Raman spectra of Cs_2CdBr_4 single crystals

Shchur Ya.I., Trach I.B., Vlokh O.G.

Institute of Physical Optics, Lviv, Ukraine

Raman-Nath thin gratings on low-saturated dynamic recording materials

S.Bugaychuk, E.Korchemskaya, B.Burykin

Institute of Physics National Academy of Sciences of Ukraine

INVITED LECTURES

Holographic Scattering and Thermal Fixing Experiments with $LiNbO_3$

R. A. Rupp[1], L. Kovacs[2], G. Mandula[2], K. Lengyel[2], M. Ellabban[1], M. Fally[1]

[1]Institute of Experimental Physics, University of Vienna, Vienna, Austria
[2]Crystal Physics Laboratory, Hungarian Academy of Sciences, Budapest, Hungary

Holographic scattering is a phenomenon known now since more than thirty years to occur in $LiNbO_3$ under coherent irradiation. Despite of it, its potential as a tool for the characterization of optical, and in particular of photorefractive, properties has still by far not been fully exhausted.

An overview on the characterization of photorefractive media by holographic scattering is given. In particular, the angular and wavelength dependence of the steady state transmission is discussed. Holographic scattering has successfully been used to determine the activation energy of thermal fixing. The results are compared with those obtained by other methods. Possible reasons of apparent discrepancies between the methods are discussed. One of the methods is based on the recently discovered kinetics of the OH^- absorption band and has the perspective to provide site-specific information on hydrogen defects responsible for the thermal fixing process. The question will be dealt with, on how the density of those hydrogen defects which are „silent“ in absorption measurements, namely the free hydrogen defects, can in principle be determined by holographic scattering experiments.

Support by the Hungarian Scientific Research Fund (OTKA, No. 26088) and of the Österreichischer Austauschdienst (ÖAD-WTZ A-2/1998) in the frame of the Hungarian-Austrian Intergovernmental S&T Cooperation Programme are greatfully acknowledged.

Raman scattering and dielectric spectroscopy investigations of phonon spectra and phase transitions in $CuInP_2(Se_xS_{1-x})_6$ and $Sn_2P_2(Se_xS_{1-x})_6$ ferroelectrics

Vysochanskii Yu., Stephanovich V., Molnar O., Mytrovcij V., Mykajlo O., Yevych R., Gurzan M.

Institute for Solid State Physics and Chemistry, Uzhgorod University,
88000, Uzhgorod, Ukraine.

For crystals $Sn_2P_2(Se_xS_{1-x})_6$ with three-dimensional lattice a smearing of ferroelectric phase transitions is enough weak. Here a sublattice of Sn^{2+} cations is ferroactive and phase transitions have mixed displacive – order/disorder character. In the case of $CuInP_2(Se_xS_{1-x})_6$ layered crystals the phase transitions have clearly order/disorder character and occur by Cu^+ ions ordering in many-well local potential, that is formed by chalcogen atoms in the anion $[P_2S(Se)_6]^{4-}$ sublattice. For these crystals on dielectric data a morphotropic phase boundary $x_m(T)$, which divides on the concentration – temperature diagram the monoclinic and trigonal phases, is determined. Weaker correlation of the Cu^+ fluctuation (if compare with this one for Sn^{2+}) obviously determines strong phase transitions smearing at some inhomogeneous chalcogen atoms distribution in $CuInP_2(Se_xS_{1-x})_6$ mixed crystals. The smearing very strong at substitution of sulfur atoms in $CuInP_2S_6$ by bigger selenium atoms and it increases at growing of Se concentration till x_m. For the compositions with $x > x_m$ the second order transitions ($T_i(x)$ line) from paraelectric phase to intermediate one (obviously incommensurate) are clearly observed, but anomalies at the line $T_c(x)$ of transitions from intermediate phase to ferrielectric one are fully destroyed. The substitution of S by Se in $CuInP_2S_6$ obviously stronger influences on the local potential of Cu^+ ions if compare with such influence at substitution of Se by S in $CuInP_2Se_6$. This is confirmed by highest concentration velocity of T_c decreasing near $x = 0$ comparatively with this one for T_i near $x = 1$.

On the Raman scattering data for mixed crystals $Sn_2P_2(Se_xS_{1-x})_6$ additional bands with intensity maximum lying at the center, or at the sulphide and selenide ends of the concentration interval are related to the internal vibrations of various anion impurity configurations. Intensity of additional bands is proportional to the probability of the appearance of structural $P_2(Se_kS_{6-k})$ ($k = 1,...,6$) groups with certain S and Se content for given solid solution concentration x and testifies the statistical distribution of chalcogen atoms in the solutions $Sn_2P_2(Se_xS_{1-x})_6$. The concentration behavior of the Raman spectra for $CuInP_2(Se_xS_{1-x})_6$ crystals has more complicate character.

The lattice dynamics model calculations are used for establishing of the phonon spectra peculiarities in investigated mixed crystals. For the modeling of long wave phonons concentration behavior in the solid solutions a random element isodisplacement model was used. The phonon spectra of basis compounds were calculated in a rigid ions model with using of an axially symmetric field approach.

PARAOPT - 2001

LVIV-2001

High accuracy polarimetry and its application to studying of phase transitions

Y.Shopa

Ivan Franko L'viv National University, 8 Kyryl and Mefodiy Street, L'viv, 79005, Ukraine

Polarimetry is one of the most sensitive method of studying of the origins of phase transitions of solids, including incommesurate transitions; the analysis of the structural units configuration of solids; and the accurate determination of symmetry elements and twinning of crystals [1–3].

Technique of high accuracy polarimetry is quite popular. Different laboratories use it in various versions, particularly in the version of spectropolarimetry and development the theory and practice of such measuring. The present review is devoted to the technical aspects of polarimetric measurements by high-accuracy polarimetry as well as a detail studying of optical activity and electrogyration in ferroelectric crystals.

In most cases optical activity and electrogyration can be observed at the conditions of the presence of linear birefringence. The measuring of the optical activity in the birefringent sections is difficult because the linear birefringence is typically 1000×larger than either of the circular effects. The methods of their measuring in such conditions are more complicated, but the obtained results are usually quite interesting. The principle problem in the high-accuracy universal polarimeter is removing the characteristic parasitic errors in a linearly birefringent and optically active crystal.

All methods for measuring the optical activity in birefringent directions are based on the obtaining of the ellipticity of the normal waves, k, from the polarization state of the beam emerged from the crystal. In the case of small ellipticity of normal waves ($k < 0.001$), the measuring errors of optical activity increase, and the induced effects, such as electrogyration, become undetected for apparatus. These errors should preferably be determined in each measurement process, since the instrumental parasitics depend not only on the optical and mechanical elements of the experimental system (polarizers, rotators, detection unit etc.), but on sample quality, alignment of the system, and even in many cases exactly where the light beam passes through the sample. Thus, measurements with different samples give different values of parasitic errors.

The measurement technique and experimental results of first polarization methods on the base of the azimuthal oscillations and high accuracy null polarimetry, HAUP, tilter system are analyzed. The attention is paid to a method that is similar to HAUP, which was designed with participation of the author and is used for studying of a number of crystals.

High accuracy polarimetry during last years was useful at studying of the optical properties of dielectrics and ferroelectrics. Some results for example concerning incommensurate phases, till now remain debatable. At the same time properties of the ferroelectric crystals, obtained on the basis of the measuring of temperature behaviour of an optical activity are interesting and useful for the understanding of phase transitions mechanism. For KDP group crystals (KH_2PO_4, $NH_4H_2PO_4$, CsH_2AsO_4 and RbH_2PO_4) the temperature dependence (from 295 K to melting temperatures) of g_{11} components of gyration tensor are obtained.

1. Kobayashi J. Phase Transition. **36 (**1991) p. 95–128.
2. Condens. Matter News. 2(4) (1993) p. 19.
3. Kaminsky W. J.Rep.Prog.Phys. **63** (2000) p. 1575–1640.

The perspective of the development of the relaxed (relaxation) optics

Petro P.Trokhimchuck

Department of the theoretical and mathematical physics. Lesya Ukrayinka's Volyn state university. 43025 Ukraine. Lutsk. Voly av.13. E-mail: trope@lab.univer.lutsk.ua

The relaxed optics (RO) [1] is the branch of physics the nonadiabatic interaction the optical irradiation with matter. The awakening and development of RO is the result of the development the laser physics. The creation of the power lasers in the wide spectral region allows receiving the basic new data. Practically this branch of physics researched the "traces" of the light in matter. In this case the process of the interaction lidht and matter is little known. Basic optical and solid state physics theories have static nature. In the whole process of the interaction lidht and solid in the region of fundamental and impurity absorption of matter, including crystals, represent dynamic process. The last may be included the chain elementar processes: quantum and wave, electrodynamic and thermal, with short and long range action. The Yvon's-Bogolyubov's-Born's-Kirkwoode's-Green's chains were generalized and used for the classification the basic experimental data of RO. Elements of the physical of the irreversible phenomena, physical optics and physica status solidi was used for the creation the theory of this processes. The optimal synthesis of these elements is represented the theoretical part of the RO.

Primary process of the interaction light and matter is process with short range action (quantum, kinetic process). In this case quantum of light interact with corresponding center of the absorption. After this two processes of the reaction and relaxation of ionic subsystem may be realized: adiabatic and nonadiabatic. First processes are the processes of linear and nonlinear optics. Second are the processes of the radiation physics and photochemistry. For the irradiation with large intencity the secondary processes have basic influence on the finished state of matter. As rule it are the processes with long range action (dynamic processes). The role of these both processes on the creation the nonadiabatic changes in InSb and InAs and other matter is represented in [1].

The RO has the large perspectives of the development. In the theretical sense it is the creation new theries of the interaction light with matter: including new representations of wave-corpuscular and light-matter dualisms. The receiving new experimental data of the interaction the light with anisotropic crystals, including crystals with cubic structure, may be allowed to revise and expance the basic conceptions of physica status solidi. Formalism of RO allows studying the process of the fundamental absorption light in matter in more widely sense. Further development of new microelectronic and optoelectronic technologies is impossible without this branch of physics. It is the new procedure of the lithography, laser and optical implantaion, laser and optical annealing of the radiation damages.

The RO may be used for the creation new technologies for the renewal in the painting, archaelogy and architecture. The methods of this science may be used for the creation new materials for the stomatology too.

P.Trokhimchuck Polymetric modelling of the informative and physical processes. Lutsk, Veža, {1999}.

Optical techniques for characterization of distorted liquid crystals

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Optical characterization of a liquid crystal (LC) implies the identification of LC phases and reconstruction of the director distribution in a given LC specimen using optical facilities. Several techniques – Optical Polarization Microscopy (OPM), Polarization Confocal Microscopy (PCM), Magnetic Null technique, Crystal Rotation technique, Optical Conoscopy, RV-technique for the determination of nematic polar anchoring strength W are analyzed. The abilities of the techniques in the application to LC's are illustrated by the author's recent results obtained in collaboration with France and USA liquid crystal groups. Identification of new LC TGBA and lyotropic chromonic nematic phases via their defects, optical study of the interface between the lyotropic L_3 (sponge) phase and a solid substrate, computer simulation of the conoscopic patterns for distorted (including hidden deformations) nematic LC cells and their experimental observations, protocol for the measurements of W, the RV-technique and other results are among the problems solved using optical techniques analyzed in this paper.

Crystallooptics of the circularly-polarized waves

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The present report is devoted to the phenomenological analyze and experimental investigations of the interference and interaction of the circularly-polarized waves in the gyrotropic anisotropy crystals.

It was shown that in the gyrotropic crystals at the wavelength of isotropic point conoscopic pictures, which are connected, with the interference of the circularly polarized waves could be observed. The view of this conoscopic pictures was analyzed for crystals of all point groups of symmetry. The difference between usual conoscopic pictures, which are observed in crystals, which possess only circular birefringence, was show.

The shapes of the refractive index surfaces for the left and right circular waves at the wavelength of the isotropic point were obtained. It was show that on the contrary to the linear birefringence, circular birefringence will be in all directions if the components of gyration tensor possess the same sing; can be absent in all directions which belong to the mutually perpendicular planes (Planes of the circular optical axis) in the crystals with a point group of symmetry mm2, $\bar{4}$2m, $\bar{4}$ and can be absent in all directions which belong to the cone or elliptical cone (cone of the circular optical axis) in other gyrotropic crystals. It means that the gyrotropic crystals are optically multiaxial. The two-beam circular refraction effect (the similar effect as the conical refraction for the linear birefringence crystals) was described.

The sign condition for the induced electrogyration and piezogyration effects in enantiomorphic crystals was formulated. This condition was experimentally checked on the quartz crystals by the investigation of electro- and piezogyration effects in a longitudinal geometry.

The acoustogyration interaction between optical beams and periodical distribution of the imaginary part of dielectric permitivity induced by the acoustic wave through the piezogyration effect was described. The acoustogyration diffraction of light was experimentally investigated in the collinear geometry of the experiment in the enantiomorphic quartz crystals. The energy transferring between the left and right waves under the influence of the longitudinal acoustic wave which were propagated along Z axis was observed.

ORAL SESSION

Crystalooptical studies of propylammonium tetrachlorocuprate and tetrachloromanganate

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Tetrachlorocuprates and tetrachloromanganates of propylammonium abbreviated to PACC and PAMC in the following text belong to a general family of $(C_nH_{2n+1}NH_3)MeCl_4$ crystals with n = 3. Recently the compounds have attracted much interest of researchers since they manifest a variety of structural phase transitions, including those into ferroelectric, ferroelastic and incommensurately modulated phases (see [1]). Bis-propylammonium modifications of tetrachloromanganate and partly of tetrachlorocuprate are most extensively investigated, while their iso-propylammonium modifications still remain to be studied in a more detail. It is known that the bis-propylammonium compounds have a layered structure and possess the so-called re-entrant incommensurate phases. The iso-propylammonium tetrachlorocuprate lacks such the temperature behaviour, manifesting instead a thermochromic phase transition. The crystals manifest an interesting temperature dependence of linear birefringence and, in the case of bis-PAMC, a controversial presence of optical activity effect within centrosymmetric incommensurate phase. This encourages further optical experiments on the above objects.

In this work we report the results of combined crystal optical studies of iso-PAMC and bis-PACC crystals. We have measured their linear birefringence, the optical indicatrix orientation, the optical activity and the linear dichroism. The Senarmont and the universal null-polarimetric techniques (see [2]) have been employed with this aim. The temperature range under test has been located above the room temperature. Several crystal samples have been measured and the results compared to each other in order to reveal the influence of structural defects, the domain state and the optical quality of samples on the optical parameters.

A continuous second-order phase transition at 38 ^oC occurs in iso-PAMC compound manifesting itself in changing of the temperature slope of the birefringence. The birefringence of bis-PACC crystal depends nonlinearly on temperature, showing slight changes at the 107 ^oC phase transition into incommensurate phase. The results correlate fairly well with the data of the earlier study [3]. In agreement with the symmetry (the inversion point group *mmm*), the optical activity and the indicatrix rotation in the room-temperature phase are absent. The measurements in the incommensurate phase face serious difficulties since the optical quality of the sample surfaces rapidly decreases there, due to irreversible processes in the open atmosphere. However, preliminary results demonstrate a presence of some amount of the optical activity, similarly to the case of bis-PAMC known from the literature.

1. H.Z.Cummins, *Phys. Rep.* **185**. 211 (1990)
2. O.S.Kushnir, Y.V.Burak, O.A.Bevz, I.I.Polovinko, *J. Phys.: Condens. Matter*. **11**. 8313 (1999)
3. S.A.Sveleba, I.I.Polovinko, M.I.Bublyk, V.J. Kusto, *Kristallografiya*. **40**. 104 (1995).

Modification of optical properties of bacteriorhodopsin's base film structures

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At the moment, research for new photochrome materials for processing optical information are performed, which are regarded with special attention as compared to other known materials. Biopolimer films on the base of bacteriorhodopsin look promising. Our investigation are dedicated to the development of photosensitive media on the base of bacteriorhodopsin and study of possibilities to regulate its optical parameters by the addition of sensibilizing compound with the purpose of eludicification of opportunities for practical application in the field of optoelectronics.

The main task is the clarification of the questions of effective regulation of the optical parameters of the BR films, theoretic and experimental founding of the principles which would allow this regulation. It's necessary to investigate the kinetics of reversible photochemical transformations in order to reach this aim.

Bacteriorhodopsin (BR), a light-driven proton pump is a simple energy transforming protein that forms trimers within a twodimensional hexagonal crystalline lattice array in the purple membrane (PM) of *Halobacterium halobium*. The process of transforming energy is performed within the frame of one molecule. The protein consists of a single polypeptide chain; 248 amino acids form seven transmembrane α–helixes with the retinal linked to lysine 216 via the protonated Schiff base.

The photoexcited light-adapted BR, containing all-trans retinal, passes through a series of intermediate states (denoted by the letters K, L, M, N and O) that thermally interconvert in the picosecond to millisecond time scale and translocate a proton through the membrane. The intermediate states are characterized spectroscopically by different absorption spectra. The L to M transition plays an important role in the proton pumping mechanism. The transition is indicated by a blue shift of the absorption maximum, from 545 to 410 nm, when the Schiff base loses its proton.

Optical absorption kinetic measurements were carried out on suspensions and dried samples of bacteriorhodopsin in gelatine matrix treated by chemical additives at different concentrations and humidities, in order to get information about the effect of these additives on the photocycle. The photocycle of dried sample slowed down by two orders of magnitude in the presence of chemical additives. The effect of water content on the chemically treated dried samples was studied, giving the longest lifetime at 0.5 relative humidity. To understand the mechanism of triethanolamine, several bacteriorhodopsin mutants (D96N, D212N, and E204Q) were investigated.

Numerical-experimental approach for reconstruction of stress tensor distribution

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Hybrid, experimental-computational technique for reconstruction stress tensor distribution for weakly inhomogeneous weakly anisotropy medium has been presented.

Hybrid approach is based on the optimisation algorithm as follows. First, mathematical model that describes stress tensor distribution, is chosen. According to this model computational data is generated (direct problem) and than comparised with data of experiment. The output of comparison is improving of mathematical model above. Procedure is continued until suitable coincidence of computational and experimental data is achieved.

Hybrid approach was built with assumption that the body is probed by the linear polarized light for 4 noncomplanar direction (racurs). For each direction 2D distributions for parameters of Jones matrix of elliptical retarder (phase difference, azimuth and ellipticity angle of eigen polarization state) have to be obtained.

Numerical experiment for disk under diametrical compression was performed for verification the hybrid approach. Real accuracy of 3 parameters whole field polarimetry was taken into account.

Photorefractive properties of $Sn_2P_2S_6$ ferroelectrics

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Tin hypotiodiphosphate $Sn_2P_2S_6$ is a ferroelectric crystal possessing a linear electrooptic effect (below 66°C) and a photoconductivity. This combination provide the photorefractive properties of these crystals and makes its suitable for various applications, such as coherent beam amplification, phase conjugation and laser beam clean-up, image processing, etc. The photosensitivity of the crystal cowers the range from 530 to 1300 nm, that is potentially attractive for using the crystal with diode lasers.

In the communication a review of the optical and photorefractive properties of the $Sn_2P_2S_6$ crystals is presented. The experimental studies of two- and four-wave mixing, phase conjugation, photorefractive beam fanning and parametric scattering were performed using red (He-Ne) and infrared (diode) laser beams, and a set of the microscopic parameters responsible for the photorefractive effect was obtained.

Some attention has been given to the improving the photorefractive parameters of the studied material. It is shown that these parameters (two-beam gain coefficient, response time constant) can be effectively modified by post-grown treatment (light irradiation, thermal annealing), as well as by vapor-transport growth conditions. The best modified $Sn_2P_2S_6$ samples exhibit large values of the gain coefficient (from 38 cm^{-1} at 633 nm light wavelength [1] to 12 cm^{-1} at 852 nm).

Applicability of the proposed crystals was demonstrated on the example of the novelty filters in one- and two-beam schemes, wavefront converter, motion detection and tracking, edge enhancement. The high contrast and relatively short time constant permits to realize the image transforming in real time.

1. A. A. Grabar, I. V. Kedyk, M. I. Gurzan, I . M. Stoika, A. A. Molnar and Yu.M. Vysochanskii, *Opt.Commun.,* **188** 187 (2001)

The standard error of concurrent determination hemoglobin derivatives the optical density ratio's method

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Hemoglobin has the property of accepts and donates the molecular oxygen to forming the molecular base of respiratory function of blood. The hemoglobin interact with oxygen gives rise to oxyhemoglobin (HbO). The interaction of hemoglobin with carbon oxide may result in a molecule of carboxyhemoglobin (HbCO). The oxidant impact on the hemoglobih in blood human is responsible for derivatives of methemoglobin (MtHb) and deoxyhemoglobin (RHb) which are devoid of oxygen must be transported. For this reason the determination of hemoglobin derivatives are of the utmost significance. The optical methodes of determination of hemoglobin derivatives in blood was founded on Lambert-Beer law and described in literrature. By this means the operating of the instruments IL 282 CO-Oximeter (Instrumentation Laboratory Inc.,USA) , OSM3 Hemoximeter, acid-base laboratory ABL 330 and ABL 520 (RADIOMETER A/S., Denmark). This instruments analysis of % deoxyhemoglobin, % oxyhemoglobin, % carboxyhemoglobin, % methemoglobin and total hemoglobin (tHb). In paper [1] describes a five-wavelength method for the simultaneous of RHb-, HbO-, HbCO-, MtHb- and sulphemoglobin (SHb). In this method to determihation of hemoglobin derivatives is required the equals the absorbances at five wavelengths, and equals the molar extinction coefficients matrics. The values of concentration the derivatives can be calculated assuming that the values the absorbances and molar absorbency coefficients are known. Instrumental error of determination of hemoglobin derivatives this methods the following:

- the error of absorbency measurements;
- the error of determinated of 25 molar extinction coefficients;
- the error of calculated of concentration the derivatives.

A spectrophotometric method optical density ratio for simultaneous determination of four derivatives as for deoxyhemoglobin, oxyhemoglobin, carboxyhemoglobin, methemoglobin and sulphemoglobin in a blood sample is described [2]. These method of determination of hemoglobin derivatives which is not warranted of 25 molar extinction coefficients, whereas relative quantites, which determined across the absorption spectrum of two hemoglobin derivatives at are constant concentration. In these report the standard error of concurrent determination hemoglobin derivatives the optical density ratio's method is described. The normalized averaged spectrum the standart errors of derivatives hemoglobin as deoxyhemoglobin, oxyhemoglobin, carboxyhemoglobin and methemoglobin in the spectral range 14200-21000 cm^{-1} is reduced. A special feature the optical spectra in the visible regions of sulfgemoglobin is described.The relation between electron withdrawal from iron in heme porfine and peculiarity via absorption and resonanse Raman spectra in spectrochemic line is consided.

1. Zwart A., Buursa A, E.J. van Kampen, Geseburg B., Zijlstra W.G. A multi-wavelength spectrophotometric method for the simultaneous determinationof five haemoglobin derivatives, J.Clin.Chem.and Clin. Biochem., **19**, 457, (1981).
2. Bilyi O. I., Veliky M. M., Dudok K. P. Original method of concurrent determination of hemoglobin derivatives, Pros. SPIE, **3926**, 228, (2000).

Non-reciprocal acoustooptic effects in gyrotropic cubic crystals with electroinduced anisotropy

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One of the most actual problems of modern laser physics is receipt of one- frequency generation regime. By this, non-reciprocal effects, caused by difference of amplitudes and phases of waves passing the optical element in the ring resonator in contrary directions are widely used. However, use of traditional Faraday elements, for which presence of non-reciprocity is caused by influence of external magnetic field, is not expedient in the case of powerful solid state infrared lasers because of absence of materials with high magnetooptic activity for given spectrum range. Last years the opportunity of receipt of one- frequency generation with the help of diffraction of contrary light waves on propagating ultrasonic wave is grounded theoretically and experimentally [1-3].

In the present report it has been considered the influence of optical activity (gyrotropy) and electroinduced anisotropy on non- reciprocal acoustooptic (AO) effects. It has been shown that by diffraction of counter- propagating light waves on ultrasonic wave in gyrotropic cubic crystal with electroinduced anisotropy connected amplitude, phase and polarization non- reciprocities appear. It has been established their dependence on parameter of gyrotropy and value of external electric field. It has been found that presence of optical activity leads to doubling the number of non- reciprocal maximums. It has been grounded necessity of calculation of gyrotropy by use non- reciprocal acoustooptic elements on the base of non-centrocymmetrical crystals.

It has been discovered that by application of external electric field maximums of amplitude and phase non- reciprocities are displaced and increased. It has been shown that by change of direction of field it is possible change of sign of non- reciprocity and, hence, direction of ring laser generation.

It has been established essential influence of polarization characteristics of incident light on value and sign of amplitude non- reciprocity. It has been proposed the method of polarization control by generation regimes of ring laser.

Obtained results may be used for creation and optimization of parameters of non- reciprocal elements with electric and polarization controlling.

1. T. Vesevovskaya, E.Klochan, E. Lariontsev et al, *Kvantovaya electronika*. **17.** 823 (1990).
2. W. Clarcson, A. Neilson and D. Hanna, *Opt.Commun*. **91.** 365 (1992).
3. S. Kurilkina, *Kvantovaya electronika*. **22**. 941 (1995).

The effect of low molecular weight metabolites on the optical qualities of complexes of nitric oxide and protein polimers

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In mammals nitric oxide (NO), enzymatically obtained from arginine, plays the role of one of the universal regulators of metabolism [1]. Many regulatory effects of this low molecular weight lipophillic radical are owed to its ability to modify biopolymers [2]. Our research has shown that NO, reacting with globular proteins, changes the optical charscteristics of the latter.

Treatment of serum albumin with nitric oxide at pH 7.36 was accompanied by a hypochromic effect in the region where light is absorbed by aromatic aminoacids (277 nm) The hypochromic effect was 25%. The treatment of albumin solutions with nitric oxide in the presence of the cardioprotector taurin was accompanied by a significant hypochromic effect, equal to 80%. Here a hypsochromic effect was also observed. This hypsochromic efect was expressed as a shift of 8.7nm in the absorbtion maximum to the shortwave region. When nitricoxide is passed through solutions of deoxyhemoglobin (Hb) and deoxymyoglobin, the formation of nitrozohemoproteids was observed. These nitrozohemoproteids were characterized by electron spectrums with absorbsion maximus at 543.5 and 572.6 nm in the visible region of the spectrum, and 344.9 and 280 nm in the ultraviolet region.

It was noted that, as nitrolizing increases, the intensity of absorbtion at 344.9 nm decreases, and with a full change over of deoxyhemoglobin to Hb-NO, it vanishes completely. Here a hypsochromic effect in the Soret region was also observed. The dipeptide carnosine (well known as a mobile buffer and antioxidant) slowed down the process of nitrolizatian of the respiratory hemoproteids of blood and muscle. The particularities observed in the electron spectra of the biopolymers under study may be used to develop sensitive methods for detecting NO in vivo and in biomaterial outside the organism. Considering the fact that metabolites of low molecular weight (taurin and carnosin) define the efficiency of the interaction between NO and biopolymers, they be used in clinical practice in the capacity of natural regulators of the circulatory processes of NO in the organism.

1. T.V. Dawson, S.H. Snyder, J. Nturosci
2. T. Shiga, K-J. Hwang, I. Tyuma, *Biochemistry.* **8**. 1 (1969)

Light beams focusing in periodically non-uniform crystalline medium

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Effects of non-lens focusing of light in crystalline media are of great theoretical and practical interest. Earlier it has been shown [1,2], that analogous phenomena may take place in linear uniform biaxial gyrotropic crystals. Last years attention of many investigators attracts study of non-uniform media, for example, with periodical non-uniformity (layered periodical crystalline structures, photonic crystals). In the present paper it has been considered the peculiarities of propagation and diffraction of optical waves in the crystalline periodically non-uniform media.

It has been obtained correlation of light beam divergence in the crystal with curvatures W_a of wave vector surface. It has been shown, that if curvatures are negative, the beam is focusing; by $W_a>0$ the beam is defocusing; if $W_a=0$, nondiffractional propagation takes place. It has been established, that presence of the periodic non-uniformity of the crystal and natural anisotropy leads to essential deformation of wave vector surface, namely, to appearance of local regions with negative curvature. Hence, it is possible the effect of light focusing in corresponding directions. It has been found the correlation between focusing, dielectric properties of the non-uniform crystal, depth of modulation of its dielectric permeability and parameters of incident optical beam.

It has been investigated the different types of periodical non-uniformity of the medium and their influence on light focusing. It has been obtained conditions of the tolerance of focusing properties to variations in depth of modulation of dielectric properties.

It has been shown, that presence of uniform electric field may lead to deformation of wave vector surface and intensify the light focusing. It has been determined the conditions of this phenomenon.

It has been proposed the diffractional lenses based on the use of crystalline media with periodical non-uniformity. It has been made estimation of their focusing length and angular aperture. It has been investigated the opportunity of changes of lenses parameters by uniform electric field and variation of incident light beam polarization. It has been established essential influence of the latter on the focusing.

Results o

Charged domain walls in $Sn_2P_2S_6$

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Domain structure of the $Sn_2P_2S_6$ uniaxial proper ferroelectrics is considered. A possibility of appearance of the charged domain walls is analysed on the base of the crystal symmetry, its dielectric and elastic properties, and the model of the charged wall between opposite domains in the $Sn_2P_2S_6$ was constructed in the electrostatic approximation.

Some manifestations of such kind of domains were observed in optical and dielectric experiments. For example, specific directional light scattering [1] in $Sn_2P_2S_6$ ferroelectrics-semiconductors (and their solid solutions) in polydomain state was registered. This light scattering is directed at almost direct angle to the incident light beam at some specific orientation of the sample. Behaviour of this effect suggests that it is caused by light reflection on layers formed by charge carriers which screen charged domain walls between opposing 180° domains. An orientation of the reflecting layers and its distribution on the bulk of $Sn_2P_2S_6$ samples was studied. The results of the pictures of scattering are compared with alternative methods and with the result of the above analysis.

By the other hand, the existing of charged domains indirectly manifest itself in dielectric properties, such as high domain wall contribution in the dielectric permittivity and conductivity, light-induced dark conductivity etc. The eventual influence of the charged walls on the electrical properties of $Sn_2P_2S_6$ is also discussed.

It is demonstrated that the effect of the directional light scattering permits to check a unipolarity grade over the $Sn_2P_2S_6$ samples, and also to refine optically their complete crystallographic orientation.

A.A.Grabar, *J. Phys.: Cond. Matt.* **10** 2339 (1998)

A microscopic model for elastic, piezoelectric and dielectric properties of rochelle type crystals

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We modify the conventional two-sublattice Mitsui model, usually used for description of phase transitions and dielectric characteristics of ferroelectrics with asymmetric double-well potential – Rochelle salt and RbHSO4. The crystals may undergo two (Rochelle salt) or one (RbHSO4) phase transitions. The Rochelle salt possesses piezoelectric properties in all phases, whereas RbHSO4 is piezoelectric only in the ferroelectric phase. We include into consideration the shear strain (spontaneous in ferroelectric phase or induced by electric field applied along the axis of spontaneous polarization). The model takes into account the fields produced by piezoelectric coupling with this strain. Calculations are performed withing the mean field approximation. We find the related to these strains elastic and piezoelectric characteristics of the crystals. Now the theory also distinguishes between dielectric permittivities of mechanically clamped and free crystals. Dielectric relaxation in the crystals above the frequency of piezoelectric resonance is studied. Dynamic dielectric permittivity is calculated within the Glauber approach. Within this model we are also able to consistently describe the influence of external fields conjugate to the order parameter - electric field along the axis of spontaneous polarization and shear stress of the same symmetry as a spontaneous strain.

A tolerable agreement with the available experimental data is obtained for elastic and piezoelectric characteristics of the crystals. Also a perfect fit to all the dielectric characteristics of RbHSO4 is obtained, whereas for Rochelle salt we can fit either polarization (and then the static and dynamic susceptibilities are poorely described) or the susceptibilities (and then we get a too low value of polarization). This problem can be resolved in several ways. First is to assume the existence of the third low-temperature phase transition in Rochelle salt, which is allowed at certain values of the Mitsui model parameters, and there is some experimental evidence for it. Then we shall have more freedom in choosing the theory parameters and can fit both polarization and susceptibilities. Second, if we assume that the number of ordering units per unit cell in Rochelle salt is twice as small as generally thought (because of a very complicated structure of Rochelle salt it is still not clear what elements play the role of ordering units in it; there is no such a problem in RbHSO4). Third, we should take into account the striction effects; this may be helpful, since a description of polarization and susceptibilities of Rochelle salt obtained within a model that does not take into account the piezoelectric effect is much worse than within the model which does.

Day 1
POSTER SESSION

Symmetry analysis of the photorefractive electrogyration and electrogyration study in the $LiNbO_3$ crystals

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The article is devoted to the phenomenological investigation of the possibility of the optical activity appearing under the photorefraction effect in the non-gyrotropic crystals. On the base of the symmetry analysis it is shown that in the crystals which belong to the planar and axially-inversion point groups of the symmetry ($\bar{4}$3m, $\bar{6}$m2, $\bar{6}$, 3m, 6mm, 4mm) optical activity could be induced by the electrogyration effect caused by the photorefractivity. In the crystals which belong to the point group of symmetry 6mm, 4mm, 3m, $\bar{6}$, $\bar{6}$m2 optical activity could be induced by photovoltaic and linear electrogyration effects while in the crystals that belong to the $\bar{4}$3m group of the symmetry - by photovoltaic and quadratic electrogyration effects. The electrogyration effect in the $LiNbO_3$ crystal was experimentally investigated. The component of electrogyration tensor was determined as $\gamma_{41}=3.33\times10^{-12}$m/V and diffraction effectivity was calculated η=1.5%. It was shown that diffraction of light on the electrogyration photorefractive grating should only anisotropical.

The combined piezo-electrooptical effect in the $Ca_2Pb(C_2H_5CO_2)_6$ $K_2Cd_2(SO_4)_3$ and $LiTaO_3$ crystals

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The present report is devoted to the investigation of the combined piezo-electrooptical effect in the $Ca_2Pb(C_2H_5CO_2)_6$, $K_2Cd_2(SO_4)_3$ and $LiTaO_3$ crystals as under the ferroelectrical and ferroelastical phase transitions as well as at room temperature. This effect could be described by the additional change of the polarization constants $\delta(\Delta B)_{ij}$ under the simultaneous influence of the electrical field E_m, E_n and mechanical stress σ_{kl}:

$$\delta(\Delta B)_{ij}=N_{ijklm}\sigma_{kl}E_m+R_{ijklmn}\sigma_{kl}E_mE_n,$$

where N_{ijklm} and R_{ijklmn} - five and six rank polar tensors, respectively.

It was found out that:

1.The absolute coefficients difference of combined piezo-electrooptical effect for the $LiTaO_3$ crystals is N_{33113}-$N_{11113} \approx -4.6\times10^{-19}$ $m^3/N{\cdot}V$.

2.The change of refractive indixes and piezooptical coefficients at ferroelectrical phase transition of the $Ca_2Pb(C_2H_5CO_2)_6$ crystals can be described as electrooptical effect and combined piezo-electrooptical effect induced by spontaneous polarization, respectively.

3.The coefficients of quadratic electrooptical effect induced by spontaneous polarization of the $Ca_2Pb(C_2H_5CO_2)_6$ crystals are $M_{1133}=6.7\times10^2$ m^4/C^2 and $M_{3333}=6.8\times10^2$ m^4/C^2 as well as the coefficient of spontaneous piezo-electrooptical effect $R^*=(aR_{113333}+bR_{333333})=\delta(n_1^3\pi_{1133}-n_3^3\pi_{3333})/\delta P^2_{s3}=1.3\times10^{-6}$ m^6/NC^2 (where a and b – constants; $\delta(n_1^3\pi_{1133}-n_3^3\pi_{3333})$ – change of the piezooptical constants; P_{s3} – spontaneous polarization).

4.The change of the electrooptical coefficient r_{41} at the ferroelastical phase transition of the $K_2Cd_2(SO_4)_3$ crystals can be described as piezo-electrooptical effect induced by spontaneous deformation and is proportional to the amplitude of the order parameter that linearly depend on the spontaneous deformations.

Pressure behaviour of birefringence near Lifshitz point in $Sn_2P_2S_6$ ferroelectric crystals.

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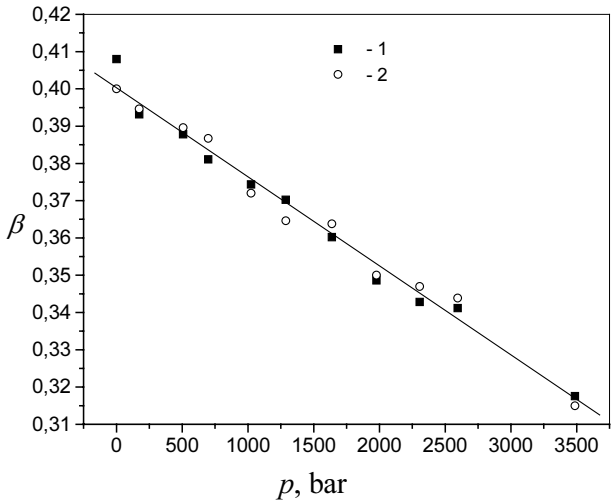
$Sn_2P_2(S_{1-x}\ Se_x)_6$ crystals are ferroelectric, at their *p,T,x*-diagram the line of the polycritical points – the Lifshitz points (LP) is realized [1]. The exploration of the behaviour of the critical indexes and of the thermodynamic parameters of these crystals along the *p,T*-diagram at approaching to LP, which is observed in $Sn_2P_2S_6$ crystals at T_{LP}=293K and p_{LP}=0,18GPa is realized urgent [1].



Pure $Sn_2P_2S_6$ single crystals were obtained by chemical vapour transport. The crystals birefringence was studied by Senarmont technique (λ=0,6328 mkm).

In figure the pressure dependence of the critical index of the β order parameter of $Sn_2P_2S_6$ crystal are presented (different points are referred to different methods of the results treatment). With the growth of pressure and the approaching to the Lifshitz point β decreases linearly from the values 0.41 at $p=p_{atm}$ to β_{LP}=0.35 in the Lifshitz point $p=p_{LP}$. This values is close to that being determined in approaching of the medium field. On transformation of the temperature dependences of the value $d(\Delta\varphi)/dT$ along the *p,T*-diagram the behaviour of *B* coefficient at Ps^4 in decomposition of the thermodynamic potential into the degrees of the order parameter *Ps* is valued. The growth of the hydrostatic pressure leads to the increments of *B.* It testifies to the fact hat the given polycritical point at the *p,T*-diagram of $Sn_2P_2S_6$ the crystals is realized at the positive *B* and is the Lifshitz point.

1. Phase p,T,x-diagram and peculiarites of physical properties of $Sn_2P_2(Se_xS_{1-x})$ ferroelectric crystals near Lifschitz point./A. G. Slivka, E. I. Gerzanich, P.P. Guranich, V. S. Shusta// Ferroelectrics.-1990.-v103.-p.71-82.

Photoelectric properties of solid solutions of the $CuInS_2$–CdS and $CuGaS_2$–CdS systems.

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Modern solid state electronics feels a need for materials with predictable photoelectric parameters which would be intermediate with respect to parameters of well-known semiconductor compounds. As such photosensitive in visible spectrum materials are solid solutions on the basis of wide-gap semiconductors of the II–VI groups and their electronic analogues which belong to the I–III–VI_2 group ternary compounds. Electric and photoelectric properties depending on components percentage of the tetrary chalcogenide solid solutions of the $CuInS_2$–CdS and $CuGaS_2$–CdS systems which were obtained in Volyn University were investigated in the paper. Synthesis conditions, phase diagrams analysis and X-ray diffraction investigations are described in our paper [1].

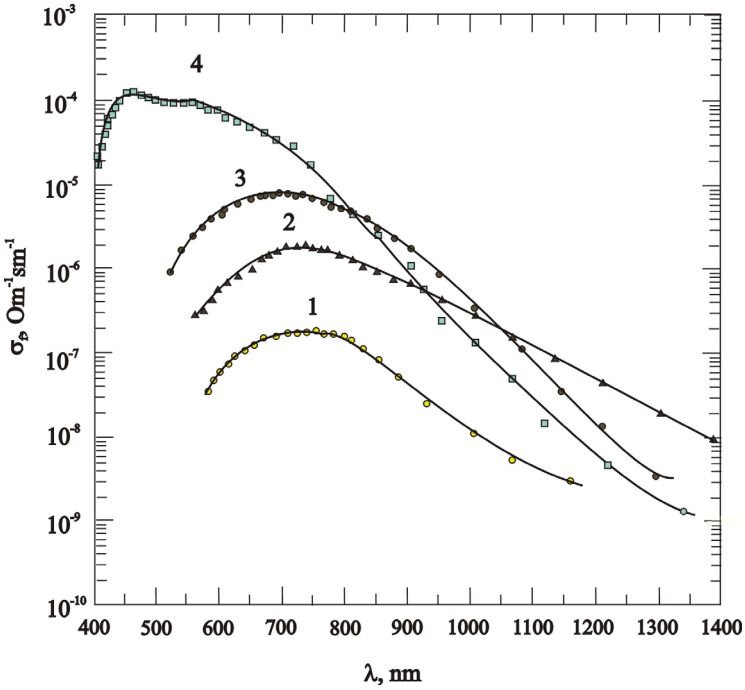
All obtained patterns have p-type conductivity depending on thermoelectric investigations. Photoconductivity spectral distribution of the $CuInS_2$–CdS system patterns at T=77 K is shown in the figure. The 1 curve corresponds to the solid solution with 70 mol.% CdS; 2 – 80 mol.% CdS; 3 – 90 mol.% CdS; 4 – 95 mol.% CdS. Similar curves with some another distribution of photoconductivity maximums are typical for the $CuGaS_2$–CdS system patterns.

As figure shows, increasing of the patterns photosensitivity and shift of self-photoconductivity maximum to short-wave spectrum region with CdS content in the solid solution increasing are observed that indicate gap energy of the solid solutions enlargement.

Photoconductivity maximums tailing on the spectral distribution curves is determined by presence of big concentration of technological origin structural defects in the patterns which are sintered polycrystals.

Copper atoms which fill some cation sublattice points of the solid solution with wurtzite structure are responsible for the photoactive centres of extrinsic photoconductivity in solid solutions with big CdS content (more than 60 mol.%).

Solid solutions of the $CuInS_2$–CdS and $CuGaS_2$–CdS systems with adjustable spectral domain of maximal photosensitivity (depending on CdS percentage) may be perspective materials of radiation-resistant photosensors and other photoelectric devices.



1. Olekseyuk I.D., Davydyuk H.Ye., Parasyuk O.V., Voronyuk S.V., Halka V.O., Oksyuta V.A. *Journal of Alloys and Compounds*. 309. 39 (2000).

Temperature behaviour of optical parameters of α-ZnP_2 single crystals

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Photoinduced magnetic linear dichroism in *YIG:Co* film.

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The films of yttrium iron garnet doped by cobalt (*YIG:Co*) are especially interesting as the objects for studies of photoinduced magnetic phenomena. The origin of photomagnetism in this material is still under discussion though the number of models quite adequately interpreting the experimental data have been proposed by different researching groups [1]. Reported here are the results of the magneto-optic spectral low temperature studies of *YIG:C*o film.

The optical linear dichroism (LD) induced by external magnetic field has been observed in *YIG:Co* film in the visible range of light. Magnetic field was applied perpendicularly to a light propagation vector. The series of LD spectra have been obtained for different directions of magnetic field relatively to cubic crystallographic axis of the film. The induced linear dichroism axes have been defined. The forms of the magnetic LD spectrum at certain orientations of magnetic field were similar to the LD spectrum induced by linearly polarised light at certain light polarisation direction [2].

The similarity of both the photoinduced linear dichroism properties with revealed magnetic linear dichroism ones lead to conclusion about the magnetic origin of the photoinduced optical anisotropy in *YIG:Co* film. The microscopical mechanism of photoinduced changes of anisotropy properties in this material supposedly related to valence change of *Co* ions and their site occupancy redistribution is discussed. The redistribution of anisotropic *Co* ions among the definite crystallographic sites results in change of orientation of magnetic moments of the magnetic subsystem in the film. In its turn it yields in the change of the spontaneous magnetic linear dichroism.

1. A.B. Chizhik, S.N. Lyukhiments, A. Maziewski, M. Tekielak, *Journ. Magn. Magn. Mat.* 140-144, 2111, (1995)
2. A. Milner, yharchenkoer, b. Maziewski, bMDitevimagnts,

Photochromic and photorefractive properties of $YAlO_3$-Mn

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The high potential of Mn-doped $YAlO_3$ (YAP) crystals for holographic recording and optical storage has been demonstrated not long ago [1]. The grating observed in YAP-Mn is associated with the refractive index grating and with the absorption grating. The Ar^+-laser light (λ=514 nm) is used as writing beam and the He-Ne-laser light (λ=633 nm) can be used for nonviolate reading.

The changes of optical absorption of YAP-Mn under Ar^+-laser illumination and spectroscopy of Mn ions in YAP in different valent states (5+; 4+; 3+; 2+) were studied earlier [1,2].

In the present work the recharging of Mn ions that underlie the photochromic properties of the crystal is studied by means of influence of γ-irradiation and high-temperature redox treatments on optical absorption, thermally stimulated destruction of the induced absorption and thermoluminescence studies. The photorefractive properties of the crystal are studied by the way of measuring of electro-optical effect.

Mn-doped YAP crystals were grown by the Czochralski technique in nitrogen atmosphere with up to 0.5 % of oxygen [1].

Under γ-irradiation of YAP-Mn the same recharging processes of Mn ions (concerned with ionization of Mn+

Absorption edge of $Sn(Pb)_2P_2S(Se)_6$ crystals under hydrostatic pressure

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Hydrostatic compression of crystals reduces interatomic distances, resulting in the energy gap variation. This causes the shift of the energy position of the fundamental optical absorption edge. If the absorption edge is described by the Urbach rule, the pressure dependence of its energy position can be given by

$$E_g^{\alpha}(T, p) = E_0(p) - W(T, p) \cdot \ln\left(\frac{\alpha_0(p)}{\alpha}\right),$$

where E_0, α_0 are the Urbach law parameters, W – the absorption edge energy width, characterizing the crystal disordering.

The studies of external hydrostatic pressure and isomorphous atomic substitution on the fundamental absorption edge in mixed ferroelectric $Sn(Pb)_2P_2S(Se)_6$ crystals, aimed at the elucidation of the main trends in the pressure and compositional behaviour of their optical parameters, are reported.

The analysis of the obtained experimental results has enabled the pressure behaviour of E_0, α_0 and W parameters for different compositions of $(Pb_ySn_{1-y})_2P_2S_6$, $Sn_2P_2(S_{1-x}\ Se_x)_6$ and $(Pb_ySn_{1-y})_2P_2Se_6$ solid solutions to be studied. The contributions of the pressure variation of E_0, α_0 and W parameters into the total behaviour of $E_g^{\alpha}(p)$ at T= 293 K. are calculated. The main contribution to the pressure variation of the absorption edge energy position $\frac{\partial E_g^{\alpha}}{\partial p}$ is made by the pressure variation of E_0 and α_0. parameters.

Cationic substitution of Sn by Pb in $(Pb_ySn_{1-y})_2P_2S_6$, and $(Pb_ySn_{1-y})_2P_2Se_6$ solid solutions results in the energy gap increase and the gap pressure variation $\frac{\partial E_g^{\alpha}}{\partial p}$ decrease. Substitution of S by Se in a series of $Sn_2P_2(S_{1-x}\ Se_x)_6$ solid solutions reduces the energy gap and leaves the $\frac{\partial E_g^{\alpha}}{\partial p}$ value practically unaffected. The temperature variation of the energy gap in these crystals is shown to be caused mostly by the interaction of electrons and vibrations of the anionic sublattice atoms. The value of this electron-phonon interaction increases with Pb content.

Structural transformations and optical transmission spectra of Sb_xSe_{1-x} films

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For optical recording and erasing on storage disks photothermal processes are used where the energy of the absorbed light is converted into heat and results in a thermostimulated phase transition in the photosensitive medium. For reversible recording the amorphous state $\leftrightarrow$ crystalline state reaction is effective. Non-crystalline antimony chalcogenides (Sb–S and Sb–Se systems), possessing high crystallizability, are promising as photosensitive media.

Here we report the results of investigation of thermo- and photostimulated processes of crystallization and amorphization of Sb_xSe_{1-x} ($0.20 \leq x \leq 0.70$) films and their optical transmission spectra.

Sb_xSe_{1-x} amorphous films were obtained by thermal evaporation in $5 \cdot 10^{-6}$ Torr vacuum onto glass substrates. Optical transmission spectra were studied in the range $0.6 \leq \lambda \leq 2.7$ μm. Optical absorption edge of fresh amorphous films is located near $\lambda = 1.0$ μm and tends to exhibit a red shift at the increase of Sb content in the film composition.

Photocrystallization of amorphous Sb_xSe_{1-x} films was achieved by a laser beam ($\lambda = 632.8$ nm) focused to a 1.0-μm spot and was determined from the variation of reflectance. The exposing pulse power P_c=15–40 mW decreases with the antimony content in the film composition. Photocrystallization is most effective for the layers with $x \geq 0.40$ and is accompanied by a sharp decrease of the film optical transmission. The difference of reflectance values in the amorphous and crystalline states is maximal for $Sb_{0.65}Se_{0.35}$ film.

The effect of thermal annealing on the transmission spectra of the films is studied and the temperatures T_p of their phase transition to the crystalline state are determined. T_p value decreases with the increase of antimony content in the film. At the transition of the film from the amorphous to the crystalline state the nonselective decrease of transmission in the whole spectral range ($0.6 \leq \lambda \leq 2.7$ μm) occurs, related to the transformation of the film structure. The results of Sb_xSe_{1-x} films optical transmission studies enable one to conclude about the similarity of their crystallization mechanisms both under thermal effects and exposed to irradiation by laser beam.

Photoinduced amorphization of crystallized Sb_xSe_{1-x} films was achieved by a single laser pulse, reaching the film through the substrate with $\lambda = 1.06$ μm and duration $\tau = 15$ ns from a YAG:Nd^{3+}-laser. The transmission spectra of amorphized areas are close to those of the fresh films, this being the evidence for the similarity of their structure.

Based on the performed studies the threshold intensities of the film crystallization and amorphization are determined (e. g. for $Sb_{0.60}Se_{0.40}$ $I_{t.c.} \approx 5 \cdot 10^3$ Wt/cm^2 and $I_{t.a.} \approx 3 \cdot 10^6$ Wt/cm^2), the conclusion of the possibility of multiple information recording on the Sb_xSe_{1-x} films is made.

Optical and photoelectric properties of non-crystalline antimony chalcogenides

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Glassy materials in antimony–chalcogen systems (chalcogen – sulphur, selenium, tellurium) are studied unsufficiently due to the considerable difficulties of their obtaining.

Here we report the results of Raman spectroscopic st**u**dies, optical absorption edge, dc (σ_T) and ac (σ_ω) electric conductivity and photoconductivity (σ_{ph}) of Sb–S system glasses. σ_T, σ_ω, σ_{ph} were measured in the temperature interval 293–500 K and in the frequency range 10^4–10^8 Hz.

The spectral dependence of Sb_xSe_{1-x} glasses ($0.35 \le x \le 0.50$) in the fundamental absorption range is described by the Urbach rule $\alpha = \alpha_0 \exp\Gamma(h\nu - h\nu_0)$. The determined optical energy gap values E_g are within 1.52–1.76 eV. The increase of antimony content in the glass composition results in the E_g decrease.

Sb_xSe_{1-x} glasses Raman spectra consist of an intense band centered at 290 cm^{-1}, caused by internal vibrations of SbS_3 trigonal pyramids, and weak bands at 200 and 155 cm^{-1}, related to the presence of a certain amount of homopolar S–S and Sb–Sb bonds in the glass network. The concentration of homopolar bonds is calculated. The variation of the glass composition does not result in essential changes in the Raman spectra. This enables a conclusion to be made that Sb_xSe_{1-x} glass matrix is built mostly by SbS_3 structural groups, linked by two-fold coordinated sulphur atoms.

Electric conductivity σ_T in the given temperature range is typical for semiconductors, described as $\sigma_T = \sigma_0 \exp(-E_a/kT)$. The studies have shown σ_T and E_a to be weakly dependent of the glass composition and stay within $3.0 \cdot 10^{-12}$ $\Omega^{-1}cm^{-1}$ and 0.79–0.84 eV, respectively. The analysis of $\lg\sigma_T$ versus 1/T plot enaled us to conclude that in the dc mode in Sb_xSe_{1-x} glasses conductivity over delocalized states prevails.

In the given frequency range $\sigma_\omega \sim \omega^s$. At T = 300 K the value of s, depending on composition, varies within 0.78–0.83, this being the evidence of the hopping character of the ac conductivity. $\sigma_\omega(T)$ and $\sigma_\omega(\omega)$ dependences are treated in the framework of the model of charged defect centres (D^-D^0, D^+) and is explained by a united hopping mechanism of charge transfer between these centres by bipolarons and simple polarons.

The photoelectric studies of Sb_xSe_{1-x} glasses have shown them being photosensitive in the spectral range 500–1200 nm. The photoconductivity spectra of the single-phase glasses ($0.35 \le x \le 0.45$) consist of a single broad band whose maximum energy position depends on the chemical composition (for x=0.40 $h\nu_{max}$=1.38 eV). Glassy Sb_2S_3 is characterized by the maximal photosensitivity. For this material the variation ratio $K_{ph} = \sigma_{ph}/\sigma_T$ at T = 293 K is $\sim 3 \cdot 10^3$ (σ_{ph} is the photoconductivity value at the illumination intensity of 10^4 lx). Both increase and decrese of antimony content result in the K_{ph} decrease. The nature of the maxima in the photoconductivity spectra is explained.

Lux-ampere characteristics of Sb_xSe_{1-x} glasses are studied. The conclusions on the influence of the defect centres on the photoelectric properties of the glasses is made.

Effect of light irradiation on the optical properties of $Ca_3Ga_2Ge_3O_{12}$:Mn garnet

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Persistent photoinduced changes of optical properties have been found in garnet $Ca_3Ga_2Ge_3O_{12}$ doped with 0.8 weight percent of manganese. Irradiation by visible light results in a change of optical absorption spectrum of the crystal.

Fig. 1 demonstrates time dependences of the photoinduced optical absorption at the wavelength 375 nm under irradiation by green light (wavelength of maximum 510 nm, band halfwidth 50 nm, flux density 3 mW/mm^2). The magnitude of the photoinduced absorption decreases as temperature increases and the effect vanishes near room temperatures.

Irradiation of the crystal by linearly polarized light causes an appearance of photoinduced linear dichroism (Fig. 2), which also decreases with increase of the temperature.

The photoinduced changes in $Ca_3Ga_2Ge_3O_{12}$:Mn are observed practically up to room temperatures as distinct from concentrated manganese garnet $Ca_3Mn_2Ge_3O_{12}$ [1] in which the photoinduced effects vanish at much lower temperature (T ~ 190 K).

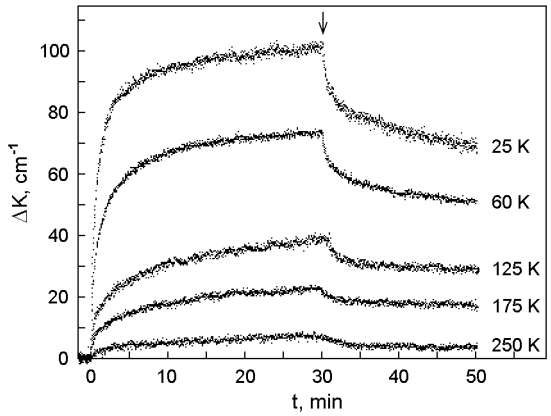

Fig. 1. Time dependences of the photoinduced absorption of $Ca_3Ga_2Ge_3O_{12}$:Mn at the wavelength 375 nm at different temperatures. The moment of switching off irradiation is indicated by arrow.

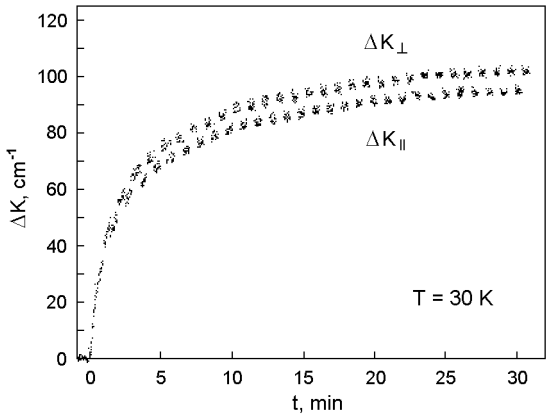

Fig. 2. Time dependences of the photoinduced absorption of $Ca_3Ga_2Ge_3O_{12}$:Mn at the wavelength 375 nm registered in polarization parallel ($K_{\parallel}$) and perpendicular ($K_{\perp}$) to the pumping polarization.

The observed phenomena are associated with light-induced transfer of electrons between manganese ions in different valence states and are described within the model of active charges (hole polarons) [1]. The expansion of the temperature range of existence of the photoinduced effects in $Ca_3Ga_2Ge_3O_{12}$:Mn compared to the concentrated garnet is related to an enhancement of hole hopping barrier.

Wide temperature range of the photoinduced changes together with high transparency of the crystal compared with other garnets makes it a promising material for optical recording.

This work was supported in part by the INTAS grant N 97-366.

1. V. V. Eremenko, S. L. Gnatchenko, I. S. Kachur, V. G. Piryatinskaya, A. M. Ratner, V. V. Shapiro, *Phys. Rev. B*. **61**. 10670 (2000).

Long-lived photoinduced changes of optical properties of calcium-manganese-germanium garnet

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Comprehensive studies of light-induced optical effects in $Ca_3Mn_2Ge_3O_{12}$ garnet have been carried out, including both polarization-independent changes (photoinduced absorption) and polarization-dependent effects (photoinduced linear dichroism).

The experiments display: 1) coincidence of the spectral dependences of photoinduced absorption and dichroism (Fig. 1) and their similarity to the initial absorption spectrum; 2) saturation of the photoinduced effects with pumping intensity; 3) a broad distribution of photoexcited absorption centers over relaxation times; 4) similarity of the relaxation curves after switching off illumination for photoinduced absorption and dichroism (Fig. 2).

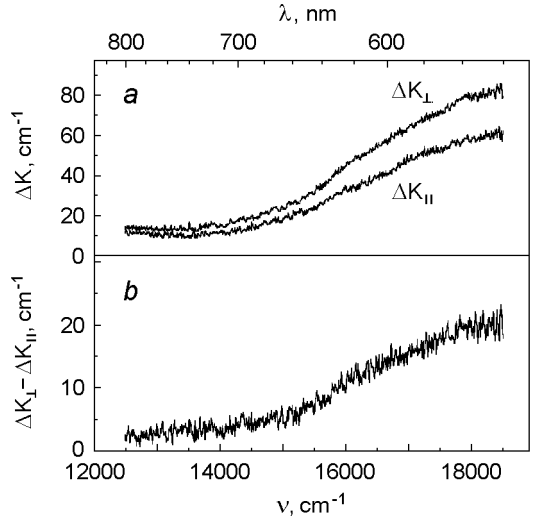

Fig. 1. Spectral dependences of the photoinduced absorption of Ca_3Ga_2 Mn_3O_{12} registered at T=35 K in polarization parallel ($K_{\parallel}$) and perpendicular ($K_{\perp}$) to the pumping polarization (*a*). Spectral dependence of linear dichroism, $K_{\perp}$ - $K_{\parallel}$ (*b*).

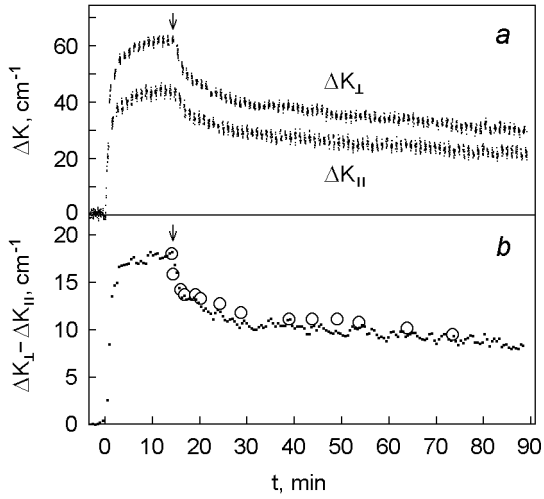

Fig. 2. Time dependences of the photoinduced absorption, registered at λ=565 nm in two polarizations (*a*). Time dependence of linear dichroism (*b*, dots). Kinetics of the photoinduced birefringence [1] (*b*, circles). The moment of switching off irradiation is indicated by arrows.

The experimental data are explained within the model, involving hole transfer between manganese ions in different valence states. Initially the holes occupy the sites adjacent to negative impurity charges. Under irradiation, they are transferred to regular Mn^{3+} ions, thus creating pairs of spatially separated charges of opposite signs. These charges create electric fields sufficient to enhance the oscillator strength of forbidden optical transitions.

Photoinduced dichroism is caused by the predominant generation of holes polarized in a fixed direction. This effect is of the common nature with photoinduced birefringence [1] and displays the same time dependence after switching off irradiation (Fig. 2).

This work was supported in part by the INTAS grant N 97-366.

1. V.A. Bedarev and S.L.Gnatchenko, *Low Temp. Phys.* **20.** 100 (1994).

The indicative surfaces of induced optical effect for biaxial crystals. An example of piezooptical effect for Cs_2HgCl_4 crystals

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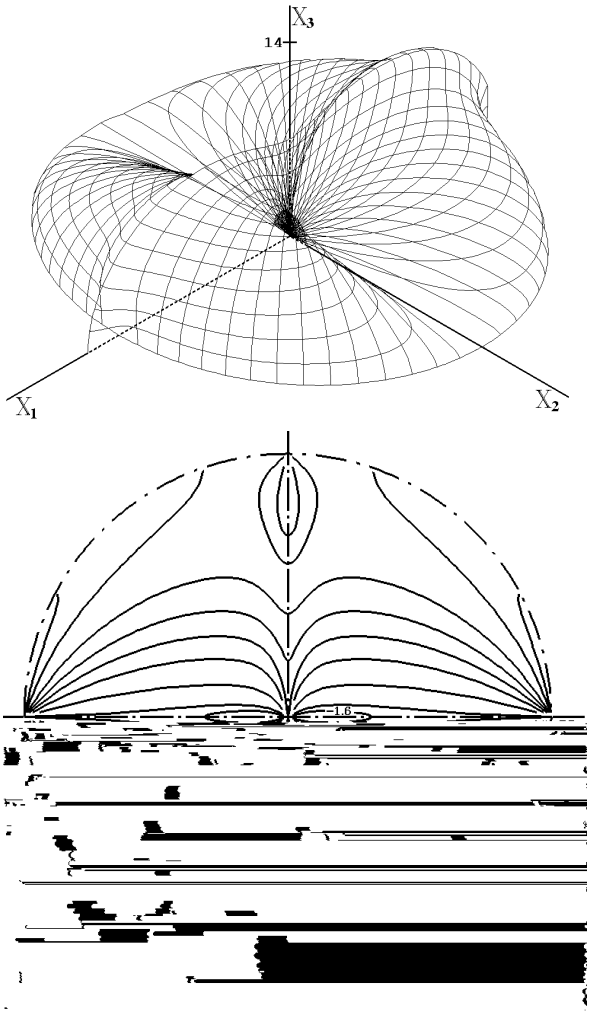
For effective application of induced optical effects in low-symmetrical crystals it is important to know the spatial distribution of these effects. In geometrical representation of spatial anisotropy of induced optical effects, which are described by third and higher ranks tensors, may be used only indicative surfaces [1]. In previous paper [2] the indicative surfaces for different components of tensor for uniaxial and cubic crystals were represented.

In this report the main principles of indicative surfaces construction for general case of the biaxial crystals are represented; this allows to construct the indicative surfaces for crystals of any symmetry class. The equations of the indicative surfaces have been found on the basis of Fresnel theorem for directional cosines. For the case, when the refractive indices $n_1=n_2$, the general equations of the indicative surfaces correspond to the case of uniaxial crystal. We have examined the indicative surfaces for longitudinal and transverse tensor components. For transverse effect the directions of applied external action and light polarization **i** were taken as radius-vector **r** of indicative surface.



The results of our calculations are represented on the example of piezooptical effect for Cs_2HgCl_4 crystals (*mmm* symmetry class). For example, the indicative surface and its stereographic projection for transverse effect, when **r**||**i**, are demonstrated on Figure. It is seen the symmetry elements for *mmm* class show itself also for this indicative surface. This correspond to Curie-Neumann principle. Let's notice that for the transverse indicative surfaces the continual number of effect values are observed along principle crystallophysical axis (see Figure). This is a special feature of biaxial crystals, which can be explained by inequality of piezooptical coefficients: $\pi_{12}\neq\pi_{21}$, $\pi_{13}\neq\pi_{23}$ and $\pi_{31}\neq\pi_{32}$. On the basis of construction of the indicative surfaces the extreme values and anisotropy power for longitudinal and transverse piezooptical effect in Cs_2HgCl_4 crystals are also determined.

1. L. Shuvalov, A. Urusovskaya, I. Zheludev et.al. *Modern Crystallography*. Moscow, Nauka, (1981) - vol.4.
2. B. Mytsyk, A. Andrushchak, *Ukr. J. of Phys*. **40**. 1016 (1995).

Day 2
POSTER SESSION

Vibration spectra of an anion in $Sn_2P_2S_6$ type crystals

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The $Sn_2P_2S_6$ type crystals attract the researchers because they are very perspective as piro- and piezosensors. The investigation of the properties of these compound has also fundamental importance, except for applied, because ferroelectrics class as $(Sn_yPb_{1-y})_2P_2(Se_xS_{1-x})_6$ is the a unique system, which has the structural phase transitions been similar to thricritical Lifshits point [1]. It can be noted the experimental results, in main, are well agreed with the phenomenological theory. But the adequate microscopic model of the observable phenomena requires more careful study the nature of interatomic interactions.

In this work the results of *ab initio* calculating of internal vibration of complexes anions at $Sn_2P_2S_6$ type crystals are presented. The possibility of such calculation in this compound is explained by nonequivalence ionic Sn(Pb)-S(Se) and covalent P-P і P-S(Se) bonds [1].

The calculation was provided in framework of the standard computation program GAMESS [2] on example an anion $[P_2S_6]^{-4}$ being in a non-bonding condition. The shape of vibrations stectrum and values of the force constants for P-P and P-S of bonds are presented. By using an Hartee-Fock approach with the basis 6-311G frequencies and intensities of spectra of this anion was also calculated. The results of this calculation are well agreed with experimental data for Raman scattering spectra for this crystal.

The results of concentration transformation of the vibration spectra of the anions complexes Sn2P2S6 type crystals for isovalent substitutions S→Se and Sn→Pb are analyse too. The influence of temperature and pressure on local vibration modes of an anion $[P_2S(Se)_6]^{-4}$ was computed. The results obtained are compared with experimentally observable changes of frequencies and redistribution of lines intensity in Raman spectra.

1. Semak D. G., Rizak V. M., Rizak I. M. Photothermostructural transformation in chalkogenides, 1999, 392 p., (in Ukrainian).
2. Schmidt M. W., Baldridge K. K., Boatz J. A., Elbert S. T., Gordon M. S., Jensen J. H., Koseki S., Matsunaga N., Nguyen K. A., Su S. J., Windus T. L., Dupuis M., Montgomery J. A., J. Comput. Chem. 14, 1347-1363(1993)

Birefringence of barium metaborate crystals in temperature range 80 – 330 K

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Barium metaborate single crystals represent the class of optical crystals in two modifications -- low-temperature noncentrosymmetrical β-phase - β-BaB_2O_4 (BBO) and high-temperature centrosymmetrical α-phase - α-BaB_2O_4 (ABO). The phase transition between these two phases takes place at 1198 K [1]. The crystals of both modifications are negative and possess large birefringence.

The refractive and birefringence indices are the basic characteristics for all optical materials. Therefore, we found the information about their values for BBO crystals only for the room temperature and above it [2], and for ABO we have these data for the room temperature. The information about investigations at temperatures below the room one are not available at present. This paper is devoted to the determination of birefringence changes of crystals for both modifications in the temperature range 80 - 330 K.

The investigations were performed for oriented samples cut from optically qualitative BBO and ABO crystals with sizes 4×5×0.8 mm^3 (X×Y×Z), which were grown by melt-solution and Czochralsky methods, respectively. The measurements of optical birefringence change δ(Δn) for Z-cut samples of BBO and ABO crystals were performed by Senarmont technique using magnetooptical modulator and synchrodetector in the temperature range 80 - 330 K and at wavelength λ=633 nm. The accuracy for δ(Δn) measurement was 10^{-7}. The temperature was stabilized and measured with accuracy 0.01 K. The temperature dependence for δ(Δn) was measured in the heating regime with the temperature rate V=0.5 K/min.

The obtained δ(Δn)=f(T) dependence for both phases BaB_2O_4 possesses complex behavior with special features. At temperature ~320 K the Δn values coincide for both phases, later the curves rapidly diverge up to T~295 K and further pass almost in parallel and are separated by the distance δ(Δn)=0.5÷0.7 down to 80 K (the curve for BBO crystals changes quite monotonously), for BBO single crystals the curve δ(Δn)=f(T) has two sharply defined peaks at temperatures ~295 K and ~175 K. From the obtained δ(Δn)=f(T) behavior one can expect the existence of structural modifications in β- BaB_2O_4 single crystals in the vicinity of mentioned temperatures. Similar peculiarities were also observed for ΔL/L=f(T) dependencies at the same temperatures for BBO crystals.

1. R Frohlich. *Z. Kristallogr*. **168,** N1-4. 109 (1984).
2. I.T. Bodnar, A.U. Sheleg, A.S. Milovanov. *Opt. and Spectrosc.* **84,** № 5. 495 (1998).

The skin retraction effect in the clinical surgical and therapeutic practice

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For the most part, biological and medicinal laser applications account for therapeutic researches with the helium-neon laser radiation in the spectrum range 0.6328 μm (the red line). At the same time an infrared spectrum range (both near, middle and far area) is as a rule considered as a preference field of surgery.

In the given paper we show the absolutely unexpected slant on the infrared laser beam at 10.06 mcm wavelength. The irradiation of a wound on a skin surface (after the vast non-malignant growth has been removed, for example) by means of the IR laser beam was revealed to be observed the energetic retraction of the wound edges. In so doing the wound area may be reduced in one and half and more times. It should be noticed that the value of the wound area changes depends on both the beam intensity and the exposition time. We found that the change of the wound area is proportional to the wound area itself and the exposition time at the laser beam intensity lying from 100 to 300 mW/cm^2. It was observed that the healthy skin tissues are not subjected to any destruction. Moreover the regeneration tissue time and consequently the cicatrisation wound time is reduced in two and more times.

This amazing medicinal and surgical phenomenon we call the retraction skin effect.

Optical and dilatative properties of diglycine nitrate crystals

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Experimental investigation of the thermal linear expansion $L(T)$ and temperature dependences of the interference optical path difference $D(T)$ have been carried out for diglycine nitrate (DGN) crystals, $(NH_2CH_2COOH)_2 \cdot HNO_3$, for three principal directions of optical indicatrix in the range of 130-295 K including ferroelectric phase transition T_c

Spectra of fundamental dichroism of $K_2Ca(SO_4)_2 \cdot H_2O$ crystals reconstructed by the birefringence dispersion in the range of transparency

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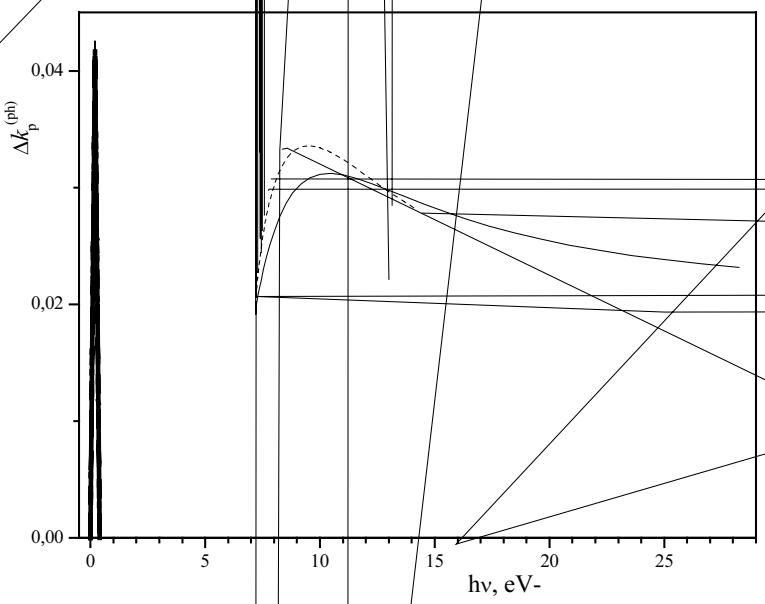
The results of experimental investigation of spectral (300-700 nm), temperature (294-470 K) and baric uniaxial stress (0-250 bar) dependences of birefringence Δn and refractive indices n of $K_2Ca(SO_4)_2 \cdot H_2O$ crystals characterizing by spectral inversion of birefringence sign (SIBS) are presented. The greatest piezooptic coefficient by birefringence, $\pi_{pg} = -1{,}7 \cdot 10^{-12}$ m^2/N, is found for the direction of light propagation along the *p*-half axes of optical indicatrix (direction of SIBS, $\Delta n_p = 0$) and for the direction of uniaxial stress along the *g*-half axes.

The spectra of fundamental dichroism $\Delta k(\omega')$ of the crystal studied are reconstructed (Fig.1) on the basis of dispersion of birefringence $\Delta n(\omega)$ measured in the range of transparency by means of solving the integral equation (1):

$$\frac{2}{\pi}\int_0^{\infty} \frac{\omega' \Delta k(\omega') d\omega'}{\omega'^2 - \omega^2} = \Delta n(\omega) \ . \qquad (1)$$



Calculation of refractive indices for complicated crystals

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Taking into account that the ferroelectric crystals are low-symmetry objects with numerous atoms in the elementary unit cell, the first principal calculation of its electron structure and corresponding refractive indices is connected with computational problems. In this situation the calculation of refraction of elementary unit cell in the scheme of oriented gas on the basis of known refractions (polarizabilities) of chemical bonds [1] can be useful as first approximation of the problem.

The method and results of calculation of refraction R_j of elementary unit cell and corresponding refractive indices n_j for the principal directions of optical indicatrix ($j = p, m, g$) of the ferroelectric crystal diglycine nitrate (DGN), $(NH_2CH_2COOH)_2{\cdot}HNO_3$, are presented in this investigation.

Molar refraction R of a material can be presented by the polarizabilities Π_i of all the structure elements of the corresponding molecule. For the case of high-symmetry cubic crystals and isotropic materials this value can be expressed through the refractive index n using the known Lourents-Lourentz formula,

$$R = (4\pi N_A/3)\sum_i \Pi_i = \frac{(n^2-1)M}{(n^2+2)\rho}\ , \qquad (1)$$

where N_A is Avogadro number, M is molar weight, ρ is density.

We used the method of calculation of the molar refraction R based on the summation of the polariazabilities Π_i of the chemical bonds of corresponding molecule, which is considered to be known [1]. After that the refractive indices n were calculated by the formula (1).

As well as two formula units $(NH_2CH_2COOH)_2{\cdot}HNO_3$ are present in the unit cell of DGN crystal ($Z = 2$), the formula for the refraction R_j of this unit cell in the j-direction of light polarization can be presented in the form

$$R_j = \frac{(n_j^2-1)MZ}{(n_j^2+2)\rho}\ . \qquad (2)$$

Calculation of the unit cell refractions R_j for arbitrary j-direction of light polarization have been done in the model of oriented gas by the summation of the refractions R_{ij} for all the chemical bonds of elementary unit cell ($i = 1, 2, ..., N$),

$$R_j = \sum_{i=1}^{N} R_{ij} = \sum_{i=1}^{N}[R_i^{(l)}\cos^2\alpha_{ij} + R_i^{(t)}(1-\cos^2\alpha_{ij})]\ , \qquad (3)$$

where $R_i^{(l)}$ and $R_i^{(t)}$ are the longitudinal (l) and transversal (t) refractive components of the i-th bonds, α_{ij} is an angle between an axes of the i-th chemical bond and the selected direction j. The $R_i^{(l)}$ and $R_i^{(t)}$ values were taken from [2]. Spatial orientation of chemical bonds in the elementary unit cell of DGN (angles α_{ij}) was taken from the reference data on the crystal structure in paraelectric ($T = 295$ K) and ferroelectric ($T = 123$ K) phases [3].

Despite of the fact that the variable parts of calculated refractive indices (n_j - 1) are 1-5% greater than the experimentally measured ones, the calculations reflect correctly the experimentally observed refractive indices sequence, $n_p < n_m < n_g$, and negative optical sign of DGN [4]. Besides, orientation of the calculated indicatrix (the angle between n_p-half axes and crystallographic c-axes is equal to 28°) is close to the experimentally observed one (32°).

1. S. Batsanov *Strukturnaya refraktometriya*. Moscow, Vysshaya shkola, (1976).
2. R. Le Fevre, *Rev. Pure Appl. Chem.* **20**. 67 (1970).
3. S. Sato, *J. Phys. Soc. Jap.* **25**. 185 (1968)
4. V. Varikash, N. Romanyuk and B. Mytsyk, *Zhurnal prikladnoj spektroskopii.* **37**. 319 (1982).

Refractometric parameters of vitreous alloys of Mg-As-Se system in the infra-red range

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The introduction of Hg into vitreous alloys of As-Se system both in a pure form and in HgSe compound is characterized by the peculiarity in the region of 1-2 at% Hg on a diagram “composition-characteristics” [1]. Further increase of Hg content only slightly influences the changes of physical-chemical, dielectric and optical properties up to 20 at.% [2]. From the applied point of view the Hg-As-Se system alloys are of interest because the introduction of Hg (about ~2 at%) into As_2Se_3 and As_2Se_5 glasses result in the increase of acoustooptical properties M_2 to $750 \cdot 10^{-15}$ cm^3/kg thus improving the acoustooptical parameters of the radiation modulators based on As-Se system glasses.

In the paper the results of the investigation of the changes in density ρ, refractive index and its dispersion n(λ) of vitreous alloys of Hg-As-Se system along the cut $x \cdot HgSe(100^{-x})As_2Se_3$, x=0÷20 are presented. The ternary glasses of this system were obtained by the alloy quenching method. The mixtures of Hg, As, Se elements (B5 purity) were sealed in vacuum into quartz tubes and heated at 980 ^0C in a furnace during 20h. The alloy was annealed by cooling in the air. To decrease the breaking point the tube was annealed additionally during 60 min at the temperatures close to T_g temperatures of the correspondent glasses. The refractive index measurements were carried out by a prism method on the samples with triangular prism, polished to 14 surface finish class of 6x8 mm^2 surfaces. The measurements of the deflection angles of the light beam was carried out with the attachment established on the base of optical indexing head ОДГ-10 allowing to take readings of the angular values accurate within 10".

The results of the measurements of the refractive index dispersion showed that in the region of transparency the dispersion n for x of all alloys under investigation has normal course, this testifying to the absence of the absorption bands in this range of spectrum. The increase of the HgSe content results in a non-linear change of n from 2.773 for a pure As_2Se_3 to 2.810 for x=20. In a short-wave spectrum region due to a edge absorption a sharp increase of the refractive index was observed.

The dispersion dependences n of the alloys under investigation have been analyzed in a framework of a generalized oscillator Wemple-Di Domeniko model [1]. The strengths and the length of the oscillators responsible for the dispersion course n(x) and the average coordination number of these alloys with the change in their composition were determined.

1. S.H. Wemple, M.Di Domeniko. Phys. Rev. Lett., 23, 1156, 1969.

Electron – stimulated changes in optical – refractometricproperties of glassy semiconductors of As-S(Se)-Ag(Hg)

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The detailed investigations of the influence of high-energy penetrating irradiation on chalcogenide glassy semiconductors (HGS) [1,2]showed that the radiation stimulated changes in physical-chemical parameters and optical properties are also accompanied with substantial structural transformations. It is established that the radiation structural transformation mechanism is determined by the processes of formation of coordination defects, i.e. induced switching of chemical bonds: the accompanying relaxation processes can include the regions of the structure amounting to several interatomic distances (medium order).

In this paper the influence of the electron radiation with the energy of 30 KeV and 1,3 MeV on the optical, refractometric and acoustic-optical properties of monolithic samples of arsenic trisulphide and triselenide with Ag and Hg dopants was studies. The radiation-structural changes were studies by the methods of building the curves of induced optical density in the spectrum range of the fundamental absorption bands of the investigated HGS (400-100 cm^{-1}) and structural refractometry, and by the investigations of IR-absorption and Raman spectra.

It was found that the radiation-structural changes lead to a long-wave shift of the absorption edge by the value up to 0,05 eV and the refraction coefficient – up to 0,01. The observed changes in optical and refractometrical parameters are increasing during transition from selenide to sulphide; they depend to a great extent on Ag and Hg concentration and are determined by the intensity of an electron beam and radiation time. During repeated cycles of radiation annealing at the temperatures 20-30K lower than T_g the data of the change are of a reverse character. The irreveresible component of the process conditioned by chemical interaction of matrix destruction products with the absorbed dopands is increasing with the increase of the absorbed dose up to 2-8 MGr.

1. E. Radelein, G.H. Frischat and B. Speit, *The Physics of Non-Crystalline Solids*. London, Taylor & Francis,(1992).
2. S.R. Elliot *Physics of amorphous materials*. London, Longman Scientific &Technical, (1990)

Raman scattering spectrum of the blood albumin with alcohol content

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It is well known that human blood as quite complicate multicomponent system that in general can be very informative about the process which take place in the human organism. For example if different external impurities are present in the human organism the components of them necessary will be present in the blood. Blood can also save the information about the heritable disease. In such a case if to analyze the parameters of blood it could be possible to determinate the possibility of the heritability or other reason of different disease without direct genetic investigations. The alcoholism is one of the mental desiase for which reason is not correctly determined. There are two principle point of view - heritable reason and social reason of alcoholism. However it is known that low activity of the such ferment as alcoholdehydrogynaza lead to the alcohol dependence. Alcoholdehydrogynaza disintegrate the alcohol for water and carbon dioxide molecules. In other case the toxic compounds enter to the human organism. The low activity of this ferment can be connected with heredity.

From other side the presence of different external chemical compounds in blood could effect as on it absorption spectrum as well as on Raman scattering libration and vibration molecular spectrum. In this case it can be possible to determine the presence of additional chemical compounds and bonds by the studying of changing of the spectrums of the blood components. The first step of the investigation of the alcoholism heritability problem by optical spectroscopy methods could be studying of the spectral parameters of the components of blood with and without alcohol. Present report is devoted to the investigation of the Raman scattering spectrum of the albumin which is isolated from the human blood with different concentration of added alcohol.

The experimental procedure was held with the help of the argon gas laser (λ=488nm, P=150W) and spectrophotometer in the transverse geometry of scattering. First of all we studied Raman spectrums of absolute alcohol. At the wavelength of 2938cm^{-1} intensity pick which correspond to the vibration of the C-H groups was observed. The broad maximum around the 3422cm^{-1} correspond to the vibration of O-H groups. The weak lines at 1457cm^{-1} and 880cm^{-1} correspond to the vibration of the C-C and C-C-O groups, respectively. In the Raman scattering spectrum of human albumen we observed only broad maximum arround 1947cm^{-1}. Direct adding of the alcohol to the albumin lead to the courdle of it. In spectrums of albumin with 5, 10, 15, 20, 25% concentration of the absolute alcohol we observed the same broud maximum arroun 1947cm-1. But in the albumin with 45% - alcohol concentration we observed the lines which are connected with the presence of alcohol and correspond to the vibration of functional active groups. It means that only at 45% concentration in the albumin such alcohol bonds as C-H, O-H, C-C and C-C-O are saved. The investigations of the Raman scattering and absorption spectrums as of the alcoholdehydrohynaza with alcohol contains as well as blood albumin tacking from patients with alcohol dependence is in process if studying.

Growth and optical microscopy observation of the lysozyme crystals

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Biological crystals belong to the quite new class of materials that is called "soft state materials" [1]. Among them there are lysozyme [2], meoglobin and haemoglobin [3], insulin crystals [4] etc. Unfortunately, the physical properties of the biological crystals are not studied yet. This is connected with the fact that it is very difficult to grow large, perfect crystals. Many papers are devoted to the growth technology and structural studying of biocrystals (see for example [5]). Never the less the investigations [1] show the presence of the ferreoelectricity in the L-alanine crystals. As about optical properties of the biocrystals, we did not find any dates in the scientific literature. From other side these crystals could possess unique optical properties due to the unusually large chiral biological molecules and unusually large lattice parameters. Lysozyme crystals in the capillary after 15 days of growth process with average size $0.1\times0.1\times0.16\text{mm}^3$ were obtained. It was shown that lysozyme crystals are optically anisotropical and birefringence along *a* axis is $\Delta n=(2.2\pm0.5)\times10^{-3}$ in visible spectrum region. From the measurements of crystallographic angles follows that on the {001} faces angles are equal $\alpha=81^o, \beta=99^o$. On the sexangle faces angles are equal $\varepsilon=100^o$, $\phi=140^o$ and $\gamma=120^o$. On the base of obtained results the lysozyme crystal habit is constructed. It was shown that this habit corresponds to the 222-point group of symmetry. Little birefringence was observed along *c* axis that means that in crystals small strains exist that could be connected as with growth remains strains as well as with existing in the lysozyme crystals ferroelastical phase transition with symmetry lowering $422\rightarrow222$.

1.Lemanov V.V. Ferroelectrics (2000) **238** pp.211-213
2.Ataka M. and Asai M. J.Crystal Growth (1994) **90** p.86
3.Howard S.B. J.Crystal Growth (1994) **50** p.424-426
4.Cacoippo E.J. Crystal Growth (1991) **114** p.286
5.Izumi K., Sawamura S., Ataka M.J.Crystal Growth (1996) **168** p.106-111

Optical analysis of middle-molecular weight molecules of blood of individuals suffering from myocardial ischemia

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The study of the molecular processes of the pathogenesis of myocardial ischemia is the most actual problem in modern cardiology. It is known that an insufficient supply of oxygen to the myocard leads to the activation of free radical processes [1], of lipid peroxidation and consequently,to serious bichemical and morphological changes in the heart muscle, and also causes destructive processes that are accompanied by an increase in ischemia endotoxins [2}. Since ischemia toxins are among the middle weight peptides [MMW] of the blood [3], a study of their nature and physiochemical properties are of significant interest in cases of miocardial ischemia.We have shown that the content of middle molecular weight molecules in the blood of individuals suffering from myocardial ischemia is twice that in the norm. Here the marked changes in the chemical composition of the blood fractions under study are of importance. In the blood plasma of healthy individuals there are 13 ninhydrinpositive chromatographic components while, in the plasma of individuals suffering from myocardial ischemia the number of these components increases to 18. The spectrophotometric analysis of solutious of MMW molecules extracted from the blood of healthy people indicated that these solutions intensively absorb light in the ultraviolet region of the spectrum with an absorbtion maximum of 290.9 nm. At the same time, electron spectra of solutions of middle-molecular-weight molecules from the blood of individuals suffering from ischemia were characterized by a maximum of 291.6 nm with an intensivity twice that of the norm. In comparative ivestigation of fluorescence spectra, it turned out that, for middle-molecular-weight molecules of individuals suffering from myocardial ischemia,there is a hypochromic effect of 316-317 nm in relation to solutions of MWM of healthy people .The presence of such an extreme shortwave structured component of the spertrum allows us to place this peptide fraction of MMW in the S class [4]. The hyperchromic effect of the area of the spectrum under discussion reflects the fact that MMW peptides in the blood of indidviduals suffering from myocardial ischemia differs from similar molecules in the norm by the character of the local steric microenvironment of tryptophan fragments in the peptide component.

The spectrum,normalized relative to absobtion at 290 nm and relative to the intensivity of absorbtion at 310 nm**,** is evidence of the significant changes in the microenvironment of tryptophan fragments in the composition of the peptide component of the MMW molecules of individuals suffering from myocardial ischemia in comparison to the norm.Therefore, we may conclude that MMW peptides of individuals sufferity from myocardial ischemiashors significant

Structural differences from thosein the norm.

1. M. Diaz., B. Frei., J. Vita et al. NewEngland J. Med. 337 404.(1997).
2. V.A. Baraboy. D.A. Stukovoy. Oxydative-antioxidant (1997). Homeostas in norm and in pathology. Kiev. Cernobylinterinform. (1997).
3. T.M. Oksman, M.V. Dalin. Pathogesis of early postischemtsia disorders. Tissue hypoxy and its
4. corection. Nauka. CO. (1981).
5. E.A.Burstein, Protein fluorescence: nature and applications. Moscow. (1977).

Optical and ultrasound investigations of phase transitions near triple point on temperature-pressure diagram of $Sn_2P_2S_6$ ferroelectric

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For $Sn_2P_2S_6$ ferroelectric crystals temperature dependencies of optical birefringence and longitudinal ultrasound velocity were investigated as function of hydrostatic pressure P in an interval 0 – 450 MPa. It was found that with increasing of the pressure a second order phase transition at T_0 for $P \geq 180$ Mpa splits into second order (T_i) and first order (T_c) transitions. The lines aencieBs(Mtt8ptNxrYb8RdGtEMBfdGt1f8Ghe lines ixž„1Mf

For Sn

Determination of magnetic point symmetry of the magneto-electric $LiCoPO_4$ crystal by magneto-optic and SQUID-magnetometry techniques

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It is known that the magneto-optics can be a useful tool for determination of the symmetry of magnetically ordered crystals. The task of the present work was to use the magneto-optic and high sensitive magnetic methods for re-examination of the magnetic symmetry of the well-known antiferromagnetic magneto-electric $LiCoPO_4$ crystals. This compound with an extremely high value of the linear magneto-electric effect is a good candidate as the high voltage solid electrolyte material. Recently a number of unexplained anomalies have been observed in this compound. $LiCoPO_4$ behaves like a weak ferromagnet but a spontaneous magnetisation has not so far been observed by direct measurements. Moreover, the weak ferromagnetism should be forbidden in the case of the magnetic point symmetry group ***mmm′,*** that was determined in the earlier neutron diffraction investigations.

The results of investigation of a linear and circular birefringence in a magnetic field and results of magnetic SQUID measurements are presented in this report. The birefringence of linearly polarised light was found to be linear in relation to the magnetic field strength. This linear magneto-optic effect testifies that magnetic point symmetry group of the antiferromagnetic crystal has not the anti-inversion operation. In the absence of this symmetry the additional contribution to magnetisation, being quadratic in magnetic field and the existence of the weak ferromagnetism could be allowed. The longitudinal component of quadratic magnetisation was not found, but the very weak spontaneous magnetic moment directed along the ***b***-axis was revealed.

The experimental results and the performed symmetry analysis shown that magnetic point symmetry group of the $LiCoPO_4$ crystal most probably is ***2′***, with the twofold axis directed along of the of the a-axis, instead of mmm' that was accepted earlier.

Day 3
POSTER SESSION

The studies of domain structure in ferroics by imaging polarimetry. The case of Rochelle salt and lead orthophosphate.

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The application of imaging polarimetry to the studies of domain structure is presented. Peculiarities of the instrument configuration and operation are considered. Measurement example for the case of Rochelle salt crystals are presented and analysed. Experimental results, demonstrate high measurement accuracy of the imaging polarimeter and its capabilities to visualize domain structure in the ferroic crystals. The instrument was designed in the Physical Optics Institute. Three blocks of domains S_1, S_2 and S_3 are observed at room temperature studying in the $Pb_3(PO_4)_2$ ferroelastics crystals. The differences in the extinction positions in this blocks are determined as $\Delta\varphi_{12}$=32.04° and $\Delta\varphi_{13}$=-2.83°. In the second and third domain block the difference between light intensity in extinction position and diagonal position is smaller than in the first block. It means that light propagated along *Z*-axis pass through few different domains. Obtained results are discussed on the base of Jones matrix approach. It was shown that at the studying of the orientation of the optical indicatrix in the neighbouring domains it is necessary to take into account the intensities of light transmitted through sample in crossed polarizers. The advantage of the imaging polarimeter for this aim is demonstrated.

Size effects in Raman spectra of $Sn_2P_2S_6$ ferroelectrics

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Tin hexathiohypodiphosphate $Sn_2P_2S_6$ crystal is a model semiconducting ferroelectric, where at 339 K a second-order structural phase transition $P2_1/c \rightarrow Pc$ occurs [1]. For oxygen-containing ferroelectrics the characteristic parameters are changed with the size decrease from bulk to microcrystals [2]. It should be also noted that semiconductor microcrystalline materials, synthesized in different inorganic and organic matrices, are extensively studied by spectroscopic techniques due to the quantum-size effects related to the spatial confinement of charge carriers [3].

Here we report the size-related effects in Raman scattering spectra of $Sn_2P_2S_6$ at the transition from bulk to microcrystalline samples. $Sn_2P_2S_6$ microcrystals were obtained both in powder and incorporated into a polyvinil alcohol matrix by dispersion in aqueous solution and subsequent thermal procedures. The concentration of microcrystals in the obtained films varied from 1 to 10 mass %, their X-ray structural analysis having been performed. The Raman measurements were carried out at room temperature using a LOMO DFS-24 monochromator and He-Ne laser (λ=632.8 nm) as the excitation source.

Bulk $Sn_2P_2S_6$ crystals are known to possess a rich Raman spectrum [4]. As our measuremets have shown, the Raman spectra of $Sn_2P_2S_6$ microcrystals reproduce the unpolarized Raman spectrum of the bulk material, especially in the frequency range 160–300 cm^{-1} where the deformational S-P-S modes, are observed, and in the interval 550–600 cm^{-1} corresponding to the internal vibrations of $(P_2S_6)^{4-}$ anionic structural groups. The convenient spectral position and high intensity of P–P bond vibration of $(P_2S_6)^{4-}$ anions enabled its frequency, halfwidth and lineshape to be chosen for the detection of size-related effects in the Raman spectrum. We observed the P–P band frequency to decrease from 381.4 cm^{-1} in the bulk samples to 379.9 cm^{-1} in 5-μm microcrystals, accompanied by the growth of the band halfwidth from 5 to 11 cm^{-1} and lineshape transformation.

The observed effects are discussed in view of the surface-related phonon mode contribution into $Sn_2P_2S_6$ Raman spectrum. In microcrystalline and porous semiconductors the relative contribution of surface into the effects, observed optically, substantially increases, the direct evidence for this being surface-related modes in the Raman spectra due to the increased surface-to-bulk contribution ratio revealed as additional features with frequencies below those for the corresponding bulk phonon maxima. In our case of $Sn_2P_2S_6$ the surface-related phonon modes are not resolved as separate Raman peaks but result in the observed bands shift and broadening.

1. Yu.M.Vysochanskii and V.Yu.Slivka, *Uspekhi fiz. nauk*. **162**, 139 (1992).
2. W.I.Zhong, B.I.Jiang, P.L.Zhang, J.M.Ma, H.M.Cheng, Z.H.Yang and L.X.Li, *J. Phys.: Condens. Matter*. **5**, 2619 (1993).
3. S.V.Gaponenko, *Fiz. tekhn. poluprovodn.* **30**, 577 (1996).
4. A.V.Gomonnai, Yu.M.Vysochanskii, A.A.Grabar and V.Yu.Slivka, *Fiz. tverd. tela.* **23**, 3623 (1981).

Multichannel acoustooptical spectrum analyzers with the time integration

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The two schemes of the acoustooptical spectrum analyzer (AOAS) with time integration in which is realized chirp transformation algorithm on the base of the Michelson interferometer (with one acoustooptical modulator) and on the base of the Mach-Zehnder interferometer (with two acoustooptical modulators) has been designed and experimentally studied.

In known schemes AOSA [1, 4-6] the little number of parallel channels are limited by the quantity of elements of array laser diodes which are used as multichanel input. We proposed to use as the multichannel input of investigated signals the acoustooptical deflector (AOD), which operate in the multichannel diffraction mode [3]. The quantity of spatial channels in that multichannel AOSA is determined by number of resolvable position of AOD. It was shown that it can be more then 200 [2]. Thus, the using of AOD as the input signals create possibility to increase the number of channels in the acoustooptical spectrum analyzers and to construct AOSA with the number of channel more then 200. Moreover, the suggesting designs has simple optical scheme and low sensitivity to the external influences.

Experimentally obtained performance characteristics for spectrum analyzer on the base of Michelson interferometer with $PbMoO_4$ acoustooptical deflector and flint glass acoustooptical modulator are: bandwidth 3.3kHz and resolution 55Hz at time integration 20ms. For the AOSA on the base of Mach-Zehnder interferometer with TeO_2 acoustooptical modulators and acoustooptical deflector the bandwidth is 0÷3.25kHz. The introdusing of the time delay t between the two chirp signals which apply to AOMs allow to adjust the bandwidth of the AOSA in wide range. For example, at the time delay τ_{el}=60ms the bandwidth is equal 6.0÷9.25kHz. The experimentally determined resolution of the AOSA on the base of Mach-Zehnder interferometer is 52Hz at the time integration T=20ms and 14Hz at the time integration T=80ms, respectively that is in agreement with the calculated values - 50Hz and 12.5Hz, respectively. The improvement of the resolution AOSA may be achieved by the increasing of the time integration.

1. 1.Casasent D. and Psaltis D. Appl.Opt. (1980) 19 N126 p.2034 - 2037.
2. 2.Balakshiy V.I., Parigin V.N., Chirkov L.A Physical basis of the acoustooptics Moscow ”Radio i svyaz” (1985) 280p. (in Russian).
3. 3.Korpel A. TIIER (1981) 69 N1 p.55-62 (in Russian).
4. 4.Shih-Chun Lin. Appl.Opt. (1982) 21 N18 p.3227-3229.
5. 5.Lin S.-C. US Patent 4.531.197 (1985).
6. 6.Lin S.-C. and Tveten A.B. Opt. Letters (1982) 7 N9 p.448-450.
7. 7.Lee J.N., Lin S.-C. and Tveten A.B. Appl.Phys.Lett. (1982) 41 N2 p.131-133.

Computer simulation of conoscopic papperns for distorted nematic cells ad their experimental observations

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We propose an algorithm to compute the conoscopic pattern for distorted uniaxial liquid crystal cells. The computed conoscopic figures for several cells (homeotropic, planar, twist, hybrid, hybrid under an external field) are compared to the corresponding experimental conoscopic patterns. We demonstrate that conoscopy can be used for the characterization of the distorted nematic cells with the director deformations which can not be detected and unambigously characterized by direct microscopy observations and other techniques.

Optical investigations of phase transitions in $CuMP_2X_6$ (M=In,Cr; X=S, Se) layered crystals

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$CuInP_2S_6$ layered crystals are ferrielectrics with two cation sublattices – indium and copper. They undergo a first-order phase transition (PT) of order/disorder type from paraelectric to ferrielectric phase (T_c=315 K), the symmetry reduction at the PT (C2/c→Cc) resulting from ordering in copper sublattice and displacement of cations from centrosymmetric positions in indium sublattice. In $CuInP_2Se_6$ crystals two PTs are realized: a fist-order transition at T_c=235.5 K and a second-order one at T_0=248.5 K with the symmerty reduction $R\bar{3}1c \rightarrow R31c$. In $CuCrP_2S_6$ crystals two PTs at $T_{c1}\approx$190 K and $T_{c2}\approx$150 K occur, separating three phases: unpolar paraelectric phase ($T>T_{c1}$), antipolar antiferroelectric ($T<T_{c2}$) and intermediate quasi-antipolar phase in the temperature interval $T_{c2}<T<T_{c1}$. The paraelectric phase symmetry is C2/c, antiferroelectric – Pc. $CuInP_2S_6$ and $CuCrP_2S_6$ single crystals were obtained by chemical transport reaction method, and $CuInP_2Se_6$ – by a combined technique of recrystallization and vapour-phase transport.

The absorption edge temperature studies have shown that in the ferrielectric phase of $CuInP_2S_6$ the absorption edge shape corresponds to direct allowed interband transitions, while in the paraelectric phase exponential Urbach shape is observed. At low temperatures ($T<$180 K) in $CuInP_2Se_6$ the bands at the absorption edge are observed, smearing with temperature, and at $T\geq$180 K the absorption edge is also of the Urbach shape. In the antiferroelectric ($T<T_{c2}$) and paraelectric ($T>T_{c1}$) phases the absorption edge in $CuCrP_2S_6$ possesses exponential Urbach shape. In the intermediate phase $T_c<T<T_0$ in $CuInP_2Se_6$ and $T_{c2}<T<T_{c1}$ in $CuCrP_2S_6$ there is no convergence point, the exponential edge is shifted parallelly and the absorption edge energy width is temperature-independent. Such behaviour of the absorption edge in the intermediate phase of $CuInP_2Se_6$ and $CuCrP_2S_6$ is, evidently, the consequence of the structure modulation, typical for incommensurate phases. The exponential Urbach tails, appearing in $CuInP_2S_6$, $CuInP_2Se_6$ and $CuCrP_2S_6$ can be related to the essential effect of dynamical structural disordering, occurring in copper cation sublattice.

In the PTs range the Urbach absorption edge parameters and parameters of exciton(electron)-phonon interaction are changed. Thus, the energy gap of $CuInP_2S_6$ shows a stepwise temperature behavior in the PT vicinity, typical for the first-order transitions, the smeared character of this behavior is explained by the effect of various types of disordering. The energy gap variation at the paraelectric-to-ferrielectric phase transition is a linear function of the squared spontaneous polarization. At the temperature dependences of the energy gap in $CuInP_2Se_6$ and $CuCrP_2S_6$ the features typical for the first- and second-order PTs are observed: the smeared stepwise behaviour in the first-order PT range and the change in the slope of the temperature dependences in the second-order PT range.

Optical absorption edge anomalies at superionic phase transition in Cu_6PSe_5Br crystals

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Cu_6PSe_5Br crystals belong to the family of compounds with argyrodite-type structure, characterized by a closed tetrahedral packing of phosphorus and sulphur atoms as well as partial occupation of equivalent copper sites [1]. At room temperature they belong to cubic syngony (space group $F\bar{4}3m$). At low temperatures in Cu_6PSe_5Br crystals superionic phase transition (PT) is realized at T_s=(259±1) K. The low-temperature phase symmetry at $T<T_s$ has not been clearly determined yet.

Cu_6PSe_5Br single crystals were grown by chemical transport reaction method. Absorption edge studies of Cu_6PSe_5Br crystals were performed in the spectral range of direct optical transitions in the temperature range 77-320 K. In the whole temperature range the absorption edge is shown to possess exponential Urbach edge, two convergence points for superionic ($T>T_s$) and non-superionic ($T<T_s$) phases being observed. The Urbach behaviour of the absorption edge is explained by electron-phonon interaction (EPI). The Urbach absorption edge parameters (coordinates of the convergence points, optical pseudogap E_g^* and absorption edge energy width w values at different temperatures) and EPI parameters are determined. In the range of the superionic PT the parameters of EPI, namely the EPI constant and the energy of the effective phonon participating in the absorption edge formation, are changed. It should be noted that for both phases the EPI constant σ_0 is below unit, what indicates the strong EPI in the crystals under investigation.

In the vicinity of the first-order superionic phase transition a sharp stepwise change of the optical pseudogap E_g^* and the anomalous behaviour of the absorption edge energy width w are observed. The temperature dependences of optical pseudogap and absorption edge energy width are analyzed in Einstein model of non-interacting harmonic oscillators.

From the isoabsorption studies (the studies of the temperature behaviour of the absorption edge energy position at the fixed absorption levels α=const) the $E_g^\alpha(T)$ dependence was obtained. The analysis of this dependence enabled us to obtain the temperature dependences of the energy gap variation ΔE_g^α in the PT vicinity induced by the PT order parameters as well as the temperature dependences of the derivative $d(\Delta E_g^\alpha)/dT$ reflecting the temperature behaviour of the anomalous part of the crystals specific heat.

1. W.F.Kuhs, R.Nitsche and K.Scheunemann, *Mater.Res.Bull.* **14**. 241 (1979)

Textural and conoscopic studies of chiral liquid crystals possessing cholesteric – smectic *A* or cholesteric – TGBA –smectic *A* phase transitions

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There is well documented analogy between the phase transitions cholesteric – smectic *A* and normal metal – superconductor in magnetic field. According to this analogy any chiral liquid crystal (CLC) material exhibiting the smectic *A* phase can be subscribed either to I or II smectogenic type as a liquid crystal analogue of the superconductor of I or II type, respectively. In this paper we describe our results aimed to develop a simple identification procedure to establish the smectogenic type of CLC material using only the polarization microscope.

On the piezooptical properties of multidomain KDP crystals

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In most of cases optical, dielectric, piezooptical and parametric properties of ferroelectric crystals have been studied on the multidomain or not completely singledomain samples. In this report we illustate the possible consequences of such the approach on the exemple of piezooptical properties of the KDP crystals [1].

Basing on the assumption that the relation between the mechanical strains in the domain of the given polarity and the changes in its optical indicatrix axes orientation are analogous to the corresponding spontaneous change occuring in the course of the phase transition, we have obtained the relation for the baric path difference changes taking place for the light rays passing through the multidomain KDP – type crystal:

$$\delta\Delta n^e_x d_x = n^3/2\cdot(\pi_{22}-\pi_{32})d_{1x}\sigma_2 + n^3/2(\pi_{11}-\pi_{31})(d_x-d_{1x})\sigma_1,$$
$$\delta\Delta n^e_x d_x = n^3/2\cdot(\pi_{23}-\pi_{33})d_{1x}\sigma_3 + n^3/2(\pi_{13}-\pi_{33})(d_x-d_{1x})\sigma_3$$
$$\delta\Delta n^e_y d_y = n^3/2\cdot(\pi_{11}-\pi_{31})d_{1y}\sigma_1 + n^3/2(\pi_{12}-\pi_{32})(d_y-d_{1y})\sigma_2$$
$$\delta\Delta n^e_y d_y = n^3/2\cdot(\pi_{13}-\pi_{33})d_{1y}\sigma_3 + n^3/2(\pi_{23}-\pi_{33})(d_y-d_{1y})\sigma_3$$
$$\delta\Delta n^e_z d_z = n^3/2\cdot(\pi_{11}-\pi_{21})d_{1z}\sigma_1 + n^3/2(\pi_{12}-\pi_{22})(d_z-d_{1z})\sigma_2$$
$$\delta\Delta n^e_x d_x = n^3/2\cdot(\pi_{22}-\pi_{32})d_{1x}\sigma_2 + n^3/2(\pi_{11}-\pi_{31})(d_x-d_{1x})\sigma_1$$

wheare σ_i are the uniaxial stresses along the axes 1, 2 and 3, d_x – the sample thickness along the x – axis, d_{1x} – the total thickness of the domains of given polarity along this axis, and the same for the other axes, n – the refractive indices, and π_{ij}-the piezooptical constants.

It is concluded that, basing on the piezooptical studies of the path difference, one can reveal a baric shifts of the phase transition temperature and describe their defference from the results derived under the hydrostatic pressure [2].

It is shown that the degree of sample unipolarity would influence the sensitivity of determination of the T_c baric shift coefficient. It is ascertainet that the refractive indices of the KDP crystals increase along the axis of the uniaxial stress and decrease (or increase) for the perpendicular direction.

The possible effects of the twinning in crystals on their integral optical characteristics are considered and the ways in which those effects should be accounted for in the case of impossibility for achieving the complete singledomain state (e.g., in the lithium niobate crystals) are sketched. This is important while one measures precisely the numerical parameters of crystals and evaluates the experimental data scattering.

1. T.S. Narasimhamurty, *Photoelastic and electro-optic properties of crystals*. Plenum Press. New York (1981).
2. V.Y.Stadnyk, N.A.Romanjuk, R.G.Chervonyi, *Optics and spectroscopy*. **84**.273 (1998).

Refractometry of incomensurate phase in *LiRbSO4* crystals

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The aim of this paper is to study thermal expansion $\Delta l/l_i$, piezoelectric constants π_{ij}, and thermal and spectral changes of the refraction indices n_i, in order to reveal a nature of anomalous changes in the latter in the phase transitions (PTs) of the paraelectric (PP1, T_i=477K)–incommensurate (IP, T_{c1}=475K) – commensurate ferroelectric (CP1, T_{c2}=458K)- ferroelectric (CP2, T_{c3}=439)- paraelectric (PP2).

It was observed that the anisotropy of thermal expansion coefficients in the region of the IP is anomalously large. This fact may be caused by arising and then disappearing of incommensurate modulation in this phase or by fixing of the discommensurations by impurities. It was determined that the most significant changes in the spontaneous increment of refractive index were present in the IP: the increase of the refractive index is equal to ~ $0.5\cdot10^{-3}$, while in the commensurate phase the refractive indices almost do not change with temperature. The magnitude of the jump in $\Delta\delta n_c^s$ at the PT from the IP to the CP1 is insignificant and equals to ~ $0.05\cdot10^{-3}$. The PTs CP1-CP2 and CP2-PP2 are accompanied by considerable jump-like changes: $\Delta\delta n_c^s$ ~ $3.3\cdot10^{-4}$ (458K) and $\Delta\delta n_c^s$ ~ $8.2\cdot10^{-4}$.

In order to describe the spontaneous increment of the refractive index in the LRS, let us expand the components of the dielectric impermeability tensor $B_{ij} = \partial E_i/\partial D_j$. One can derive

$$\delta n_i^s(T) = \frac{n_i^3(T)}{2}\left[\zeta_i \Delta T + R_{ij}^*(T)P_s^2(T) + \sum_{i=j}^{3} p_{ij}\chi_j + \omega_i \rho^2\right]$$

where the first, second and the third terms describe, respectively, the contributions from the thermooptical, quadratic electrooptical and elastic-optical effects, and the fourth term refers to the contribution of the order parameter. It was determined that the elastooptical effect makes the main contribution (~ 60%) in the IP. The contributions from the quadratic electrooptical effect are insignificant (~ 2%), that being in a good agreement with the assumption that the magnitude of spontaneous polarization in the IP equals actually to zero. At the same time, the contributions from the order parameter to the temperature changes in the refractive indices of LRS crystals within the IP amount to ~ 38%. Thus, the changes in the elementary cell in the IP of LRS crystals, as well as the changes of the order parameter have considerable effect in the formation of thermal changes of the refractive indices. The changes of the order parameter, in their turn, are related to the change in the wave vector of the modulation wave, the formation of soliton lattice and the changes in the soliton density.

In the CP1 the contributions from the spontaneous deformation remain almost unchanged, the contribution from the order parameter under decreasing temperature at first also remains almost invariable and then (T ~ 467K) decreases to zero at T = 458K. The existence itself of the contributions from δn_i^ρ in the commensurate phase may be caused by the existence of solitons at temperatures lower than the point of the PT IP-commensurate phase, i.e. the existence of multi-soliton state. The temperature width of this interval for the LRS crystal equals to about 8K. This value almost coincides with that of the interval in which the existence of the modulation wave vector is revealed.

The phase boundary and the domain structure in ferroelastic $K_2Mn_2(SO_4)_3$ crystals

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$K_2Mn_2(SO_4)_3$ crystals belong to the langbeinite mineral family [1] and undergo a proper ferroelastic phase transition of the first order at the temperature $T_c = -72^0$C with a symmetry change 23F222 [2]. The peculiarity of this phase transition, according to the theory of the J.Sapriel [3], is no permissibility of the creation of domain structure at the ferroelastic phase transition. However, in the $K_2Mn_2(SO_4)_3$ crystal ($d_{\langle 001\rangle}$=0.3mm) at the cooling rate we observed the appearance of the ferroelastic domains at the T_c=-76°C that exist in whole temperature region below T_c [4]. Present report is devoted to the more precise studying of the domain structure in this crystals.

The observed domains belong to two ferroelastic orientation states and were separated by thick walls with average thickness of 50μm. The domain walls always extinct under crossed polarizers and belong to the paraelastic cubic phase. These domain-phase walls were parallel to the $(\bar{1}10)$-plane and are deviated from the mutually perpendicular positions by an angle ~19°. Such deviation was explained as distortion deviation [5] and was calculated on the base of spontaneous deformation tensor components (β=19,47°). Since, the results of the calculation of the orientation of the domain-phase walls is in good agreement with the experimental results.

At $T=T_c$ phase boundary with (100)-orientation was observed, that confirmed that the phase transition in the $K_2Mn_2(SO_4)_3$ crystal is of the first-order. In the vicinity of T_c we observed the movement of the phase boundary along [100]-direction. From another side the movement of the phase boundary with (110)-orientation was observed in other domain. The change of the orientation of the phase boundary from (100) to (110), perhaps, is connected with the presence of a noticeable thermal gradients in the specimen.

In our point of view, the orientation of the phase boundary could be explained only by the elastic compatibility between the paraelastic and ferroelastic phases [6] with taking into account that the least difference of the spontaneous deformation components followed to zero on the phase boundary ($\varepsilon_b - \varepsilon_c \rightarrow 0$). At the slowly cooling rate the third orientation state appeared but at the further cooling strong internal strains lead to the its displacement from the crystal and appearance of the cracks.

1. 1.H.F. Mc.Murdie, M.C..Morris, J. de Groot, H.E.Swanson, *Journal of research of the national bureau of standards. A. Phys. and chemistry*., **75 A**, N5, 435, (1971).
2. T.Hikita, H.Sekiguchi, T.Ikeda, *J. Phys. Soc. Jpn.,* **43**, N4, 1327, (1977).
3. J.Sapriel, *J. Phys. Rev. (B)*, **12**, N11, 5128, (1975).
4. R.Vlokh, Z.Czapla, B.Kosturek, I.Skab, O.V.Vlokh, *Ferroelectrics*, **219**, 243, (1998).
5. E.F.Dudnik, L.A.Shuvalov, *Ferroelectrics*, **98**, 207, (1989).
6. A.L.Rojtburd , *Izv. Akad. Nauk SSSR Ser. Fiz*., **53**, 1407, (1983).

Effect of unaxial influence pressures on the location and shape of the fundamental absorption edge of Rochelle salt crystals

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The aim of the present studies is to determine the changes in fundamental absorption edge of the Rochelle salt (RS) crystals under the influence of uniaxial mechanical pressures at room temperature. The measurements of the absorption spectra have been performed with the aid of the KSVU-23 complex. The analysis of the barical changes in the fundamental absorption edge has been carried out by the way of comparing the absorpation spectra of mechanically free and uniaxially mechanically stressed sample.

It is known that the spectral change in the absorption coefficient of RS crystals in the $\sqrt{k(\hbar\omega)} = f(\hbar\omega)$ coordinates is described by the three linear regions [1], so that one can say indirect transition with the participation of two phonons. We have also revealed the three linear regions on the $\sqrt{k_X(\hbar\omega)} = f(\hbar\omega)$ curves in case of mechanically stressed RS. The anisotropy of the *K* changes and the forbidden band width are observed. It is established that for the mechanically free crystal the forbidden gap width is equal to E_g=5,13 eV, while under the unaxial pressure σ_z=50 bar the E_g value decreases down to 5,11 eV ($dE_g/d\sigma = -4\cdot10^{-4}$ eV/bar) and under the stress σ_y=60 bar it increases reaching the value of E_g=5,16 eV ($dE_g/d\sigma=5\cdot10^{-4}$eV/bar). So the influence of the σ_z stress is equivalent to increasing temperature and that of the σ_y stress to its decreasing. The forbidden gap width increases nonlinearly with cooling the sample, the coefficient being $dE_g/dT = 2{,}3\cdot10^{-4}$ eV/^{0}K. The observed anisotropy correspond to the anisotropy of birefringence and refractive indices under the influence of unaxial stresses [2].

The results obtained agree well with the conclusions of the phenomenological theory which takes into account the dependence of the forbidden gap of ferroelectrics not only on temperature and spontaneous polarization but also spontaneous strains [3].

The polarization and baric changes in the absorption edge are related to the infrared spectra. The energy of the first phonon is equil 0,205 eV and so is close to energy of the asymmetric vibrations of the `carboxyl-ions $C_1O_1O_2$ and .$C_4O_3O_4$. The energy of the second phonon is equil 0,05 eV end corresponds to the range in which the heavy O-K and O-Na lattice fragments vibrate. It is ascertained that the uniaxial stresses lead to decreasing the frequencies of the first phonon and increasing the frequencies of the second phonon one. It is expected that increasing or decreasing of these phonons frequencies under the effect of uniaxial stresses σ_z and σ_y take place through damping the vibrations of the carboxyl ions and changes in the vibration friquencies characteristic for the C-OH group

1. N.A. Romanyuk, I.F. Viblyj, *Optika i spectroscop*. **41**. 1011 (1976)
2. V.Yo.Stadnyk, M.O.Romanyuk, V.Yu.Kurlyak, V.F. Vachulovych, *Ukranian Journal of Physical Optics*. **1**. 19 (2000).
3. V.M. Fridkin. M. Nauka. 408 (1976).

Cs_2HgCl_4 crystals as perspective acoustooptical material

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In spite of numerous studies of Cs_2HgCl_4 crystals the estimation of their acoustooptical properties has not yet been performed. The advantage of crystals among materials for acousto-optical applications is anisotropy of their properties, that allows to choose their optimal combination for construction of acousto-optical devices. Here we represent our results of experimental investigations and calculations for Cs_2HgCl_4 crystals as perspective acoustooptical material.

Table. The results of acoustic and optical measurements and calculated parameters of acoustooptical qualities for Cs_2HgCl_4 crystals (for wavelength λ=632,8 nm and T=20°C).

indi-ces	Acoustic invest.	Optical investigations		Calculated parameters		
	C_{mn}, 10^{10}N/m^2	π_{im}, 10^{-12}m^2/N	p_{in}	M×10^{15},s^3/kg	M′×10^8,m^{2}s/kg	M″×10^{11},ms^2/kg
11	2.55	2.4	0.40	50	52	21
12	1.03	17.5	0.40	114	69	36
13	1.07	14.8	0.39	100	64	32
21	1.03	-1.4	0.26	23	24	9.6
22	1.48	11.8	0.29	65	39	21
23	0.78	16.6	0.34	85	53	27
31	1.07	-1.7	0.17	9.0	9.4	3.8
32	0.78	7.3	0.19	26	15	8.1
33	1.56	13.3	0.25	41	26	13
44	0.31	-11.0	-0.034	7.1	0.9	1.0
55	0.45	-5.8	-0.026	3.8	0.7	0.7
66	0.31	-10.4	-0.034	7.0	0.3	1.0

Using pulse-echo overlap method we have determined velocities of ultrasonic waves: longitudinal V_1=2509m/s; V_2=1911m/s; V_3=1960m/s and transverse V_4=868m/s; V_5=1058m/s; V_6=863m/s acoustic waves on direct-cut sample and quasilongitudinal V_7=1895m/s; V_8=2251m/s; V_9=2151m/s waves for [110], [101], [011] directions, respectively. Then from Christoffel equations all components of elastic constant tensor C_{mn} have been calculated (see Table). All components of piezooptical effect tensor π_{im} have been measured by means of interferometric technique using two-stage measurements method. On the basis of the complete piezooptical coefficients matrix, all magnitudes and signs of elastooptical coefficients p_{in} have been calculated according to formula $p_{in}=\pi_{im}C_{mn}$. Coefficients p_{in}, indicated in Table, are effective elastooptical coefficients for given parameters $M=p^2_{ef}n^6/\rho V^3$, $M'=p^2_{ef}n^7/\rho V$, $M''=p^2_{ef}n^7/\rho V^2$. The large values of elastooptical coefficients and low values of velocities of Cs_2HgCl_4 crystals allow to reach higher values of acoustooptical quality parameters M in comparison with M of such acoustooptical materials as α-HJO_3 and $PbMoO_4$. The priority for Cs_2HgCl_4 crystals is acoustooptical interaction between longitudinal acoustic modes V_2, V_3 and optical wave with polarization vector along [100] direction.

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Raman-Nath thin gratings on low-saturated dynamic recording materials

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Recording of Raman-Nath thin gratings in the saturation region has attractive considerable interest in the area of optical information processing recently [1, 2]. In this work, the numerical model of the holographic grating kinetics of both self-diffraction of recording beams and diffraction of an independent probe beam in the region of saturable absorption is proposed. Modeling is performed for a two-level non-linear absorbed saturated medium. For low-saturated material, the refractive index spatial distribution leads to the higher-order diffracted beams. We obtain, that an interference of higher-order diffracted beams in self-diffraction conditions results in the significantly higher diffraction efficiency for self-diffraction compared to the diffraction of an independent probe beam on the same grating. The numerical results agree well with experimental ones on the bacteriorhodopsin films with low-saturated absorption [3].

1. N.Burykin and E. Korchemskaya, "Holographic registration of vibrations in Raman-Nath self-diffraction conditions on bacterioghodopsin films", Proc. SPIE 2868, 196-204 (1996).
2. E.Korchemskaya, N.Burykin, and D.Stepanchikov, "Properties of photorefractive gratigns in bacterirhodopsim films for real-time optical signal processing", OSA Trends in Optics and Photonics 62, 370-378 (2001).
3. N. Hampp, "Bacteriorhodopsin as a photochromic retinal protein for optical memories", Chemical Reviews 100, 1755-1776 (2000).

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