National Academy of Sciences of Ukraine
Institute of Physics
G.V.Kurdyumov Institute for Metal Physics
Institute for Information Recording
Uzhgorod laboratory of optoelectronics and photonics materials of the
Institute for Information Recording
Uzhgorod National University

INTERNATIONAL MEETING

CLUSTERS AND NANOSTRUCTURED MATERIALS (CNM-5)

Uzhg**orod** ***Vodograj*** **Ukraine,**
22-26 October 2018

PROGRAM & MATERIALS
OF THE MEETING

Uzhg**orod**
2018

УДК 536:669
ББК 34

Published by the decision of the Organizing Committee of CNM-5 and the Academic Council of the Institute for Information Recording NAS of Ukraine

Materials of the International Meeting "Clusters and nanostructured materials (CNM-5)" – Uzhgorod, Ukraine, 2018 – 332 p.

The materials represent the contents of meeting's reports based on the results of fundamental and applied works on topical questions in the field of nanostructured systems, nanomaterials and nanotechnologies. Main attention is given to the consideration of problems of nanophysics and nanoelectronics, to atomic and electronic structure of cluster and nanostructured materials, amorphous alloys, nanostructured films and coatings, colloidal and biofunctioal materials, to study of their properties. The results of investigations in the field of supramolecular chemistry, synthesis of nanoparticles, nanostructores and multifunctional nanomaterials, physico-chemistry of superficial phenomena and diagnostics of nanosystems are presented.

The edition is designed for scientists, engineers, higher school lecturers, post-graduates and students of corresponding specialities.

ISBN 978-966-02-8629-0

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PROGRAM

MONDAY, 22TH OF OCTOBER, 2018

8^{00} – 13^{00} – registration of CNM'5 participants, coffee-break

13^{00} – 14^{00} – lunch

15^{00}– 15^{30} – Opening MEETING (official speakers)

PLENARY
Chairman: **Studenjak I.**

15^{30} – 16^{20} – NANODIMENSIONAL SYSTEMS:INVESTIGATIONS FND DEVELOPMENT IN THE NATIONAL AKADEMY OF SCIENCE OF UKRAINE
Uvarov V.M., Malchevskii I.A., Bespalov S.A.

16^{20} –17^{10} – USING A DIRECT LASER RECORD TO CREATE SUB-MICRON STRUCTURES
Petrov V.V., **Kryuchyn A.A.**, Shanoylo S.M., Beliak Ie.V., Manko D.Yu., Gorbov I.V. .

17^{10} –18^{00} – FERROELECTRIC NANO-STRUCTURES FOR ULTRAFAST THZ COMMUNICATIONS, LOW-DISSIPATION ELECTRONICS, AND MULTI-LOGIC COMPUTING CIRCUITS
Igor Lukyanchuk, Daoud Mezanne, Anna Razumnaya, Yuri Tikhonov, Elena Zaitseva, Vitaly Levashenko

19^{00}– 20^{00} – dinner

TUESDAY, 23TH OF OCTOBER, 2018

8^{00} – 9^{00} – breakfast

PLENARY
Chairman: **Malchevskii I.**

9^{00}– 9^{50} – PHONON SPECTRUM OF COMPOSITE OXIDE SYSTEMS OF THE PEROVSKITE FAMILY IN THE CONCEPT OF SUPER SPACE SYMMETRY
Shkyrta I. M., **Nebola I. I.**, Katanitsa A. F., Ochkaj I. I.

9^{50}– 10^{40} – SEMICONDUCTORS – FERROICS OF PHOSPHOROUS CHALCOGENIDES FOR VERY DENSE AND FAST MEMORY ELEMENTS
Vysochanskii Yu., Haborets V., Yevych R., Glukhov K., Babuka T., Medulych M., Kohutych A., Molnar A.

10^{40} – 11^{10} – coffee-break

PLENARY
Chairman: **Vysochanskii Yu.**

11^{10} – 12^{00} – NEW NONLINEAR NON-STATIONARY OPTICAL PHENOMENA IN THE INTERACTION OF ULTRASHORT LIGHT PULSES WITH MATERIALS FOR OPTOELECTRONIC AND TELECOMMUNICATION USE: FUNDAMENTAL AND APPLIED ASPECTS
Blonskyi I.V., Kadan V.M., Dmytruk A.M., Dmitruk I.M., Korenyuk P.I., Pavlov I.A., Pavlova S.V., Rybak A.S., Shpotyuk O.I., Yarusevych O.I.

SECTION
12^{00} – 12^{20} – GRAPHENE-LIKE MATERIALS AND NANOCOMPOSITES BASED THEREON: MECHANOCHEMICAL PREPARATION, STRUCTURE, PROPERTIES AND FUNCTIONAL APPLICATION
Posudievsky O.Yu., Kondratyuk A.S., Kozarenko O.A., Koshechko V.G., Pokhodenko V.D.

12^{20} – 12^{40} – HIGH TEMPERATURE PLASMONS AND CARRIER MOBILITY SIMULATION IN n-type WIDE HgTe QUANTUM WELLS
Melezhik E.O., Gumenjuk-Sichevska J.V., Mikhailov N.N.

12^{40} – 13^{00} – NANOCLASTERS IN HEA COATING
Danylenko M.I., Gorban'V.F., Krapivka M.O., Firstov S.O.

13^{00} – 14^{00} – lunch

SECTION
Chairman: **Uvarov V.**

14^{00} – 14^{20} – THE ALUMINUM METALOTERMIC ALLOYS
Zhiguts Yu.Yu., Lazar V.F., **Levdar K.E.**

14^{20} – 14^{40} – METHOD OF DETERMINATION OF PHASE COMPOSITION OF SYNTHESIZED ALLOYS BY THE METHODS OF GEOMETRIC THERMODYNAMICS
Zhiguts Yu.Yu., **Polishchuk O.S.,** Beyresh Ya.Ya.

14^{40} – 15^{00} – PROPERTIES OF CLUSTERED METAL AND HIGH-ENTROPY ALLOY COATINGS TiZrHfVNbTa
Gorban V.F., Andreev A.A., Firstov S.A., Chikryzhov A.M., Stolbovoy V.A., Krapivka N.A.

15^{00} – 15^{30} – coffee-break

SECTION
Chairman: **Kokenyesi S.**

15^{30}– 15^{50} – STRUCTURE AND PROPERTIES OF NANOCRYSTALLINE COPPER- AND ALUMINUM-BASED CONDENSATES
Zhadko M.A., Lutsenko E.V., Sobol' O.V., Zubkov A.I.

15^{50}– 16^{10} – SUPERCONDUCTIVITY OF GASB MICROCRYSTALS AT WEAK MAGNETIC FIELDS
Druzhinin A.A., **Ostrovskii I.P.**, Khoverko Yu.M., Liakh-Kaguy N.S.

16^{10}– 16^{30} – PHOTOCATALYTIC PROPERTIES OF POLYSULFONIC MEMBRANES MODIFIED WITH SnO_2 NANOPARTICLES
Kolesnyk I., Dzhodzhyk O., Konovalova V., Burban A.

16^{30}– 16^{50} – SPHEROIDAL MULTILAYER NANOSCALE CARBON CLUSTERS - POLYFUNCTIONAL FUEL ADDITIVES OF NEW GENERATION
Polunkin Ye.V., Gaidai O.O., Bereznitskyi Ya.O., Pilyavskyi V.S., Kamenieva T.M.

16^{50}– 18^{00} –POSTER SECTION (DISCUSSION)

19^{00}– 20^{00} – dinner

WEDNESDAY, 24TH OF OCTOBER, 2018

8^{00} – 9^{00} – breakfast

PLENARY
Chairman: **Bespalov S.**

9^{00}– 9^{50} – DEVELOPMENT OF FUNCTIONAL POLYMER NANOCOMPOSITES FOR DIRECT OPTICAL RELIEF RECORDING
Molnar S., Burunkova J., Bohdan R., Bako J., Daroczi L., **Kokenyesi S.**

9^{50} – 10^{20} – INFLUENCE OF TECHNOLOGICAL FACTORS AND THERMAL TREATMENT ON THE STRUCTURE AND PROPERTIES OF CHALCOIODIDE GLASSES AND NANO-, MYCROCOMPOSITES ON THEIR BASIS
Rubish V.M., Rizak I.M., Mykaylo O.A., Maryan V.M., Gorina O.V., Gasinets S.M.

10^{20} – 10^{50} – coffee-break

SECTION
Chairman: **Rubish V.**

10^{50} – 11^{10} – SELF-ORGANIZATION OF CRACKING IN THIN FILMS OF CHALCOGENIDE GLASS As_2S_3
Kozak M.I., Loya V.Yu., Zhikharev V.N., Fedelesh V.I.

11^{10} –11^{30} – MAGNETICALLY SENSITIVE NANOCOMPOSITES BASED ON MAGNETITE AND GEMCITABINE FOR APPLICATION IN ONCOLOGY
Petranovska A.L., Abramov M.V., **Opanashchuk N.M.,** Turanska S.P.,Kusyak N.V., Gorbyk P.P., Lukyanova N.Yu., Chekhun V.F.

11^{30} – 11^{50} – SELF –ORGANIZED HETEROSTRUCTURES INORGANIC CARRIER – NATIVE ENZYME MIXTURE AND THEIR ELECTROCHEMICAL APPLICATIONS
Kazdobin K.A., Pershina K.D., Khodykina M.O., Trunova E.K., Bespaliuk A.A.

12^{00} – 13^{00} – lunch

PLENARY
Chairman: **Mykaylo O.**

13^{30} – 14^{00} – THE EFFECT OF VACANCIES ON CHARACTERISTICS OF METAL CLUSTERS
Pogosov V.V., Reva V.I., Korotun A.V.

14^{00} – 14^{30} – NEWTYPE RECORDING MEDIA BASED ON "NOBLE METAL NANOPARTICLES/ChVS FILMS" COMPOSITIES
Rubish V.M., Trunov M.L., Lytvyn P.M.

14^{30} – 19^{00} – POSTER SECTION (DISCUSSION)
EXCURSION

19^{00}– 20^{00} – dinner

THURSDAY, 25TH OF OCTOBER, 2018

8^{00} – 9^{00} – breakfast

SECTION

9^{30}– 12^{30} – Satellite conference ACCELERATE

Chairman: **Rizak V.**

CERIC-ERIC, THE MULTI-TECHNIQUE RESEARCH INFRASTRUCTURE FOR MATERIALS RESEARCH IN CENTRAL-EASTERN EUROPE
Matthias Girod

TEACHER OF PHYSICS AND INNOVATION CHANGES IN SLOVAK SCHOOL EDUCATION
Seben Vladimir

"HORIZON" OF DEVELOPMENT AND INNOVATION FOR UzhNU AND TRANSCARPATHIA
Taisiya Symochko

XPS, SRPES, LEED AND NEXAFS INVESTIGATION OF ADENINE THIN FILM ON TITANIUM OXIDE SURFACES
V. Matolin A. Barta, S.Bercha, N. Popovych, N. Tsud, T. Duchon, K. Veltruska, I. Khalakhan, V. Rizak

X-RAY STUDY OF ELECTROCHEMICAL STERN LAYER: ORDERING AND LAYERING
Yihua Liu, Tomoya Kawaguchi, Michael S. Pierce, **Vladimir Komanicky**, Hoydoo You

HIGH-PRESSURE SINGLE-CRYSTAL SYNCHROTRON DIFFRACTION STUDY OF $LIKB_4O_7$
L. Dubrovinsky, I. Chobal, A. Pakhomova, O. Chobal, D. Simonova,A. Kurnosov, V. Adamiv, V.Rizak

NEAR-AMBIENT PRESSURE XPS STUDIES OF THE CATALYTIC AND GAS SENSING PROPERTIES OF COPPER AND TIN OXIDES
Vorokhta M., Khalakhan I., Hozák P., Vrňata M., Vondráček M., Lančok J., Matolín V.

INFLUENCE AMMONIA AND HUMIDITY ON THE LUMINESCENCE OF QUANTUM DOTS IN NANOCOMPOSITE STRUCTURES BASED ON BACTERIOHODOPSIN
S. O. Korposh, I. I. Trikur, I. Y. Tsoma, M.Y. Sichka, V. M. Rizak

MICRO- AND NANOSIZED PROTECTIVE ELEMENTS ON As-Se AND Ge-As-Se THIN FILMS
A.Feher, B.V.Bilanych, O.Shylenko, V.Komanicky, V.S.Bilanych, I.M.Rizak, V.M.Rizak

13^{00} – 14^{00} – lunch

PLENARY
Chairman: **Mitsa V.**

14^{30}– 15^{20} – ON THE DERIVATION OF THE DIRAC EQUATION
Simulik V.M., Bulgakova A.I., Zajac T.M.

15^{20} – 16^{10} – CARBONIZATION PROCESSES AND FORMATION OF METAL NANOPARTICLES IN ION-IRRADIATED POLYMERS AND COMPOSITE MATERIALS: POSITRON ANNIHILATION SPECTROSCOPY APPROACH
Kavetskyy T. and Kiv A.

16^{10} –16^{40}– coffee-break

SECTION
Chairman: **Kavetskyy T.**

16^{40} – 17^{00} – THE FLASH-LAMP TREATMENT OF THE Cu_2ZnSnS_4 NANOCRYSTALS AND THE RAMAN CHARACTERIZATION OF POSSIBLE SECONDARY PHASES SYNTHESIZED BY THE SAME METHOD
Havryliuk Ye.O., Dzhagan V.M. , Yukhymchuk V.O. , Valakh M.Ya.

17^{00} – 17^{20}– DFT-CALCULATIONS OF THE STABILITY AND RECONSTRUCTION OF THE CRYSTAL SURFACE
Nykyruy L.I., **Naidych B.P.**

17^{20} – 18^{00}–POSTER SECTION (DISCUSSION)

19^{00}– 20^{00} –dinner

FRIDAY, 26TH OF OCTOBER, 2018

8^{00} – 9^{00} – breakfast

PLENARY
Chairman: **Uvarov V.**

9^{00}– 9^{50} – **COORDINATION DEPENDENCE OF BOSON PEAK POSITION AND CRYOGENIC THERMAL ANOMALIES IN NANOSTRUCTURED As_xS_{100-x} GLASSES**
V. Mitsa, A. Feher, V. Tkáč, R. Holomb, M. Veres, N. Shumilo

9^{50} – 10^{40} – **NANOSTRUCTURED UREASIL-BASED POLYMER COMPOSITES FOR CONSTRUCTION OF AMPEROMETRIC ENZYME BIOSENSORS: STATE-OF-THE-ART AND FUTURE OUTLOOK**
Kavetskyy T.

10^{40} – 11^{10} – coffee-break

11^{10} – Closing MEETING

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- **OBLIQUE LOCALIZED JOSEPHSON PLASMA WAVES IN A PLATE OF LAYERED SUPERCONDUCTOR**

  Shymkiv D.V., Rokhmanova T., Maizelis Z.A., Kadygrob D.V., **Apostolov S.S.**

- **NANOCOMPOSITES OF GRAPHENE-LIKE CARBON AND COBALT OXIDES FOR CATALYTIC HYDROGENATION OF QUINOLINE**

  Asaula V. N., Pariiska O. O., Ryabukhin S. V., Gavrilenko K.S., Volochnyuk D. M., Kolotilov S. V.

- **ELECTRONIC AND VIBRATIONAL PROPERTIES OF $Cu(Ag)InP_2S(Se)_6$ CRYSTALS: THEORETICAL INVESTIGATION**

  Babuka T., Glukhov K., Vysochanskii Yu., Makowska-Janusik M.

- **METHOD FOR IDENTIFICATION OF OPTICAL RESONANCES OF METAL FILMS**

  Barabash M.Yu., Vlaykov G.G., Martynchuk V.E., Kolesnichenko A.A., Rybov L.V.

- **INVESTIGATIONS OF MECHANICAL PROPERTIES IN Cu_6PS_5I-BASED THIN FILMS**

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- **EFFECT OF GREEN BODY ANNEALING ON LASER PERFORMANCE OF YAG:Nd^{3+} CERAMICS**

  Bezuglyi V.A., Yavetskiy R.P., Parkhomenko S.V., Vorona I.O., Tolmachev A.V., Kosyanov D.Y., Kuryavyi V.G., Mayorov V.Y., Gheorghe L., Croitoru G., Enculescu M.

- **MAGNETO - INDUCED ANISOTROPY IN A MAGNETOACTIVE ELASTOMER**

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- **$Hg_3Te_2Cl_2$ AS AN EFFICIENT NANOMATERIAL FOR NONLINEAR OPTICAL APPLICATIONS**

  Bokotey O.V., **Slyvka V.A.**, Bokotey O.O., Slivka A.G.

- **ON THE STRUCTURAL AND OPTICAL PROPERTIES OF TERNARY THALLIUM CHALCOGENIDE COMPOUNDS**

  Bokotey O.V., Slivka A.G.

- **HIGH-TEMPERATURE ELECTROCHEMICAL SYNTHESIS OF MOLYBDENUM CARBIDE NANOSTRUCTURED COATINGS ON THE SURFACES OF DIELECTRICS AND SEMICONDUCTORS IN IONIC MELTS**

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- **COMPOSITE POLYMER FIBERS COATED WITH NANOSTRUCTURED INORGANIC PARTICLES: SYNTHESIS AND APPLICATION**

  Bondar Yu., Kuzenko S., Slivinsky V.

- **LUMINESCENT PROPERTIES OF YTTRIUM OXIDE NANOPOWDERS**

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- **PORPHYRINS WITH PERIPHERAL SUBSTITUENTS AS INHIBITORS OF AMYLOID FIBRIL FORMATION**

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- **SYNTHESIS OF PHOTOCATALYTIC ZnO NANOMATERIALS FORM DIFFERENT ROUTES**

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- **TEMPERATURE DEPENDENCE OF RAMAN-ACTIVE MODES OF $TlIn(S_{0.95}Se_{0.05})_2$ SINGLE CRYSTAL**

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- **Ag-DECORATED WIDE GAP OXIDES**

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- **NANOSTRUCTURED WEAR-RESISTANT SURFACE LAYERS Cu-Fe-O**

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- **INFLUENCE OF INTRINSIC POINT DEFECTS ON THE ELECTRONIC STRUCTURE, PHOTOELECTRIC AND PHOTOLUMINESCENCE PROPERTIES OF $GeSe_2$**

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- **DYNAMICAL AND ELASTIC PROPERTIES CHANGES INDUCED BY SUBSTITUTIONAL IMPURITIES IN β-InSe QUASI-TWO-DIMENSIONAL CRYSTALS**

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- **MULTIFUNCTIONAL NANOSTRUCTURED COATINGS, DEPOSITED BY VACUUM-ARC METHOD**

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- **STRUCTURALTRANSFORMATION OF As_2S_3 CHALCOGENIDE MATERIALS BY DOPING OF Mn AS PROSPECTIVE MATERIALS FOR THE NANOOPTICS AND COMPUTER ENGINEERING**

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- **THE DIPOLE POLARIZABILITY OF AN ELLIPSOIDAL BIMETALLIC NANOPARTICLE**

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- **THE CHEMICAL POTENTIAL AND THE WORK FUNCTION OF A METAL FILM ON A DIELECTRIC SUBSTRATE**

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- **CALCULATING METHOD OF THE EVAPORATION PROBABILITY OF CHALCOGENIDE GLASSES VAPOUR CLUSTERSS**

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- **INFLUENCE OF NATURAL MINERALS NANOPARTICLES ON THE SYNTHESIS OF BIOLOGICALLY ACTIVE COMPOUNDS BY BACTERIA-COMPONENTS OF THE PREPARATION AZOGRAN**

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- **EFFECT OF THE SURFACE MORPHOLOGY OF SUBSTATES 6H-SiC ON THE LUMINESCENCE SPECTRA**

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- **MAGNETORESISTIVE PROPERTIES OF NANOCOMPOSITES BASED ON Co AND SiO**

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- **RAYLEIGH-BRILLOUIN LIGHT SCATTERING IN CHALCOGENIDE GLASSES OF THE As-Sb-S**

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- **STRUCTURAL STATE AND PROPERTIES OF VACUUM-ARC COATINGS BASED ON HIGH-ENTROPY ALLOY TiZrHfNbTa**

  Sobol' O.V., Andreev A.A., Serdyuk I.V., Gorban`V.F., Stolbovoy V.A., Meylekhov A.A., Subbotina V.V., Kovteba D.V., Zvyagolskiy A.V.

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  Sobol' O.V., Postelnyk A.A.

- **IMPEDANCE SPECTROSCOPY ANALYSIS OF LEAD-FREE Zr DOPED $Ba_{0.8}Ca_{0.2}Ti_{(1-x)}Zr_xO_3$(xBCZT) FERROELECTRIC CERAMICS**

  S. Merselmiz, A. Neqali, D. Mezzane B. Asbani, Y. Gagou, A. Lahmar, El Marssi, I. Lukyanchuk, Z. Kutnjak and V. Gorbach

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- **EFFECT OF SILVER NANOPARTICLES INTRAVENOUS TREATMENT ON OOCYTES AND CELLS OF THEIR FOLLICULAR ENVIRONMENT UNDER CONDITIONS OF EXPERIMENTAL GLOMERULONEPHRITIS**

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- **IMPROVEMENT OF MECHANICAL PROPERTIES OF PCBN BY APPLICATION OF NANO-LAYER VACUUM-ARC COATINGS**

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- **RESEARCH OF ELECTRIC IMPEDANCE OF IONOTRONIC NANOSTRUCTURES FOUNDED IN BASIS INSE AND RbNO3**

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  Trunov M.L., Lytvyn P.M., Sterligov V.A., Lofaj F., Durkot M.O., Kyrylenko V.K., Rubish V.M., Tarnaj A.A.

- **INFLUENCE OF THERMOMECHANICAL PROCESSING ON TEMPERATURE STABILITY OF AMORPHOS ALLOYS BASED ON IRON, NICKEL AND COBALT**

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  Tsyhyka M., Pavlyshyn R., Grabar A.

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  Tykhonovych V.V., Grypachevskyi O.M., Uvarov V.M.

- **OPTICAL FUNCTIONS CALCULATION FOR Ag_7GeS_5I SUPERIONIC COMPOUND**

  Vakulchak V.V., Bletskan D.I., Studenyak I.P.

- **OBTAINING, DTA AND X-RAY DIFFRACTION STUDIES OF $x(As_2S_3)y(Sb_2S_3)z(SbI_3)$ GLASSES**

  Gasinets S.M., Makar L.I., Mykaylo O.A., Pisak R.P, **Yasinko T.I.**, Solomon A.M., Bandurin Yu.A., Shpyrko G.M.

- **THE EFFECT OF PLATINUM NANOPARTICLES ON MESENCHYMAL STROMAL CELLS OF BONE MARROW**

  Volkova N.A., Pavlovich E.V., Goltsev A.N.

- **CATION ROLE IN THE THERMAL AND ELECTRONIC PROPERTIES OF LAYERED FERRIELECTRIC MATERIALS $M^{1+}M^{3+}P_2(S,Se)_6$ (M^{1+}= Cu, Ag; M^{3+}= In, Bi)**

  Liubachko V., Oleaga A., Salazar A., Kohutych A., Glukhov K., Pogodin A., Vysochanskii Yu[1]

- **RAMAN STUDIES OF GLASSES AND COMPOSITES IN As_2S_3-Sb_2S_3-SbI_3 SYSTEM**

  Yurkin I.M., Yukhymchuk V.O., Yasinko T.I., Rubish V.M., Makar L.I, Hreshchuk O.M., Gasinets S.M.

- **LOW TEMPERATURE PLASTIC DEFORMATION OF FINE-GRAINED MAGNESIUM ALLOY AZ31**

  Zabrodin P.A., Isaev N.V., Shumilin S.E.

- **APPLICATION OF NANOLAYERED METAL FOILS IN TECHNOLOGIES OF SOLID STATE WELDING OF NICKEL SUPERALLOYS**

  Kuchuck-Yatsenko S.I., **Ziakhor I.V.**, Zavertannyi M.S.

- **FORMATION OF Ag NANOPARTICLES ARRAYS AND THEIR OPTICAL TRANSMITTANCE SPECTRA**

  Durkot M.O., **Kyrylenko V.K.,** Lytvyn P.M., Rubish V.M., Tarnaj A.A., Trunov M.L.

- **NANOSCALE SURFACE RELIEF FORMATION BY DIRECT LIGHT-INDUCED MASS TRANSPORT IN PLASMON STRUCTURES "Ag NPs/SiO LAYER/$As_{20}Se_{80}$ FILMS"**

- **Trunov M.L.,** Rubish V.M., Lytvyn P.M., Kyrylenko V.K., Durkot M.O., Tarnaj A.A.

INVESTIGATION CRYSTALLIZATION KINETICS OF Ge-As-TE AND As-S (Sb) -I SYSTEM FILMS USING OPTICAL METHOD

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Investigation of isothermal and nonisothermal crystallization of thin films based on glasses of chalcogenide systems is relevant both in terms of studying the physics of processes occurring on nanostructural and submicrostructural levels, and in connection with the possibility of practical application of these materials as recording material, photosensitive films, temperature sensors.

Alloys of Ge-As-Te ware obtained by using hard hardening of melt. The films obtained by the method of discrete thermal evaporation in a vacuum (10 ~ 5 mm Hg). Condensation was carried out on a non-heated glass substrate. The rate of condensation was within 3-10 A / s. In order to study the influence of structural transformations on the recording processes, the films studied were obtained from glasses having a different crystallization ability, which depends on the composition.

The amorphous condensates of the Ge-As-Te system were irradiated by radiation pulses of an infrared laser (λ = 1.06 microns), duration of 3.0 msec, under the influence of which crystallization, melting and evaporation of films could occur. The dynamics of phase transformations under impulse influence, for example, was investigated by changing the coefficient of reflection R by means of the time scanning of the intensity of the probe beam of a Hi-Ne laser, reflected from the surface of the film. A continuous probing laser beam, getting into photographic recording devices, generates a signal that is recorded by a memory oscilloscope, the launch of which is synchronized with the start of the pulse of an ir-laser.

The boundary value of the energy density E, in which the change in R was recorded, is 0.4 J / cm^2. The saturation of a record characterized by a maximum value ΔR = 20 + 25% occurs at E = 1.2 J / cm^2. The oscillogram of the change in the coefficient of reflection of the film $Ge_{13}As_5Te_{82}$ is shown in Fig. 1. In Fig. 2 shows oscillograms for $Ge_{13}As_5Te_{82}$ at different values of the energy density of the recording beam. With increasing E, the value of ΔR is changing, beginning and the steepness of the pulse front, changes the dynamics of changes in R. Curve 5 in Fig. 3 describes the time evolution of crystallization (for t = 0,1 <t <0,5 ms), melting of crystallites, with some increase of R (t = 0, 55 ms) and film evaporation (t> 0,55 ms) . The oscillograms characterizing R changes with the subsequent increase in the energy density of the laser pulse are shown in Fig. 3

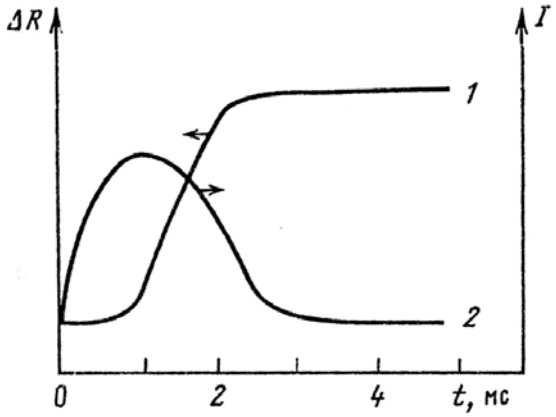

Fig. 1. The oscillogram of change in reflection coefficient ΔR (t) of a $Ge_{13}As_5Te_{82}$ film, at an irradiation energy density of E = 0.5 J / cm^2 (1) and a recording pulse shape (2)

According to the conditions of irradiation, the optical and thermophysical properties of materials, the thermodynamic regime of such pulsed laser treatment is a heat flow regime in which the temperature fields are determined by diffusion processes and there are longitudinal and transverse temperature gradients. The minimum crystallization time for these laser treatment

conditions, determined by the duration of the pulse front ΔR (t), is 100-120 μs (see Fig. 2, Curve 5, and Fig. 3).

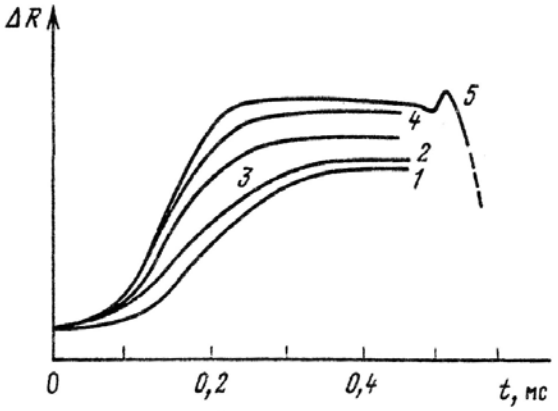

Fig. 2. Oscillograms of changes in the coefficient of reflection of $Ge_{13}As_7Te_{80}$ film at different values of E: 1 - 0.7; 2 - 0.9; 3 - 1.0; 4 - 1.5; 5 - 2.5 J / cm^2

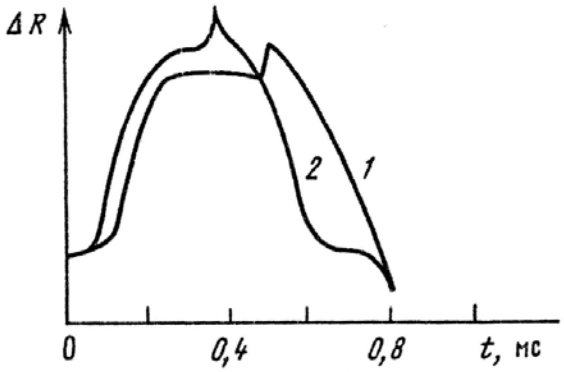

Fig. 3. The oscillograms of changes in the coefficient of reflection of $Ge_{13}As_7Te_{80}$ film at E = 3.0 (1) and 3.2 J / cm^2 (2)

A considerable number of publications are devoted to the study of phase transformations in the Ge-As-Ti system. Although the data given in the literature is somewhat contradictory, the ability of the amorphous condensates of the Ge-As-Ti system to form, depending on the external influence, is different, for both metastable and stable phases.

Thus, the complex structure of the oscillogram ΔR (t) should be expected. However, the integral contribution to the increase of ΔR of individual crystalline modifications is shown for most oscillograms only in the amplitude of the jump ΔR and the steepness of the front of the corresponding pulse (Fig. 2). This is due to the conditions of measurements in which the mode of thermal flow of laser processing is implemented: there is a superposition of crystallization processes of individual phases with close values of the crystallization temperatures. The minimum increase in ΔR is corresponding to the lower boundary value of the energy density of the recording beam, is obviously due to the crystallization of the low temperature modification of tellurium. To select the individual components of ΔR, should be use the adiabatic irradiation mode that is implemented with shorter recording impulses.

With a further increase of the power of laser radiation and achievement of a power density of more than 1.5 J / cm^2, melting is occurs (peak values of R are associated with melting material) and subsequent evaporation of the film. At the same time, for a number of oscillograms, a complicated character of both melting and evaporation of a film, which is associated with a multiphase material, was observed. One of such oscillograms, for which the two-stage character of the change of ΔR in the process of film evaporation is clearly documented, it is shown in Fig. 3 (curve 2).

It should be noted that with a laser energy density of large 1.5 J / cm^2, when the crystallization of the melt occurs, on the oscillograms before the peak increase ΔR due to the melting of crystallites, there is a reflection decrease, possibly related to scattering of probe radiation on a microscopic felief on the surface due to its local melting.

Thus, for layers of compression-containing materials of complex composition, thermal laser radiation can selectively heat certain phases, which leads to a significant change in the nature of the proceeding of nonequilibrium processes.

Comparison of the results of measurements carried out on films deposited on a substrate absorbing and non-absorbing infrared radiation confirm that the crystallization of the Ge-As-Ti layers is due to thermal heating, and the contribution of known chalcogenide glass to reversible photostructure transformations is negligible. Consequently, the multiphase environment of the type considered can be used to record the laser beam power density in time or space.

The study of isothermal and nonisothermal crystallization of thin film condensates on the basis of glasses of the As_2S_3-SbSI system by an optical method and the possibility of their use as temperature sensors. Thin films $(As_2S_3)_x (SbSI)_{100-x}$ ($10 < x < 30$) in thickness of 1-2 microns were obtained on non-heated glass substrates by the method of resistive evaporation of glass in vacuum of the corresponding compositions from quasi closed ejection cells. In the study of processes of isothermal crystallization of films, the change in their optical passage from time at constant exposure temperatures, which were selected on the basis of thermographic studies of glasses, was recorded. The temperature dependences of the relative change in the transmission of films were investigated at constant heating rates q = 0.64, 1.28 and 2.56 K / s. Registration of the change of transmission was carried out at a wavelength of 850 nm.

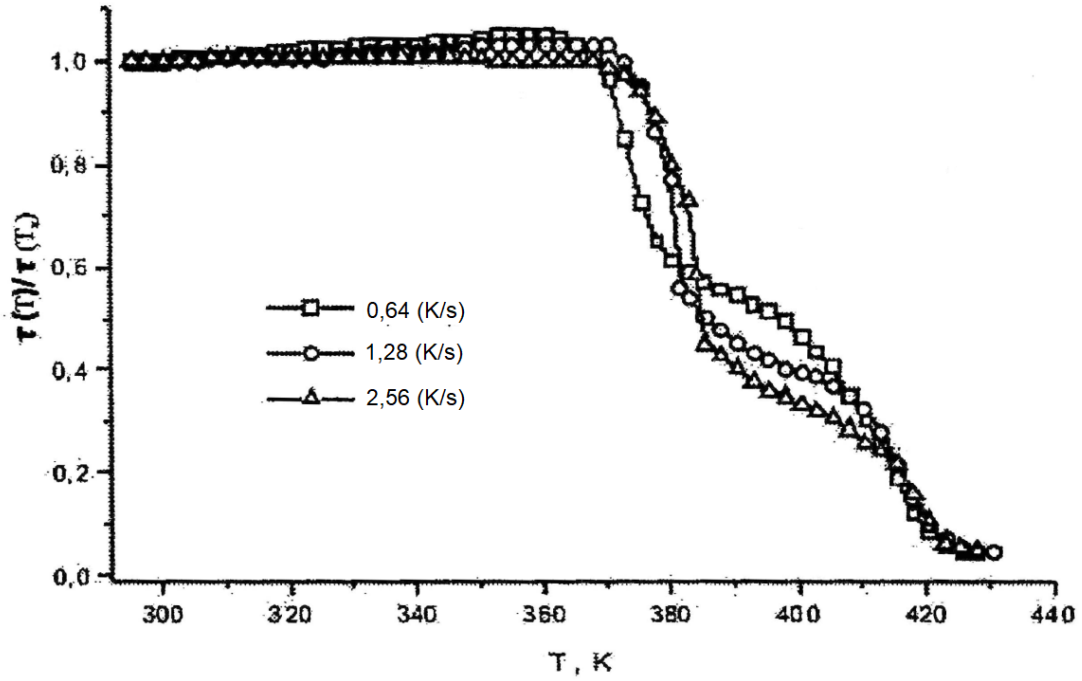

Fig.4 Dependence of the relative change in $(As_2Se_3)_{10}(SbSJ)_{90}$ film transmission from temperature

In nonisothermal crystallization, the dependence of the passage from temperature is complex (Fig. 4). Several distinct features are revealed on these dependencies, the temperature position and shape of which depend on the chemical composition of the films and the heating rate due to the transition of the amorphous film to the metastable state by the formation of crystalline nuclei and their growth. The mechanism of formation and the nature of the crystalline phase in an amorphous matrix are discussed. The stepwise nature of the change in transmission indicates the possibility of using these materials as threshold temperature sensors.