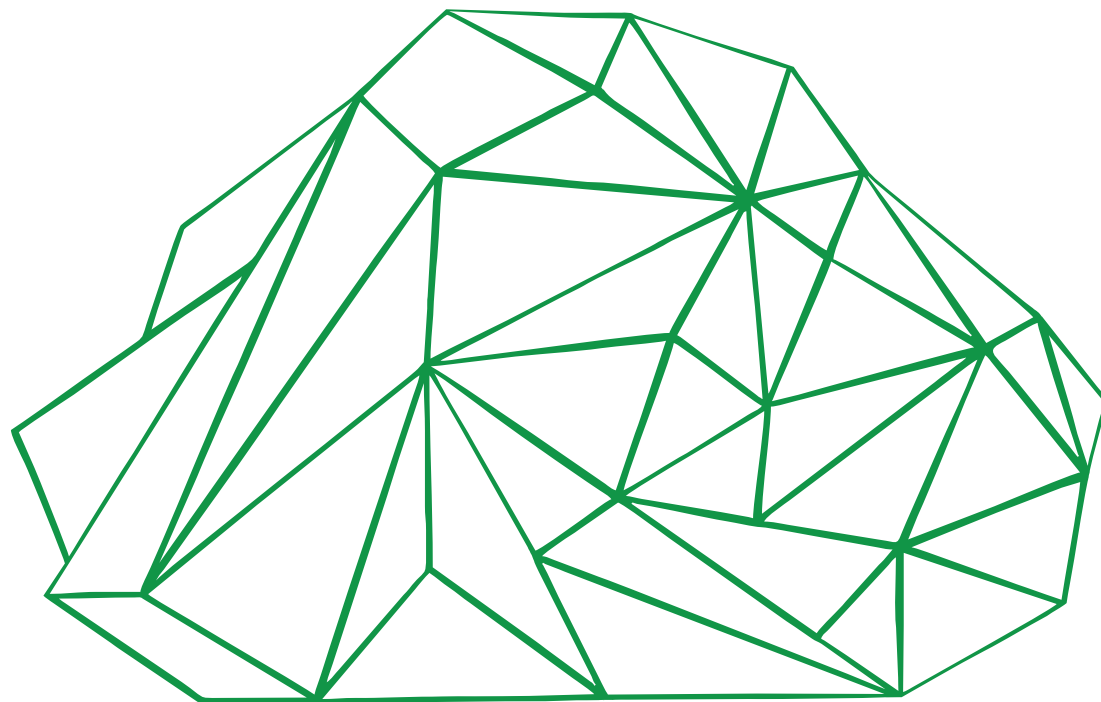


Institute of Silicate Chemistry of RAS



GlasSP

Summary

Saint Petersburg  
6 - 8 June 2017

**ФАНО России**

**Отделение химии и наук о материалах РАН**

**Институт химии силикатов**

**им. И.В. Гребенщикова РАН**

**Национальная комиссия**

**по стеклу РФ**

**International Commission on Glass**

**Российский фонд фундаментальных исследований**

**Российское керамическое общество**

**Объединенный научный совет по химическим наукам СПб НЦ**

**РАН**

**Международная конференция проводится при финансовой поддержке Российского фонда фундаментальных исследований, грант № 17-03-20155**

# EFFECT OF SINTERING TEMPERATURE ON CRYSTALLIZATION OF NEPHELINE-COMBEITE GLASS-CERAMICS

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Glass-ceramics used in dentistry must possess superior chemical, physical and mechanical properties. This study explores the potential of synthesizing glass-ceramics from novel glasses based in a multi-component alumina silica system. Glass-ceramic containing nepheline - combeite as the predominant crystal phase with desirable microstructure was successfully developed in this study.

## RANDOM MATRIX MODEL OF GLASSES

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We present a stable random matrix model of glasses with a variable strength of disorder. We show that the boson peak frequency coincides with the Ioffe-Regel criterion. We show that in the presented model the thermal conductivity is a linear function of temperature in a wide temperature range, which coincide with the experimental data on different glasses and other amorphous solids.

## A SPECIAL MOMENT IN TIME: ARRIVAL OF THE GLASS AGE

L. David Pye<sup>1</sup> and M. K. Choudhary<sup>2</sup>

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The presentation will emphasize that we are at a special moment in time for the global community of glass scientists, technologists, educators, manufacturers, and artists to declare with certainty and pride the arrival of the Glass Age.

## INVESTIGATION OF PHYSICAL PROPERTIES OF GLASSY METALS AT CRYOGENIC TEMPERATURES

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There are presented the results of experimental investigations of physical properties: magnetization, electric loss and mechanical characteristics - of glassy metals intended for

magnetic cores, operating at cryogenic temperatures in superconductive devices, such as electrical generators, motors transformers, fault current limiters, etc.

## **PHYSICAL PROPERTIES OF MAGNETIC POROUS GLASS-BASED NANOCOMPOSITES**

Cizman A.<sup>1</sup>, Bednarski W.<sup>2</sup>, Rogacki K.<sup>3</sup>, Rysiakiewicz-Pasek E.<sup>1</sup>, O. Pshenko<sup>4</sup>,  
Antropova T.<sup>4</sup>, Poprawski R.<sup>1</sup>

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A new type of the magnetic porous glass-hosted multiferroelectrics nanocomposites was synthesized. Obtained nanocomposites exhibit a small electrical conductivity which allows examining the dielectric and the magnetoelectric properties of the magnetic porous glasses. The ferroelectric and ferromagnetic (Verwey) phase transitions were observed. The ferroelectric hysteresis loop as an irrefutable proof of the ferroelectricity was observed.

## **SINTERED GLASS-CERAMICS WITH FUNCTIONALIZED POROUS FOR BIOAPPLICATIONS**

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The reconciliation of mechanical properties and bioactivity is a difficult requirement in the manufacture of structural artificial bone implants for medicine. Chemically resistant materials with high elastic modulus are typically the choice for strength, while reactivity and porosity are sought for faster adhesion to body tissues. We have developed a new glass-ceramic based template method that allows increasing matrix toughness and functionalizing pore surface to meet implant demands.

## **EXPERIMENTAL SIMS STUDY OF WATER INTERACTION WITH BOROSILICATE GLASS**

Yu. Kudriavtsev<sup>1</sup>, M. Avendaño<sup>1</sup>, G. Ramirez<sup>1</sup>, R. Asomoza<sup>1</sup>, L. Manzanilla<sup>2</sup>

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We applied SIMS method to study interaction of vapor of the isotopic water H<sub>2</sub><sup>18</sup>O with borosilicate glass surface and found hydrogenation of a near surface layer of the glass.

# DECODING THE GLASS GENOME: RESEARCH FOR THE GLASS AGE

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Advanced functional glasses play a critical role in current and developing technologies. New glass compositions have traditionally been designed empirically through trial-and-error experimentation. In this presentation, I will discuss recent advances in the design of new glasses using a combination of modeling techniques at different scales, from detailed physical models at the atomic level through application of machine learning techniques. This approach now makes it possible to decode the “glass genome” and enable the accelerated design of optimized glass compositions for production at an industrial scale. I will also discuss a series of relevant research topics to continue the forward progress in glass science and technology.

## DIFFUSION TRANSPORT OF AQUEOUS SOLUTIONS IN POROUS GLASS MEMBRANES

Pak V. N., Akuzhaeva G. S., Gavronskaya Yu. Yu.

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The diffusion coefficients of aqueous solutions of different substances upon transport in porous glass membranes with pore radius from 4.5 to 70 nm were determined. The membrane transport is discussed in terms of the structuring of the water boundary layers near the silica surface.

## STRUCTURE AND PROPERTIES OF POROUS GLASSES

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The structure and physical properties of porous glasses before and after impregnation with different substances were investigated. The analysis of infrared and dielectric spectra of porous glasses confirmed the existence of water molecules inside pores. The non-monotonic dependence of the phase transition temperature on the pore size for porous matrices embedded with the ferroelectric materials was observed. The size effect was also seen for porous glasses filled with semiconductors.

## HEALTH RISK ASSESSMENT OF NANOPARTICLES. INPUT FROM MECHANISTIC RESEARCH

Schwarze P. E., Skuland T., Refsnes M., Låg M.

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The development of nanomaterials may potentially pose risks to public health. Therefore exposure and possible detrimental health effects need to be monitored and the substances regulated accordingly.

# **THE INTERNATIONAL COMMISSION ON GLASS: A COLLABORATIVE PLATFORM FOR THE GLOBAL GLASS COMMUNITY**

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The International Commission on Glass is a non-profit international Society of national scientific and technical organizations. The aim of the ICG - to promote and stimulate understanding and cooperation among experts in the fields of glass science and technology as well as art, history and education - it achieves through the activities of its 23 Technical Committees; by compiling and publishing information on glass; sharing and disseminating knowledge through educational courses and workshops, and by organizing international conferences and meetings.

## **EFFECTS OF HYDROSILICATE NANOTUBES ON INFLAMMATION AND CYTOTOXICITY IN LUNG CELLS**

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The potential health risks of the hydrosilicated nanofibers were assessed by measuring cytotoxicity and release of inflammatory factors in two different lung cell cultures. Mg- and Ni-hydrosilicated nanofibers of different length were compared to chrysotile (asbestos), multiwalled carbon nanotubes (MWCNT) and a silica nanoparticle of 10 nm size (Si10). The main findings were that the hydrosilicated nanofibers were much less potent than chrysotile, MWCNT and Si10.

## **LIGHT TRANSMISSION OF GLASSES SYNTHESIZED ON THE BASIS OF QUARTZ SAND FROM DIFFERENT DEPOSITS СВЕТОПРОПУСКАНИЕ СТЕКОЛ, СИНТЕЗИРОВАННЫХ НА ОСНОВЕ КВАРЦЕВЫХ ПЕСКОВ РАЗНЫХ МЕСТОРОЖДЕНИЙ**

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Альбаева И. И., Хажиахметова Р. Ф., Власова С. Г.

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Glass samples with addition of local raw materials and bleaches were synthesized. Two compositions for float and container glasses were chosen. Cerium oxide and potassium nitrate as complex additive for the discoloration of the glass mass is proposed. The spectral characteristics of the glasses studied are analyzed.

**PROMISING METALLIC GLASS FOR HIGH-SPEED  
ELECTROMECHANICAL ENERGY CONVERTERS  
ПЕРСПЕКТИВНЫЕ МЕТАЛЛИЧЕСКИЕ СТЕКЛА ДЛЯ  
ВЫСОКОСКОРОСТНЫХ ЭЛЕКТРОМЕХАНИЧЕСКИХ  
ПРЕОБРАЗОВАТЕЛЕЙ ЭНЕРГИИ**

Antipov V. N., Grozov A. D., Ivanova A. V.

АНТИПОВ В. Н., Грозов А. Д., Иванова А. В.

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The report justifies the choice of metallic glasses structure for use in 100,000 rpm mini-turbine generators. It is shown that the use of domestic amorphous alloy ГМ440В provides the possibility to halve the generator weight and to increase its efficiency by 2%. Domestic nanostructured alloys are not inferior to foreign ones, but those and others for high-speed mini-turbine generators use are limited by the saturation induction magnitude.

**POROUS GLASS: MODERN PROPOSITIONS AND PROSPECTS  
ПОРИСТОЕ СТЕКЛО: СОВРЕМЕННЫЕ ПРОБЛЕМЫ И ПЕРСПЕКТИВЫ**

Antropova T. V.

АНТРОПОВА Т. В.

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The short review of research works of the Laboratory of Glass Physical Chemistry (ISCh RAS) devoted to manufacturing of porous glasses with adjustable pore structure parameters as well to their use for creation of materials and functional elements with controllable properties are presented.

**SPECIAL FEATURES OF SPECTROSCOPIC PROPERTIES AND OPTIMIZATION  
WAYS OF CERIUM SCINTILLATING GLASSES COMPOSITION  
ОСОБЕННОСТИ СПЕКТРОСКОПИЧЕСКИХ СВОЙСТВ И ПУТИ  
ОПТИМИЗАЦИИ СОСТАВА ЦЕРИЕВЫХ СЦИНТИЛЛИРУЮЩИХ СТЕКОЛ**

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Арбузов В. И.<sup>1,2,3</sup>, Бронский Е. Г.<sup>1</sup>

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Modern requirements to cerium scintillating glasses for neutron detectors are considered. Ways to increase their light efficiency - introduction of <sup>10</sup>B and/or <sup>155,157</sup>Gd isotopes with high neutron capture cross-sections into glass composition and a search for the types of glass lattice modifiers that could not cause temperature quenching of cerium luminescence are outlined. Spectroscopic characteristics of Ce<sup>3+</sup> ions in silicate, borate, borosilicate and phosphate glasses are characterized.

**THE DIFFUSIONS AND ELECTRODES PROPERTIES  
OF CHALCOGENIDE CHALCOGENIDE GLASSES AND AMORPHOUS FILMS  
ДИФФУЗИОННЫЕ И ЭЛЕКТРОДНЫЕ СВОЙСТВА  
ГАЛОГЕНИДХАЛЬКОГЕНИДНЫХ СТЕКОЛ И АМОΡФНЫХ ПЛЕНОК**

Baydakov D. L., Shkolnikov E. V.

Байдаков Д. Л., Школьников Е. В.

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By method of chemical deposition in n-butyl amine obtained chalcogenide films  $\text{CuI-PbI}_2\text{-As}_2\text{Se}_3$ ,  $\text{CuI-SbI}_3\text{-PbI}_2\text{-As}_2\text{Se}_3$ . With the help of diffusion experiments the values of diffusion coefficients  $^{110\text{m}}\text{Ag}$  isotope ratios in chalcogenide films. It was found that the values of the diffusion coefficients in chemically deposited films and starting glasses do not differ. According to diffusion experiments the chalcogenide films  $\text{CuI-PbI}_2\text{-As}_2\text{Se}_3$ ,  $\text{CuI-SbI}_3\text{-PbI}_2\text{-As}_2\text{Se}_3$  may be used as ion-selective electrodes.

**THE FORMATION OF A GLASSY MATRIX IN COMPOSITE MATERIALS  
ФОРМИРОВАНИЕ СТЕКЛОВИДНОЙ МАТРИЦЫ В КОМПОЗИЦИОННЫХ  
МАТЕРИАЛАХ**

Ban'kovskaya I. B., Kolovertnov D. V., Nikolaev A. N.

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Shows the approaches to the formation of a glassy matrix in composite materials using specially welded glass, glass obtained by the Sol-gel method and formed by the reaction. Examples of using the developed materials as coatings on various substrates: graphite, titanium carbide, silicon dioxide, magnesium oxide and aluminium oxide is presented. The effectiveness of the introduction of nanosize particles in the composite materials for energy conservation is determined.

**SYNTHESIS AND INVESTIGATION OF TRANSPARENT OXYFLUORIDE  
GLASSES DOPED WITH RARE EARTH IONS  
СИНТЕЗ И ИССЛЕДОВАНИЕ ПРОЗРАЧНЫХ ОКСИФТОРИДНЫХ  
СТЕКОЛ, ЛЕГИРОВАННЫХ ИОНАМИ РЕДКОЗЕМЕЛЬНЫХ ЭЛЕМЕНТОВ**

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Glasses in the  $\text{SiO}_2\text{-B}_2\text{O}_3\text{-Bi}_2\text{O}_3\text{-ZnO-CaF}_2$  system were studied. Received glasses were investigated using X-ray diffraction, differential scanning calorimetry, and scanning electron microscopic techniques. The IR studies indicated that these glasses were made up of  $[\text{BiO}_6]$ ,  $[\text{BiO}_3]$ ,  $[\text{BO}_3]$ ,  $[\text{BO}_4]$  and  $[\text{SiO}_4]$  basic structural units. The measured emission spectrum of



$\text{Eu}^{3+}$  glass has revealed five transitions ( ${}^5\text{D}_0 \rightarrow {}^7\text{F}_{0-4}$ ) at 579, 589, 616, 651 and 696 nm, respectively, with  $\lambda_{\text{ex}} = 396$  and 465 nm.

## CHALCOGENIDE GLASSES: YESTERDAY, TODAY, TOMORROW ХАЛЬКОГЕНИДНЫЕ СТЕКЛА: ВЧЕРА, СЕГОДНЯ, ЗАВТРА

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At present, amorphous materials occupy an increasingly important role in scientific and applied research and development. A special place among vitreous materials is occupied by chalcogenide glasses. Their unusual properties find more and more practical applications. In this paper, we will show recent developments in the field of diamond diagnostics and the creation of microlenses on the surface of infrared light and photodiodes.

## SPECTRAL AND LUMINESCENCE PROPERTIES OF FLUOROPHOSPHATE GLASSES DOPED WITH NEODYMIUM СПЕКТРАЛЬНО-ЛЮМИНЕСЦЕНТНЫЕ СВОЙСТВА ФТОРОФОСФАТНЫХ СТЕКЛ, АКТИВИРОВАННЫХ НЕОДИМОМ

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Absorption and luminescence spectra of the neodymium ions in fluorophosphate glasses  $10\text{BaF}_2 - (38-x)\text{AlF}_3 - 18,5\text{CaF}_2 - 10\text{MgF}_2 - 18,5\text{SrF}_2 - x\text{NdF}_3$ , where  $x=0.1, 0.3, 0.5, 1, 2, 5$  mol. % were studied. The analysis of the spectra was in the framework of the Judd-Ofelt theory. The parameters of  $\Omega_\lambda$ , the probability of spontaneous emission, radiative lifetime, quantum yield of luminescence and stimulated emission cross-section for the transitions  ${}^4\text{F}_{3/2} \rightarrow {}^4\text{I}_{11/2}$  and  ${}^4\text{F}_{3/2} \rightarrow {}^4\text{I}_{13/2}$  were obtained.

## THE EFFECT OF OPTICAL ANISOTROPY IN BORON OXIDE MELT ACCORDING TO LIGHT SCATTERING DATA ЭФФЕКТ ОПТИЧЕСКОЙ АНИЗОТРОПИИ В РАСПЛАВЕ ОКСИДА БОРА ПО ДАННЫМ СВЕТОРАССЕЯНИЯ

Bokov N. A.

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It was shown that the relaxation of the light scattering intensity by boron oxide melt, which is connected with a decrease its magnitude after a temperature jump as well as under influence of a temperature gradient, is synchronized with the effect of changing of the polarization state of the primary light beam passed through the investigated sample. The formation of macroscopic

elastic stresses in the sample bulk could be one of the possible reasons of the development of the detected phenomenon.

## **MODIFIED FLUORIDE GLASSES МОДИФИЦИРОВАННЫЕ ФТОРИДНЫЕ СТЕКЛА**

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Fluoride glasses remain to be an attractive material for optical applications lying in the visible and mid IR spectral range due to their low phonon energy (~500-600 cm<sup>-1</sup>) and as a unique matrix for RE activators. Modern materials science studies are aimed at searching for the new modified compositions with high optical homogeneity to create efficient active optical media in a wide spectral range. By modifying the glass composition one can control thermal, optical and spectroscopic properties.

## **TRANSPARENT GLASS-CERAMICS FOR PASSIVE Q-SWITCHING OF Er LASERS ПРОЗРАЧНЫЕ СТЕКЛОКРИСТАЛЛИЧЕСКИЕ МАТЕРИАЛЫ ДЛЯ ПАССИВНОЙ МОДУЛЯЦИИ ДОБРОТНОСТИ Er ЛАЗЕРОВ**

Dymshits O. S.<sup>1</sup>, Alekseeva I. P.<sup>1</sup>, Zhilin A. A.<sup>1</sup>, Shemchuk D. V.<sup>1</sup>, Zapalova S. S.<sup>1</sup>,  
Loiko P. A.<sup>2</sup>, Skoptsov N. A.<sup>3</sup>, Malyarevich A. M.<sup>3</sup>, Yumashev K. V.<sup>3</sup>, Vitkin V. V.<sup>2</sup>  
ДЫМШИЦ О. С.<sup>1</sup>, Алексеева И. П.<sup>1</sup>, Жилин А. А.<sup>1</sup>, Шемчук Д. В.<sup>1</sup>, Запалова С. С.<sup>1</sup>,  
Лойко П. А.<sup>2</sup>, Скопцов Н. А.<sup>3</sup>, Маляревич А. М.<sup>3</sup>, Юмашев К. В.<sup>3</sup>, Виткин В. В.<sup>2</sup>

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High peak power of pulsed Er lasers with eye-safe emission at 1.5–1.7 μm is obtained using saturable absorbers made of transparent glass-ceramics with spinel, oxide and silicate nanocrystals containing Co<sup>2+</sup> ions in tetrahedral sites providing absorption band at 1.3 up to ~1.8 μm. Its position depends on the ligand field strength around Co<sup>2+</sup> and controlled by the composition of crystal phase. Glass-ceramics are promising for passive Q-switching of diode-pumped Er, Yb:glass and Er crystal lasers.

## **MAGNESIUM – STRONTIUM BORATES DOPED BY RARE EARTH ELEMENTS: SYNTHESES AND RESEARCH СЛОЖНЫЕ БОРАТЫ МАГНИЯ – СТРОНЦИЯ, ДОПИРОВАННЫЕ ИОНАМИ РЗЭ: СИНТЕЗ И ИССЛЕДОВАНИЕ**

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Complex borates Sr<sub>2-n</sub>MgB<sub>2</sub>O<sub>6</sub>:nR and Sr<sub>1-n</sub>MgB<sub>2</sub>O<sub>5</sub>:nR (R = Eu<sup>3+</sup>, n = 0,05; 0,1; 0,2) were

obtained by solid-state reaction and crystallization of glass. The phase of synthesized materials was determined by XRD method and by DSC method their thermal behavior was studied.

## **TEMPERATURE RANGE OF FORMATION THE NUCLEUS OF CuCl IN GLASS ТЕМПЕРАТУРНАЯ ОБЛАСТЬ ОБРАЗОВАНИЯ ЗАРОДЫШЕЙ CuCl В СТЕКЛЕ**

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The dependence of particle concentration and distribution curves for the radii of particles of the CuCl phase in the glass explored by the method of exciton-thermal analysis in the temperature range 500 -560 °C. It has been established, that in the solid solution of CuCl in glass at temperature above 560 °C and below 500 °C the phase nucleus of CuCl are not formed. In the temperature range 510-520 °C the stream of supercritical clusters is maximal.

## **SPECTRAL-OPTICAL PROPERTIES OF SILVER-CONTAINING COMPOSITE MATERIALS BASED ON SILICATE POROUS GLASSES СПЕКТРАЛЬНО-ОПТИЧЕСКИЕ СВОЙСТВА СЕРЕБРОСОДЕРЖАЩИХ КОМПОЗИЦИОННЫХ МАТЕРИАЛОВ НА ОСНОВЕ СИЛИКАТНЫХ ПОРИСТЫХ СТЕКОЛ**

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Гирсова М. А., Головина Г. Ф., Анфимова И. Н., Куриленко Л. Н., Антропова Т. В.

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Silver-containing high-silica glasses were synthesized by an impregnation of the silica porous glasses first with AgNO<sub>3</sub> aqueous solution (with or without the presence of the sensitizers, such as Cu(NO<sub>3</sub>)<sub>2</sub> or Ce(NO<sub>3</sub>)<sub>3</sub>), next in the one of halide salt solutions (NH<sub>4</sub>Cl, KBr, KI). The structure of glasses was studied by UV-VIS-NIR and IR spectroscopy. IR spectra confirmed the presence B–O–B, Si–O–Si, P–O–P, O–P–O, O–B–O, Ag–O, Ce–O bonds, (PO<sub>4</sub>)<sup>3-</sup> and P–O<sup>-</sup> groups in glasses.

## **INFLUENCE OF SOL-GEL SYNTHESIS CONDITIONS AND HEAT TREATMENT ON THE STRUCTURE AND THERMAL CHARACTERISTICS OF GLASSY-LIKE EPOXY-TITANATE NANOCOMPOSITES ВЛИЯНИЕ УСЛОВИЙ ЗОЛЬ-ГЕЛЬ СИНТЕЗА И ТЕРМИЧЕСКОЙ ОБРАБОТКИ НА СТРУКТУРООБРАЗОВАНИЕ И ТЕРМИЧЕСКИЕ ХАРАКТЕРИСТИКИ СТЕКЛООБРАЗНЫХ ЭПОКСИДНО-ТИТАНАТНЫХ НАНОКОМПОЗИТОВ**

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The influence of the aging time for epoxy-titanate sols is considered. Transparent glassy-like photocatalytic and biostable epoxy-titanate nanocomposites have been obtained from these sols.

Their fractal structure depending on the ratio of epoxy and titanate components, as well as doping by detonation nanodiamond (DND) has been studied by the SAXS method, including aging in situ. The positive effect of the titanate component and DND on the temperature stability of the nanocomposites is shown.

**MULTILEVEL LASER OPTICAL INFORMATION RECORDING  
IN SILVER-CONTAINING GLASSES  
ЛАЗЕРНАЯ МНОГОУРОВНЕВАЯ ЗАПИСЬ ОПТИЧЕСКОЙ ИНФОРМАЦИИ  
В СЕРЕБРОСОДЕРЖАЩИХ СТЕКЛАХ**

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It is shown experimentally that laser action of optical information on silver-containing photosensitive glasses can be used for optical information recording in octal and hexadecimal codes. The change of irradiation dose results in the change of luminescence or absorption intensity in irradiated zones.

**INVESTIGATION OF THE PROCESS OF FORMING THE STRUCTURE OF THE  
ZOLOCHLAK POROUS GLASS AT THE STAGE OF ANNEALING WITH THE  
APPLICATION OF MATHEMATICAL MODELING  
ИССЛЕДОВАНИЕ ПРОЦЕССА ФОРМИРОВАНИЯ СТРУКТУРЫ  
ЗОЛОШЛАКОВОГО ПОРИСТОГО СТЕКЛА НА СТАДИИ ОТЖИГА  
С ПРИМЕНЕНИЕМ МАТЕМАТИЧЕСКОГО МОДЕЛИРОВАНИЯ**

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The work is devoted to the study of the process of formation of the structure of porous glass at the annealing stage using homogeneous and discrete models. The analysis of existing models of various stages of production of porous glass is carried out, the heat exchange processes in the material studied are studied at the required stage, two principal approaches to calculations of the thermal processes of porous materials are highlighted.

**GLASSY FILMS CONTAINING PLATINUM AND PALLADIUM NANOPARTICLES  
СТЕКЛОВИДНЫЕ ПЛЕНКИ, СОДЕРЖАЩИЕ НАНОЧАСТИЦЫ ПЛАТИНЫ И  
ПАЛЛАДИЯ**

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Glassy-like silicate films containing nanoparticles of Pt and Pd have been synthesized by sol-gel method via TEOS hydrolysis, hexachloroplatinic acid and palladium chloride. The structure

and composition of the films were studied using X-ray reflectometry, X-ray diffraction, atomic force microscopy, scanning and transmission electron microscopy. The catalytic reactivity of Pt/Pd nanoparticles was studied by using voltammetry characteristics.

**ANOMALIES OF HEAT CONDUCTIVITY OF THE FLUID IN THE POROUS GLASS  
IN THE WIDE RANGE OF THE CRITICAL POINT  
АНОМАЛИИ ТЕПЛОПРОВОДНОСТИ ФЛЮИДА В ПОРИСТОМ СТЕКЛЕ  
В ШИРОКОЙ ОКРЕСТНОСТИ КРИТИЧЕСКОЙ ТОЧКИ**

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Thermal conductivity of CO<sub>2</sub> was investigated experimentally in porous glass in a critical region. We found that: heat conductivity of CO<sub>2</sub> in the critical region has the anomalies; the amplitude of thermal conductivity is decreasing; the temperature of phase transition shifts towards low temperatures; the maximum thermal conductivity manifests in a wider temperature range than for pure substance. The observed anomalies are attributable to the influence of surface energy of glass and size effects.

**EFFECTIVE THERMAL CONDUCTIVITY OF THE POROUS GLASS  
FILLED BY CARBON DIOXIDE  
ЭФФЕКТИВНАЯ ТЕПЛОПРОВОДНОСТЬ ПОРИСТОГО СТЕКЛА,  
НАСЫЩЕННОГО ДИОКСИДОМ УГЛЕРОДА**

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The effective thermal conductivity of the porous glass filled by carbon dioxide was experimentally investigated in the temperature range 290-450 K and at the pressure 3,432MPa. There are identified: the mechanisms of heat transfer; the effect of temperature and pressure; the role of carbon dioxide molecules inside pores on the behavior of thermal conductivity of the porous glass.

**NANOPARTICLES AND INHOMOGENITIES IN SILICA-PHOSPHATE CORE  
GLASSES OF OPTICAL FIBER PREFORMS  
НАНОЧАСТИЦЫ И НЕОДНОРОДНОСТИ В ФОСФОРО-СИЛИКАТНЫХ  
СТЁКЛАХ СЕРДЦЕВИН ПРЕФОРМ ВОЛОКОННЫХ СВЕТОВОДОВ**

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Phase separation in Yb-activated P-doped silica preform cores was studied in samples fabricated by powder sintering method with vibrational homogenization of molten mass as well as by deposition from gas phase. Nanocrystals SiO<sub>2</sub>, YbP<sub>3</sub>O<sub>9</sub> and YbPO<sub>4</sub> and heterogeneities caused by Al and P distribution were observed in the samples made of the powder sintering. The phase separation into two glass phases and formation YbPO<sub>4</sub> nanocrystals were revealed in the samples made by the gas phase deposition.

**SOLUBILITY OF SILVER AND PALLADIUM IN BASIC BOROSILICATE  
COMPOUND FOR SOLIDIFICATION OF EDC HIGH-LEVEL WASTE  
РАСТВОРИМОСТЬ СЕРЕБРА И ПАЛЛАДИЯ В БОРОСИЛИКАТНОМ СТЕКЛЕ  
БАЗОВОГО СОСТАВА ДЛЯ ОТВЕРЖДЕНИЯ РАО ОДЦ ФГУП "ГХК"**

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The work consists in studying the sedimentation of the disperse phases of noble metals in glass melts to determine a character of their influence on the technological parameters of the HLW vitrification process on the CCIM technology. Research was carried out with using a model HLW of the EDC and a basic glass compound developed for vitrification of this waste. The work included laboratory experiments on the synthesis of glasses with incorporation of noble metals.

**UPCONVERSION PROCESSES IN DIELECTRICS BASED ON HEAVY METAL  
OXIDES OF THE SYSTEM Bi<sub>2</sub>O<sub>3</sub>-PbO-Ga<sub>2</sub>O<sub>3</sub>  
АПКОНВЕРСИОННЫЕ ПРОЦЕССЫ В ДИЭЛЕКТРИКАХ НА ОСНОВЕ  
ОКСИДОВ ТЯЖЕЛЫХ МЕТАЛЛОВ СИСТЕМЫ Bi<sub>2</sub>O<sub>3</sub>-PbO-Ga<sub>2</sub>O<sub>3</sub>**

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Upconversion materials are of especially significant importance. These materials have been widely applied in solar cells, in sensorics, in thin liquid crystal displays, in medicine and laser technology. Spectral-luminescent properties of glasses based on heavy metal oxides of the system Bi<sub>2</sub>O<sub>3</sub>-PbO-Ga<sub>2</sub>O<sub>3</sub>doped by the rare earth elements Erbium Er<sup>3+</sup>, Neodymium Nd<sup>3+</sup> and

co-doped both Er +Nd have been researched. An intense green visible upconversion luminescence was observed.

## **BASALT FIBERGLASS AS MATERIAL FOR REINFORCEMENT OF THE CALCIUM-PHOSPHATE CEMENTS БАЗАЛЬТОВОЕ СТЕКЛОВОЛОКНО КАК МАТЕРИАЛ ДЛЯ АРМИРОВАНИЯ КАЛЬЦИЙ-ФОСФАТНЫХ ЦЕМЕНТОВ**

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Kirsanova V. A.<sup>2</sup>, Sviridova I. K.<sup>2</sup>  
КНОТЬКО А. В.<sup>1</sup>, Ситанская А. В.<sup>1</sup>, Путляев В. И.<sup>1</sup>, Сергеева Н. С.<sup>2</sup>,  
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The microstructure of cements based on CaHPO<sub>4</sub> obtained from Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub> and reinforced with basalt fibers and kinetics of pH change at its contact with water phase were studied. It is shown that the hydrolysis mechanism is determined not only by the chemical form of the initial phosphate, but also by the state of the surface of the new phase grow. A significant pH change in the experiment was not observed. Studies of the cell toxicity of the materials under study were carried out.

## **APPLICATION OF LUMINESCENT GLASSES DOPED SILVER AND EUROPIUM AS A TEMPERATURE SENSOR ПРИМЕНЕНИЕ ЛЮМИНЕСЦЕНТНЫХ СТЕКОЛ ЛЕГИРОВАННЫХ СЕРЕБРОМ И ЕВРОПИЕМ В КАЧЕСТВЕ ДАТЧИКА ТЕМПЕРАТУРЫ**

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The influence of temperature on optical properties of photo-thermo-refractive glasses with silver molecular clusters and europium is investigated. A temperature quenching of the luminescence is observed for all types of photo-thermo-refractive glasses.

## **TRANSROTATIONAL MICROCRYSTALS WITH INTERNAL LATTICE CURVATURE DISCOVERED BY TEM AND RELATED NOVEL MODEL OF AMORPHOUS STATE ТРАНСРОТАЦИОННЫЕ МИКРОКРИСТАЛЛЫ С ВНУТРЕННЕЙ КРИВИЗНОЙ РЕШЁТКИ, ВЫЯВЛЯЕМЫЕ ЭЛЕКТРОННОЙ МИКРОСКОПИЕЙ, И НОВАЯ МОДЕЛЬ АМОРФНОГО СОСТОЯНИЯ НА ИХ ОСНОВЕ**

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Unusual microcrystals [1] have been discovered by transmission electron microscopy (TEM) for crystal growth in thin (10-100 nm) amorphous films. It can be traced *in situ* in TEM column.

**Transrotation** (unit cell **translation** is complicated by small **rotation**) often reach strong orientation gradients (up to  $300^\circ/\mu\text{m}$  of different geometries) and crystals resemble ideal single crystal enclosed in a curved space. Corresponding novel transrotational nanocrystalline model of amorphous state is proposed.

**THE PHASE SEPARATION PHENOMENON IN THE GLASSES OF  
THE  $\text{Na}_2\text{O-B}_2\text{O}_3\text{-SiO}_2\text{-Fe}_2\text{O}_3$  SYSTEM AND ITS APPLICATION  
FOR PRODUCING POROUS GLASSES**

**ЯВЛЕНИЕ ФАЗОВОГО РАЗДЕЛЕНИЯ В СТЕКЛАХ СИСТЕМЫ  $\text{Na}_2\text{O-B}_2\text{O}_3\text{-SiO}_2\text{-Fe}_2\text{O}_3$   
И ЕГО ИСПОЛЬЗОВАНИЕ ДЛЯ ПОЛУЧЕНИЯ ПОРИСТЫХ СТЕКОЛ**

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Конон М. Ю., Столяр С. В., Полякова И. Г., Дроздова И. А., Антропова Т. В.

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The phase separation in the glasses of the  $\text{Na}_2\text{O-B}_2\text{O}_3\text{-SiO}_2\text{-Fe}_2\text{O}_3$  system in the section of 70 mol. % of  $\text{SiO}_2$  within the concentration of  $\text{Fe}_2\text{O}_3$  0.3–10 mol. % in the temperature range 550–700 °C was studied. It was shown that  $\text{Fe}_2\text{O}_3$  does not have a homogenizing effect on phase separation in this system. Synthesized glasses in the sections of 6 and 8 mol. % of  $\text{Na}_2\text{O}$  are suitable for producing bulk samples of porous glasses.

**THE STUDY OF PHYSICOCHEMICAL REGULARITIES OF THE PHASE-  
SEPARATED INTER-CONNECTED STRUCTURE FORMATION IN GLASSES OF  
THE  $\text{Na}_2\text{O-B}_2\text{O}_3\text{-SiO}_2\text{-Fe}_2\text{O}_3$  SYSTEM**

**ИЗУЧЕНИЕ ФИЗИКО-ХИМИЧЕСКИХ ЗАКОНОМЕРНОСТЕЙ  
ФОРМИРОВАНИЯ ДВУХКАРКАСНОЙ ЛИКВАЦИОННОЙ СТРУКТУРЫ  
В СТЕКЛАХ СИСТЕМЫ  $\text{Na}_2\text{O-B}_2\text{O}_3\text{-SiO}_2\text{-Fe}_2\text{O}_3$**

Konon M. Yu., Stolyar S. V., Polyakova I. G.

Конон М. Ю., Столяр С. В., Полякова И. Г.

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The present work is devoted to the study of the effect of composition, temperature and duration of heat treatment on the formation of an inter-connected phase-separated structure in the glasses of the  $\text{Na}_2\text{O-B}_2\text{O}_3\text{-SiO}_2\text{-Fe}_2\text{O}_3$  system. It is shown that the addition of  $\text{Fe}_2\text{O}_3$  to sodium borosilicate glasses reduces the time required to complete the phase separation process at 550 °C, depending on the concentration of the introduced  $\text{Fe}_2\text{O}_3$ .



**LASER-INDUCED MICROPLASMA APPLIED FOR DIFFRACTIVE  
OPTICAL ELEMENTS FABRICATION**  
**УПРАВЛЕНИЕ ЛАЗЕРНО-ИНДУЦИРОВАННОЙ МИКРОПЛАЗМОЙ ПРИ  
ИЗГОТОВЛЕНИИ ФАЗОВЫХ ДИФРАКЦИОННЫХ ЭЛЕМЕНТОВ**

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We present the method of diffractive optical elements (DOE's) formation on the fused silica surfaces by laser-induced microplasma. The potential application of such optical elements is a beam splitting and beam shaping. This method allows us to fabricate such elements as phase gratings, random phase plates and microlens arrays.

**EFFECT OF TIN OXIDE (IV) ON PHYSICAL CHEMICAL PROPERTIES  
OF SODA-SILICATE GLASS**  
**ВЛИЯНИЕ ДОБАВКИ ОКСИДА ОЛОВА (IV) НА ФИЗИКО-ХИМИЧЕСКИЕ  
СВОЙСТВА НАТРИЕВОСИЛИКАТНЫХ СТЕКОЛ**

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The possibility of using alkaline glasses as a separator in the chemical current sources is considered. Samples of the six formulated compositions are synthesized and DSC curves of these compositions are obtained. According to obtained data the glass system can be used as electrolyte in chemical source of energy.

**INFLUENCE OF RARE EARTH IONS CONCENTRATION ON THE KINETICS  
PHOTO-THERMO-INDUCED CRYSTALLIZATION  
OF PHOTO-THERMO-REFRACTIVE GLASS**  
**ВЛИЯНИЕ РЕДКОЗЕМЕЛЬНЫХ АКТИВАТОРОВ НА КИНЕТИКУ  
ПРОЦЕССА ФОТО-ТЕРМО-ИНДУЦИРОВАННОЙ КРИСТАЛЛИЗАЦИИ  
В ФОТО-ТЕРМО-РЕФРАКТИВНОМ СТЕКЛЕ**

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In present work, experimental investigation of crystal growth kinetics in PTR glass doped with various rare earth ions concentrations was made. Analysis of the absorption spectra of the glass shows that plasmon resonance during heat treatment undergoes red shift caused by AgBr shell

growth. Increase in heat treatment duration induce blue shift which is due to the precipitation of NaF crystals. Estimation of utmost achievable refractive index change reveals is higher as in the parent glass.

**CHLORIDE-PHOTO-THERMO-REFRACTIVE GLASS AS A MATERIAL FOR  
VOLUME BRAGG GRATINGS RECORDING**  
**ХЛОРИДНОЕ ФОТО-ТЕРМО-РЕФРАКТИВНОЕ СТЕКЛО КАК МАТЕРИАЛ ДЛЯ  
ЗАПИСИ ОБЪЁМНЫХ БРЭГГОВСКИХ РЕШЁТОК**

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Properties of holograms in chloride photo-thermo-refractive (PTR) glass were studied. Analysis of the grating coupling constant behavior in the glass with different chlorine concentration on the exposure and heat treatment duration was made. Maximum values of the refractive index modulation were determined. The absorption index modulation inside the grating is equivalent to the induced absorption in the glass.

**TECHNOLOGICAL SPECIFICITIES OF A NOVEL METHOD OF PREPARATION  
GLASS BATCH USING MOH HYDROXIDES**  
**ТЕХНОЛОГИЧЕСКИЕ ОСОБЕННОСТИ НОВОГО СПОСОБА ПОДГОТОВКИ  
СТЕКЛЬНОЙ ШИХТЫ С ИСПОЛЬЗОВАНИЕМ ГИДРОКСИДОВ МОИ**

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Technological specificities and diagram of the novel method for preparation of a silicate glass batch are given, including obtainment of a binder for compaction as a mixture of water-soluble silicates during simultaneous physicochemical activation of refractory raw material using MOH hydroxides.

**INDUSTRIAL WASTE IN PRODUCTION OF GLASS AND GLASS-CERAMICS**  
**ИСПОЛЬЗОВАНИЕ ТЕХНОГЕННОГО СЫРЬЯ В ПРОИЗВОДСТВЕ СТЕКОЛ И  
СТЕКЛОКРИСТАЛЛИЧЕСКИХ МАТЕРИАЛОВ**

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Basic conditions for the production of high-quality decorative glass and glass-ceramics from various kinds of industrial waste have been established. Acid-, alkali- and heat-resistant glass

has been obtained. Charge compacting is shown to be effective using pelletizing and preforming. The effect of compacting on the glass melting process is discussed.

**MANDELSHTAM-BRILLOUIN SPECTROSCOPY  
OF OPTICAL MATERIALS: POSSIBILITIES AND FUTURE  
МАНДЕЛЬШТАМ-БРИЛЛЮЭНОВСКАЯ СПЕКТРОСКОПИЯ  
ОПТИЧЕСКИХ МАТЕРИАЛОВ: ВОЗМОЖНОСТИ И ПЕРСПЕКТИВЫ**

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Onushchenko A. A.<sup>1</sup>, Shepilov M. P.<sup>1</sup>, Yanush O. V.<sup>3</sup>  
Максимов Л. В.<sup>1</sup>, Ананьев А. В.<sup>1</sup>, Богданов В. Н.<sup>2</sup>,  
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Review of combined application of light scattering, absorbance spectroscopy and high temperature acoustics to studying nanostructure and optical parameters of glassy and glass-crystal optical materials includes analysis of possibilities of their usage for designing glasses with improved Rayleigh scattering losses, Kerr coefficient, and spectral-kinetic parameters. Application of RMBS spectroscopy for studying glasses with quantum dots is analyzed, too.

**RADIATION EFFECTS AND OPTICAL PROPERTIES OF RE-DOPED  
ALUMINOBOROSILICATE GLASSES  
РАДИАЦИОННЫЕ ЭФФЕКТЫ И ОПТИЧЕСКИЕ СВОЙСТВА  
АЛЮМОБОРОСИЛИКАТНЫХ СТЕКОЛ, ЛЕГИРОВАННЫХ РЗ ИОНАМИ**

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Мальчукова Е. В.<sup>1</sup>, Непомнящих А. И.<sup>2</sup>, Boizot B.<sup>3</sup>, Теруков Е. И.<sup>1</sup>

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The behavior of rare-earth (R3) is studied in the pristine and irradiated aluminoborosilicate (ABS) glasses. The analysis of the optical transmission/absorption and Raman spectra as a function of the dopant concentration shows that the RE ions in glass studied change both the charge state and the position in the glass matrix influencing thus amount of radiation defects and quantity of nonbridging oxygens. Mechanisms that affect this phenomenon are discussed.

**ENHANCEMENT OF  $\text{Eu}^{3+}$  LUMINESCENCE BY THE SILVER CLUSTERS FORMED WITH ION EXCHANGE METHOD IN SILICATE GLASSES**  
**УСИЛЕНИЕ ЛЮМИНЕСЦЕНЦИИ ИОНОВ  $\text{Eu}^{3+}$  КЛАСТЕРАМИ СЕРЕБРА, СФОРМИРОВАННЫМИ МЕТОДОМ ИОННОГО ОБМЕНА В СИЛИКАТНЫХ СТЕКЛАХ**

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In this paper the silicate glass doped with different concentration of antimony oxide and/or europium oxide were investigated. Doping of silicate glass by europium oxide has no substantial effect on the formation and spectral-luminescent properties of silver clusters formed with ion exchanged method. Luminescence intensity of europium ions in the glasses with silver clusters is much higher than that in the as-prepared glasses due to energy transfer from silver clusters to  $\text{Eu}^{3+}$  ions.

**CORRELATION OF PHYSICAL AND CHEMICAL PROPERTIES OF ALKALI NIOBOPHOSPHATE AND NIOBOSILICATE GLASSES WITH THEIR STRUCTURAL FEATURES**  
**ВЗАИМОСВЯЗЬ ФИЗИКО-ХИМИЧЕСКИХ СВОЙСТВ ЩЕЛОЧНЫХ НИОБОФОСФАТНЫХ И НИОБОСИЛИКАТНЫХ СТЕКОЛ С ИХ СТРУКТУРНЫМИ ОСОБЕННОСТЯМИ**

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Niobophosphate and niobosilicate glasses have been studied. Alkali niobophosphate glasses have been treated with femtosecond laser. The distribution of chemical elements along the laser treatment area in lithium niobophosphate glasses has been obtained. Structure degradation in sodium and potassium glasses has been registered. Migration characteristics, electrical conductivity in wide temperature range, mechanical properties and migration characteristics of glasses have been studied.

**OPTICAL PROPERTIES OF CHLORIDE PHOTOTHERMOREFRACTIVE GLASSES WITH THE VARIABLE CONCENTRATION OF SILVER.**  
**ОПТИЧЕСКИЕ СВОЙСТВА ХЛОРИДНЫХ ФОТО-ТЕРМО-РЕФРАКТИВНЫХ СТЕКОЛ С ПЕРЕМЕННЫМ СОДЕРЖАНИЕМ СЕРЕБРА**

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The effect of silver concentration in glass composition on silver nanoparticles formation was investigated. Based on glasses absorption spectra and literature data were made conclusions about formation of silver nanoparticles with different shell depending of silver oxide concentration.

**TECHNOLOGICAL FEATURES OF THE USE OF SECONDARY PRODUCTS  
IN THE TECHNOLOGY OF SILICATE MATERIALS  
ТЕХНОЛОГИЧЕСКИЕ ОСОБЕННОСТИ ИСПОЛЬЗОВАНИЯ ВТОРИЧНЫХ  
ПРОДУКТОВ В ТЕХНОЛОГИИ СИЛИКАТНЫХ МАТЕРИАЛОВ**

Min'ko N. I., Dobrinskaya O. A., Gridyakin K. N., Bulgakov A. S.

Минько Н. И., Добринская О. А., Гридякин К. Н., Булгаков А. С.

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The report examines the technological features of the use of processed products in the technology of silicate materials; identified the main problems that must be considered when using recycled products and substandard raw materials. The report provides concrete examples of the use of technological waste in the production. Presents the results of research, testing and implementation of a number of secondary products.

**OPTICAL PROPERTIES OF EUROPIUM-DOPED FLUOROHAFNATE GLASSES  
ОПТИЧЕСКИЕ СВОЙСТВА ФТОРГАФНАТНЫХ СТЕКОЛ,  
АКТИВИРОВАННЫХ ЕВРОПИЕМ**

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Моисеева Л. В.<sup>1,2</sup>, Батыгов С. Х.<sup>1</sup>, Бреховских М. Н.<sup>2</sup>, Жидкова И. А.<sup>2</sup>

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Optical absorption and the luminescence of  $\text{EuF}_3$ - and  $\text{EuF}_2$ -activated fluorohafnate glasses are studied. The introduction of europium causes absorption in the region of the UV absorption edge, which appeared to be its long-wavelength shift.  $\text{Eu}^{2+}$  luminescence in the fluorohafnate glasses is quenched. The  $\text{Eu}^{3+}$  luminescence spectra contain lines corresponding to transitions from several levels of the  $^5D$  multiplet to levels of the  $^7F$  multiplet.

**FEATURES OF OBTAINING STRONTIUM BOROSILICATES  
BY SOL – GEL METHOD  
ОСОБЕННОСТИ ПОЛУЧЕНИЯ БОРОСИЛИКАТОВ СТРОНЦИЯ  
ЗОЛЬ – ГЕЛЬ МЕТОДОМ**

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In this abstract, we consider the features of obtaining strontium borosilicates in the concentration triangle  $\text{Sr}_3\text{B}_2\text{O}_6 - \text{Sr}_2\text{SiO}_4 - \text{Sr}_2\text{B}_2\text{O}_5$  by the method of coprecipitation with elements of sol-gel technology (liquid-phase method). Achieved to reduce temperature of the

phase formation by 200 – 400°C in comparison with the solid-phase method. Reagents used. Method of synthesis. The results obtained and their interpretation.

**RESIDUAL DURABILITY OF THE GLAZING OF SPACE VEHICLES IN COLLISIONS WITH COSMIC PARTICLES IN NEAR-EARTH ORBITS**  
**ОСТАТОЧНАЯ ПРОЧНОСТЬ ОСТЕКЛЕНИЯ КОСМИЧЕСКИХ АППАРАТОВ ПРИ СОУДАРЕНИЯХ С КОСМИЧЕСКИМИ ЧАСТИЦАМИ НА ОКОЛОЗЕМНЫХ ОРБИТАХ**

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The reliability of the operation of the glasses in the portholes of spacecraft depends on the size of the defects formed when meteorite particles enter the porthole, their dimensions, density, velocity, and angles of collisions. In this paper, based on the theory of strength in the double layer model, formulas are derived for the dependence of the residual strength of glass on the diameter of particles, their density, velocity relative to the first cosmic velocity and the angles of impact.

**INVESTIGATION OF ANTIADHESIVE COATINGS FOR BENDING SILICATE GLASSES**  
**ИССЛЕДОВАНИЕ АНТИАДГЕЗИОННЫХ ПОКРЫТИЙ ДЛЯ МОЛЛИРОВАНИЯ СИЛИКАТНЫХ СТЕКОЛ**

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Солинов В. Ф.<sup>1,2</sup>, Солинов Е. Ф.<sup>1</sup>, Муравьев Э. Н.<sup>1,2</sup>, Скрозникова В.В.<sup>1</sup>,  
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In this paper we were investigated new classes of compounds as high separating compositions for bending - solutions based on high-temperature, Carbon-containing materials, and talc, in order to obtain an optically transparent glasses that do not require additional machining.

**MODIFICATION OF LUMINESCENT PROPERTIES OF CU- AND AG-DOPED  
BARIUM PHOSPHATE GLASSES BY X-RAY IRRADIATION  
AND HEAT TREATMENT**  
**МОДИФИКАЦИЯ ЛЮМИНЕСЦЕНТНЫХ СВОЙСТВ БАРИЙФОСФАТНЫХ  
СТЕКЛОЛ, ЛЕГИРОВАННЫХ ИОНАМИ CU И AG, РЕНТГЕНОВСКИМ  
ОБЛУЧЕНИЕМ И ТЕРМООБРАБОТКОЙ**

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In this paper, we studied the effect of x-ray radiation on the luminescent properties of barium phosphate glasses doped with Ag and Cu ions separately and glasses containing Ag and Cu ions simultaneously. It is shown that hybrid molecular clusters "silver-copper" with intense luminescence are formed in glass containing silver and copper.

**OPTICAL SILICA GLASS FROM NATURAL QUARTZ  
ОПТИЧЕСКОЕ КВАРЦЕВОЕ СТЕКЛО ИЗ ПРИРОДНОГО КВАРЦА**

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We present the results to study the six types of natural quartz. Structure- texture qualities, mineral and fluid inclusions of four types of quartzite from the East Sayan, granulated quartz from Chipiket and Brazilian quartz crystal were studied. All six types considerably differ in mineral and fluid inclusions. High purity concentrate are obtained from all types of quartz. Optical glasses are products by vacuum-compression method.

**NEW DEVELOPMENTS OF GLASSES AND GLASSCERAMICS FOR PHOTONICS  
APPLICATIONS IN ITMO UNIVERSITY**

**НОВЫЕ РАЗРАБОТКИ УНИВЕРСИТЕТА ИТМО В ОБЛАСТИ СТЕКОЛ И  
СТЕКЛОКРИСТАЛЛИЧЕСКИХ МАТЕРИАЛОВ ДЛЯ ЗАДАЧ ФОТОНИКИ**

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Modern trends and challenges of glasses development are discussed. New silicate, phosphate, and borate glasses and glassceramics doped with rare earth and transition metal ions, molecular

clusters, quantum dots, metallic nanoparticles and nanocrystals were designed in ITMO University. The materials demonstrate unique physical and chemical properties. Some examples of the materials and their applications in photonics, plasmonics, solar energy, laser and lighting technique are presented.

**RESEARCH OF THE HIGH REFRACTING LEAD AND SILICATE GLASSES WITH EXPANDED BORDER OF A TRANSMISSION**  
**ИССЛЕДОВАНИЕ ВЫСОКОПРЕЛОМЛЯЮЩИХ СВИНЦОВО-СИЛИКАТНЫХ СТЕКОЛ С РАСШИРЕННОЙ ГРАНИЦЕЙ ПРОПУСКАНИЯ**

Novogran A. I., Tuzova Y. V., Aseev V. A., Nekrasova Y. A.  
Новогран А. И., Тузова Ю. В., Асеев В. А., Некрасова Я. А.  
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In this article the problem of deterioration of illumination of white LED is conserved over time. For the decision it is problems it was offered to replace an organic component of a LED with glass. A number of lead and silicate glasses with the variable content of lead was studied. For finding of the necessary structure absorption spectra, glass transition and index of refraction of glasses were studied.

**OPTICAL PROPERTIES OF BROMIDE PHOTO-THERMO-REFRACTIVE GLASS WITH VARIABLE SILVER CONCENTRATION**  
**ОПТИЧЕСКИЕ СВОЙСТВА БРОМИДНЫХ ФОТО-ТЕРМО-РЕФРАКТИВНЫХ СТЕКОЛ С ПЕРЕМЕННЫМ СОДЕРЖАНИЕМ СЕРЕБРА**

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Орешкина К. В., Дубровин В. Д.  
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The influence of silver concentration and the effect of UV irradiation and heat treatment on optical properties and the kinetic of silver molecular clusters, nanoparticles and silver bromide nanocrystals formation in bromide photo-thermo-refractive glass was studied. The result of this crystalline phase formation is a local increase in the refractive index of the irradiated area as compared to the unexposed area  $+\Delta n \sim 800 \text{ ppm}$ .

**STRUCTURAL STUDIES OF THE FE-CONTAINING ZINC BORATE GLASSES**  
**ИЗУЧЕНИЕ СТРОЕНИЯ ЖЕЛЕЗОСОДЕРЖАЩИХ ЦИНКОВОБОРАТНЫХ СТЕКОЛ**

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Осипов А. А., Зайнуллина Р. Т., Осипова Л. М., Штенберг М. В., Лебедева С. М., Хворов П. В., Миронов А. Б.  
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The glasses with the composition of  $x\text{Fe}_2\text{O}_3-(100-x)[40\text{ZnO}\cdot 60\text{B}_2\text{O}_3]$  with  $0 \leq x \leq 10 \text{ mol\%}$  were prepared and studied by IR, Raman and Mossbauer spectroscopy. The effect of  $\text{Fe}_2\text{O}_3$  on short and intermediate range order borate structures was established based on data of a



vibrational spectroscopy. Mossbauer spectroscopy was used to determination of the valence state ( $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$ ) as well as of the local environment of iron ions in the studied glasses.

**EFFECT OF CALCIUM, BARIUM AND STRONTIUM ADDITIVES ON STRUCTURE AND HEAT PROPERTIES OF SODIUM BOROSILICATE GLASSES**  
**ВЛИЯНИЕ ДОБАВОК КАЛЬЦИЯ, БАРИЯ И СТРОНЦИЯ НА СТРУКТУРУ И ТЕРМИЧЕСКИЕ СВОЙСТВА НАТРИЕВЫХ БОРОСИЛИКАТНЫХ СТЕКОЛ**

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Shenderovich I.G.<sup>3</sup>, Brazhnikov M.P.<sup>1</sup>

Еремяшев В.Е.<sup>1</sup>, Осипов А.А.<sup>2</sup>, Жеребцов Д.А.<sup>1</sup>, Осипова Л.М.<sup>2</sup>,  
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Thermal properties of the sodium borosilicate glasses with calcium, barium and strontium additives were studied by differential scanning calorimetry. Thermal data were compared with the results of  $^{29}\text{Si}$  and  $^{11}\text{B}$  MAS NMR investigations. The obtained information provides an opportunity for correction of the heat treatment of the glassy materials used to immobilization of the nuclear waste.

**ELECTRONIC SPECTRA OF MOLTEN MIXTURES**  
 **$x\text{Na}_2\text{O}-\text{RE}_2\text{O}_3-(100-x)\text{B}_2\text{O}_3$  RE=(Ce, Pr, Nd, Sm, Eu)**  
**ЭЛЕКТРОННЫЕ СПЕКТРЫ РАСПЛАВЛЕННЫХ СМЕСЕЙ**  
 **$x\text{Na}_2\text{O}-\text{RE}_2\text{O}_3-(100-x)\text{B}_2\text{O}_3$  RE=(Ce, Pr, Nd, Sm, Eu)**

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Пайвин А. С., Вершинин А. О., Хохряков А. А., Рябов В. В.

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The melts  $x\text{Na}_2\text{O}-(100-x)\text{B}_2\text{O}_3$  and  $x\text{Na}_2\text{O}-\text{RE}_2\text{O}_3-(100-x)\text{B}_2\text{O}_3$  were studied by electronic spectroscopy method, where  $x$  is mol%  $\text{Na}_2\text{O}$ . In these mixtures, with the sodium oxide concentration increase, cyclic changes of boron atoms coordination numbers of are found. The minimal values on dependences of concentration  $\text{BO}_4^-$  on concentration of sodium oxide have different origin. It is assumed that the coordination numbers of Re ions increase from 6 to 8 for range  $0 < x < 10$  and remain constant for  $x > 10$ .

# HIGHLY-STRENGTH GLASS-CERAMIC MATRIXES FOR HAZARDOUS RADIONUCLIDES IMMOBILIZATION PREPARED VIA SPARK PLASMA SINTERING

## ВЫСОКОПРОЧНЫЕ СТЕКЛОКЕРАМИЧЕСКИЕ МАТРИЦЫ ДЛЯ ИММОБИЛИЗАЦИИ ОПАСНЫХ РАДИОНУКЛИДОВ ПОЛУЧЕННЫЕ ИСКРОВЫМ ПЛАЗМЕННЫМ СПЕКАНИЕМ

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According to the high importance of the problems in radioecology that includes the traditional techniques for conditioning of the radioactive waste and related to the immobilization of hazardous radionuclides in high dense compounds, the work is focused on the challenging task of developing new hydrolytically and mechanically resistant ceramic matrix enclosing hazardous radionuclides. The innovative spark plasma sintering (SPS) technology is suggested.

## PHOSPHORUS (V) OXIDE AND ITS STRUCTURE ОКСИД ФОСФОРА P<sub>2</sub>O<sub>5</sub> И ЕГО СТРУКТУРА

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The electronic structure of phosphorus (V) oxide was calculated by DFT method on the basis of plane wave and atomic functions. It was investigated the difference in charge states of two types of oxygen atoms.

## THE INFLUENCE OF ALKALI METAL ION TO STRUCTURE OF SYSTEMS Me<sub>2</sub>O-P<sub>2</sub>O<sub>5</sub> ВЛИЯНИЕ ПРИРОДЫ КАТИОНА ЩЕЛОЧНОГО МЕТАЛЛА НА СТРУКТУРУ СИСТЕМ Me<sub>2</sub>O-P<sub>2</sub>O<sub>5</sub>

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The mobility of alkali metal ions in disordered systems of Me<sub>2</sub>O-P<sub>2</sub>O<sub>5</sub> was investigated by DFT method. It was determined that potassium ions have a maximum of mobility in a set of ions Li-Na-K.

**INFLUENCE OF CHLORINE CONCENTRATION ON THE SPECTRAL AND OPTICAL PROPERTIES OF PHOTO-THERMO-REFRACTIVE GLASSES**  
**ВЛИЯНИЕ КОНЦЕНТРАЦИИ ХЛОРА НА СПЕКТРАЛЬНЫЕ И ОПТИЧЕСКИЕ СВОЙСТВА ФОТОТЕРМОРЕФРАКТИВНЫХ СТЕКОЛ И СТЕКЛОКЕРАМИК НА ИХ ОСНОВЕ**

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A number of photo-thermo-refractive glasses with different concentrations of chlorine were created. Influence of chlorine concentration on peak position of the plasmon resonance peak and refractive index change have been studied.

**COLOR CENTERS FORMATION IN ALKALINE BIPHOSPHATE GLASSES BY FEMTOSECOND LASER PULSES**  
**ФОРМИРОВАНИЕ ЦЕНТРОВ ОКРАСКИ В ЩЕЛОЧНО-НИОБО-ФОСФАТНЫХ СТЕКЛАХ ПОД ВОЗДЕЙСТВИЕМ ФЕМТОСЕКУНДНЫХ ЛАЗЕРНЫХ ИМПУЛЬСОВ**

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In this work, we study the color centers, which are defects in the glass and have different absorption spectrum from the intrinsic absorption of the matrix, as well as luminescence. The color centers were formed by femtosecond laser pulses in the glasses with different alkali ions. Structural features of the glasses were investigated with Raman spectroscopy. The correlation between glass structure, laser pulses parameters and color centers formation rates was studied.

**LASER TREATMENT OF POROUS GLASSES: OPPORTUNITIES AND PROSPECTS**  
**ЛАЗЕРНАЯ ОБРАБОТКА ПОРИСТЫХ СТЕКОЛ: ВОЗМОЖНОСТИ И ПЕРСПЕКТИВЫ**

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In the work we consider the peculiarities of porous glass laser-induced modification as well as perspectives of application of such a material in integral photonic devices and microfluidic elements fabrication. For example, unusually high densification  $\leq 26\%$  can be obtained without lateral residual stresses within the laser beam waist inside of the porous glass during its multi-shot femtosecond laser irradiation, which may induce in the glass the related high refractive index change  $\sim 0.1$ .

**CRYSTALLIZATION ABILITY OF SODIUM BORATE GLASSES  
EVALUATED BY MEANS OF DTA  
КРИСТАЛЛИЗАЦИОННАЯ СПОСОБНОСТЬ НАТРИЕВОБОРАТНЫХ СТЕКОЛ  
ПО ДАННЫМ ДТА**

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A coefficient for the quantitative estimation of crystallization ability of glasses evaluated by means of a single DTA curve is suggested. Unlike previously proposed solutions, the crystallization ability coefficient is a non-dimensional quantity which varies linearly from 1 for rapidly crystallizing glasses to 0 for glasses that do not crystallize in the DTA process. The applicability of the coefficient is demonstrated by the example of powder and monolithic glasses of the sodium borate system.

**FEATURES OF THE STRUCTURE OF FERROMAGNETIC POROUS GLASSES  
AND COMPOSITES WITH THE MULTIFERROIC PROPERTIES BASED ON  
THEM**

**ОСОБЕННОСТИ СТРУКТУРЫ ФЕРРОМАГНИТНЫХ ПОРИСТЫХ СТЕКОЛ  
И КОМПОЗИТОВ СО СВОЙСТВАМИ МУЛЬТИФЕРРОИКОВ НА ИХ ОСНОВЕ**

Pshenko O. A., Antropova T. V., Anfimova I. N., Drozdova I. A., Polyakova I. G.

Пшенко О. А., Антропова Т. В., Анфимова И. Н., Дроздова И. А., Полякова И. Г.

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In this work the structure of ferromagnetic iron-containing porous glasses and composites with multiferroic properties have been studied. The porous structure of porous glasses depends on the duration of alkaline etching. The structure of the composites depends on both the parameters of the porous structure of the porous glasses and the heat treatment temperature of the composites.

**THEORETICAL STUDY OF LASER CUTTING OF GLASS  
ТЕОРЕТИЧЕСКОЕ ИССЛЕДОВАНИЕ ЛАЗЕРНОЙ РЕЗКИ СТЕКЛА**

Buchanov V. V., Kartakov M. O., Muravyev E. N., Revenko V. I., Solinov V. F., Solinov E. F.

Бучанов В. В., Каптаков М. О., Муравьев Э. Н., Ревенко В. И., Солинов В. Ф.,

Солинов Е. Ф.

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The calculations of 3D distribution of temperature and elastic stresses arising under the action of the moving laser beam ( $\lambda=1.065 \mu$ ) on the glass. It is shown that at a given speed there is a limited range of values of the radiation power, allowing for a controlled crack propagation. The emergence of a stable cracks perhaps between the spots of irradiation.

## **LASER CUTTING OF SILICATE BENT GLASS ЛАЗЕРНАЯ РЕЗКА СИЛИКАТНЫХ ГНУТЫХ СТЁКОЛ**

Solinov V. F., Solinov E. F., Buchanov V. V., Kaptakov M. O., Kurchatov I. S.,  
Kustov M. E., Muravyev E. N., Revenko V. I.

Солинов В. Ф., Солинов Е. Ф., Бучанов В. В., Каптаков М. О., Курчатов И. С.,  
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3D laser cutting of glass were considered. For cutting a three-dimensional glass it is convenient to use six-axle robots. The lens is fixed on the output link of the robot, and connected with the collimating device of the optical cable. The advantage of laser cutting 3D glass front of the mechanical is the possibility of full automation of the cutting process.

## **TECHNOLOGY VITRIFICATION OF LIQUID HIGH-LEVEL WASTE AT PA “МАЯК”: HISTORY AND PRACTICE ТЕХНОЛОГИЯ ОСТЕКЛОВАНИИ ЖИДКИХ ВЫСОКОАКТИВНЫХ ОТХОДОВ (ВАО) НА ПО «МАЯК»: ИСТОРИЯ И ПРАКТИКА**

Kolupaev D. N., Remezov M. B., Tananaev I. G.

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According to IAEA rules, HLW should be transferred to solid matrices. The most important preserving matrices for protecting HLW from the biosphere are glass. At PA “Mayak” from 1987 to 2010, >26 000 m<sup>3</sup> of HLW was vitrified, > 6000 tons of aluminophosphate glass containing > 640 million Ki were produced. At present, the type and characteristics of evacuated small-sized smelters of direct electric heating on borosilicate and aluminophosphate glass were focused.

## **PECULIARITIES OF THE GLASS STATE OF ENAMEL COATINGS FOR ANTI- CORROSION PROTECTION OF STEEL PRODUCTS ОСОБЕННОСТИ СТЕКЛООБРАЗНОГО СОСТОЯНИЯ ЭМАЛЕВЫХ ПОКРЫТИЙ ДЛЯ АНТИКОРРОЗИОННОЙ ЗАЩИТЫ СТАЛЬНЫХ ИЗДЕЛИЙ**

Ryabova A. V., Khoroshavina V. V., Klimova L. V., Velichko A. Yu.

Рябова А. В., Хорошавина В. В., Климова Л. В., Величко А. Ю.

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Of all the known technologies for ensuring corrosion resistance, the use of glass enamels is most effective. In the present work, the development of a single-layer fiberglass coating for steel products with high corrosion resistance is presented. The dependence of the properties of enameled products on the structure of the glass cover is presented.

**SYNTHESIS OF INORGANIC COMPOSITES, CONSISTING OF A SERIES OF YAG  
PHOSPHORS AND A HIGH-REFRACTIVE GLASS MATRIX  
СИНТЕЗ НЕОРГАНИЧЕСКИХ КОМПОЗИТОВ, СОСТОЯЩИХ ИЗ  
ЛЮМИНОФОРОВ СЕРИИ АИГ И ВЫСОКОПРЕЛОМЛЯЮЩЕЙ СТЕКЛЯННОЙ  
МАТРИЦЫ**

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A luminescent composite based on a high refractive glass matrix and a fine powder of YAG doped with cerium was synthesized. At a temperature of 750°C sintering of phosphor and glass powders was made, samples of the composite were obtained, which can later be used in white LEDs. Spectral-luminescent studies of the resulting composite were carried out. When using the resulting composite, a white light-emitting diode was created, emitting white light with a color temperature of 5208 K.

**GENERALIZED EQUATION FOR THE DEPENDENCE OF THE GLASS  
TRANSITION TEMPERATURE SPEED COOLING GLASS-FORMING MELTS  
ОБОБЩЕННОЕ УРАВНЕНИЕ ДЛЯ ЗАВИСИМОСТИ ТЕМПЕРАТУРЫ  
СТЕКЛОВАНИЯ ОТ СКОРОСТИ ОХЛАЖДЕНИЯ СТЕКЛООБРАЗУЮЩИХ  
РАСПЛАВОВ**

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A generalized equation is proposed for the dependence of the glass transition temperature on the cooling rate of the melt. It is shown that the equation obtained is in agreement with the experimental data.

**PARAMETER ESTIMATION EQUATION FOR GLASS  
TRANSITION WOLKENSTEIN-PTITSYN  
ОЦЕНКА ПАРАМЕТРА УРАВНЕНИЯ СТЕКЛОВАНИЯ  
ПО ВОЛЬКЕНШТЕЙНУ-ПТИЦЫНУ**

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In the case of silicate glasses, the calculation of the temperature band  $\delta T_g$  characterizing the liquid-glass transition interval is considered. The value of  $\delta T_g$  is a parameter of the vitrification

equation, which determines the appearance of the glassy state at the temperature  $T_g$  during cooling of the melt.

**THEORY OF FREE VOLUME AND MODEL DELOCALIZED ATOMS OF GLASS  
ТЕОРИЯ СВОБОДНОГО ОБЪЕМА И МОДЕЛЬ ДЕЛОКАЛИЗОВАННЫХ  
АТОМОВ СТЕКЛООБРАЗНЫХ СИСТЕМ**

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There is a developed idea that the creation of a hole in amorphous media is due to delocalization of the atom - its fluctuation shift from the equilibrium position.

**THERMODYNAMIC CHARACTERISTICS OF SILICATE GLASSES WITH TWO  
ALKALINE CATIONS AND GLASSES CONTAINING ALKALI  
AND ALKALINE-EARTH CATIONS**

**ТЕРМОДИНАМИЧЕСКИЕ ХАРАКТЕРИСТИКИ СИЛИКАТНЫХ СТЕКОЛ С  
ДВУМЯ ЩЕЛОЧНЫМИ КАТИОНАМИ И СТЕКОЛ, СОДЕРЖАЩИХ  
ЩЕЛОЧНОЙ И ЩЕЛОЧНОЗЕМЕЛЬНЫЙ КАТИОНЫ**

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Based on a study of the ion exchange equilibrium, thermodynamic quantities of molten glasses containing various alkali oxides as well as alkali and alkaline earth oxides were calculated. The enthalpies of mixing for all two-alkali silicate melts are negative. Conversely, the magnitude of the mixing enthalpy for silicate melt containing sodium and barium oxides is positive. Similar results were obtained when analyzing the concentration dependences of self-diffusion coefficients in mixed glasses.

**THE RESEARCH OF MANGANESE SPECTRAL AND LUMINESCENT  
PROPERTIES IN LEAD PHOSPHATE GLASSES  
ИССЛЕДОВАНИЕ СПЕКТРАЛЬНО-ЛЮМИНЕСЦЕНТНЫХ СВОЙСТВ  
МАРГАНЦА В СВИНЦОВО-ФОСФАТНЫХ СТЕКЛАХ**

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Mn<sup>2+</sup> doped lead phosphate glasses were synthesized. Luminescence spectra, absorption spectra, Quantum yield and luminescence lifetime of Mn<sup>2+</sup> ions were measured. The maximum quantum yield in these glasses was 49 %. The luminescence maximum shifts to long wavelengths of the spectrum with increasing of concentration Mn<sup>2+</sup> ions. Luminescence lifetime curve was not exponential. Mn<sup>2+</sup> doped lead phosphate glasses can be used as phosphors.

**ELECTRIC MELTING OF REFRACTORY HIGHVISCOSITY  
BOROSILICATE GLASS**  
**ЭЛЕКТРИЧЕСКАЯ ВАРКА ТУГОПЛАВКИХ ВЫСОКОВЯЗКИХ  
БОРОСИЛИКАТНЫХ СТЕКОЛ**

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This article describes the behavior of borosilicate glass while melting and forming. It describes the electric melting glass furnace design and its features during the borosilicate glass melting. Moreover, this article gives the detailed recommendations for the technical process stabilization.

**PHOTOSENSITIVE PROPERTIES SILICATE GLASSES**  
**ФОТОЧУВСТВИТЕЛЬНЫЕ СВОЙСТВА СИЛИКАТНЫХ СТЕКОЛ**

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The photosensitive properties investigation of neodymium doped silicate glasses have been done. Holographic, spectral and luminescent properties of neodymium ion have been investigated. It was shown, that the maximum of the refractive index variation ( $9.5 \cdot 10^{-4}$ ) was achieved with irradiation dose  $2 \text{ J/cm}^2$ . These glasses are promising candidates as an active media for lasers with distributed feedback.

**X-RAY ANALYSIS OF STRUCTURALLY INHOMOGENEOUS MODIFIED  
XEROGELS BASED OF LIQUID GLASS**  
**РЕНТГЕНОГРАФИЧЕСКОЕ ИССЛЕДОВАНИЕ СТРУКТУРНО-  
НЕОДНОРОДНЫХ МОДИФИЦИРОВАННЫХ КСЕРОГЕЛЕЙ НА ОСНОВЕ  
ЖИДКОГО СТЕКЛА**

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The paper presents the results of X-ray diffraction studies of the xerogels based on a liquid glass modified by different additives (metal salts, epoxy resin oligomer). The characteristics of short-range order (coordination numbers, radii of coordination spheres and their variances) were calculated and analyzed for all investigated samples. It was shown that even the samples for which the X-ray scattering pattern was typical for amorphous materials were structurally inhomogeneous.



**SEARCH FOR MODELS OF THE ATOMIC STRUCTURE OF METAL-EPOXY-SILICATE COMPOSITES ACCORDING TO X-RAY EXPERIMENT DATA**  
**ПОИСК МОДЕЛЕЙ АТОМНОЙ СТРУКТУРЫ**  
**МЕТАЛЛОЭПОКСИСИЛИКАТНЫХ КОМПОЗИТОВ ПО ДАННЫМ**  
**РЕНТГЕНОГРАФИЧЕСКОГО ЭКСПЕРИМЕНТА**

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This paper presents the analysis of the atoms arrangement in the short-range order for the initial and modified xerogels based on a liquid glass. The salt  $\text{CuSO}_4$  (or  $\text{CuCl}_2$ ) and epoxy resin oligomer (the second component) were used as a modifiers. The proposed models of the structure were a mixture of randomly disoriented ultrasmall crystallites, which had a different composition and structure.

**THE HEAT RESISTANCE OF THE GLASS-CERAMIC COATING SYSTEM**  
 **$\text{HfSi}_2$  —  $\text{HfB}_2$  AT A TEMPERATURE OF 1000 °C**  
**ЖАРОСТОЙКОСТЬ СТЕКЛОКЕРАМИЧЕСКИХ ПОКРЫТИЙ СИСТЕМЫ**  
 **$\text{HfSi}_2$  —  $\text{HfB}_2$  ПРИ ТЕМПЕРАТУРЕ 1000°C**

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At present, the problem of creating coatings capable to protect carbon materials from oxidation at operating temperatures up to 2000 °C is urgent. As initial oxygen-free refractory compounds, hafnium disilicide  $\text{HfSi}_2$  and hafnium diboride  $\text{HfB}_2$  are used. At present work the heat resistance of the coating system  $\text{HfSi}_2$ - $\text{HfB}_2$  was investigated. It was found that the coatings do not protect the carbon from burning at a temperature of 1000°C.

**STUDY OF MAGNETO-OPTICAL IRON-CONTAINING**  
**POTASSIUM-ALUMINA-BORATE GLASS**  
**ИССЛЕДОВАНИЕ МАГНИТООПТИЧЕСКИХ ЖЕЛЕЗОСОДЕРЖАЩИХ**  
**КАЛИЕВО-АЛЮМО-БОРАТНЫХ СТЕКОЛ**

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The article presents research results of optical properties of potassium-alumina-borate glass, activated with ions of iron and manganese. The formation process of nanocrystals of manganese ferrite  $\text{MnFe}_2\text{O}_4$  in potassium-alumina-borate glass host was studied. Proposed and analyzed nanoglass-ceramics could be accepted as a basis for creation of sensing environments for sensors current and magnetic field and for creation of optical isolators based on the Faraday effect.

## ACTINIDE SPECIATION IN SODIUM-ALUMINUM IRON-PHOSPHATE GLASSES СОСТОЯНИЕ АКТИНИДОВ В НАТРИЙ-АЛЮМО-ЖЕЛЕЗО-ФОСФАТНЫХ СТЕКЛАХ

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The speciation of U, Np, and Pu in Na-Al-(Fe)-phosphate glasses was studied by XAFS, XPS, and FTIR spectroscopy. At low UO<sub>2</sub> content (≤5 wt.%) U(V) dominates over U(IV). At 5 to 10 wt.% UO<sub>3</sub> U(V) and U(VI) contents are comparable. At higher UO<sub>3</sub> content major U is present as U(VI) and minor as U(V) in the form of UO<sub>2</sub><sup>2+</sup> and UO<sub>2</sub><sup>+</sup>, respectively. Np was found to be predominantly tetravalent – Np(IV) while Pu(III) dominates over Pu(IV) in Fe free glass and on the contrary in the Fe bearing glass.

## VITREOUS MATRICES FOR NUCLEAR WASTE IMMOBILIZATION СТЕКЛОМАТРИЦЫ ДЛЯ ИММОБИЛИЗАЦИИ РАДИОАКТИВНЫХ ОТХОДОВ

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Currently high-level nuclear wastes are vitrified to produce either borosilicate or aluminophosphate (in Russia only) glass-based materials suitable for a long-term storage. To improve immobilization properties existing glasses are being modified and novel glasses are being designed. Special attention is paid to sodium-aluminum-iron phosphate glasses capable to incorporate higher amounts of transition metal oxides, sulfates, molybdates, and other troublesome components than borosilicate ones.

## THE SHRINKAGE OF BISMUTH-CONTAINING POROUS GLASSES DURING SINTERING AND THE VISCOSITY OF QUARTZ-LIKE GLASSES УСАДКА ВИСМУТ-СОДЕРЖАЩИХ ПОРИСТЫХ СТЕКОЛ В ПРОЦЕССЕ СПЕКАНИЯ И ВЯЗКОСТЬ КВАРЦОИДОВ

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The temperature dependences of Bi-containing porous glasses' shrinkage and the viscosity of quartz-like glasses obtained from industrial phase-separated glass of 8В-НТ (as analyzed, wt. %: 6.74 Na<sub>2</sub>O - 20.52 B<sub>2</sub>O<sub>3</sub> - 72.59 SiO<sub>2</sub> - 0.15 Al<sub>2</sub>O<sub>3</sub>) were studied. Preliminarily the glasses

were heat treated differently. Bi compounds were introduced into porous glasses. Comparison of shrinkage and viscosity of Bi-containing glasses for different heat treatments and Bi introduction conditions is carried out.

## AB INITIO CALCULATIONS OF OPTICAL PROPERTIES OF AG-CU MOLECULAR CLUSTERS IN PHOSPHATE GLASSES

### РАСЧЁТ ОПТИЧЕСКИХ СВОЙСТВ МОЛЕКУЛЯРНЫХ КЛАСТЕРОВ AG-CU В ФОСФАТНЫХ СТЁКЛАХ ИЗ ПЕРВЫХ ПРИНЦИПОВ

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The results of quantum chemical calculations of optical properties of bimetallic molecular clusters  $Ag_nCu_m$  are presented. In addition, their interaction with defects in phosphate glasses after X-ray irradiation is also studied. It is shown that copper doping of pure silver clusters causes the red shift of electronic absorption spectra. The comparison of obtained results and experimental data is also provided.

## PLASMA SYNTHESIS OF METAL FERRITES

### ПЛАЗМЕННЫЙ СИНТЕЗ ФЕРРИТОВ МЕТАЛЛОВ

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The paper is devoted of metal ferrites plasma synthesis from their water solutions of nitrates. The experimental installation consists of the single-phase AC plasma torch and the reaction chamber in which 0.1M of the water solution of ferrum nitrate (III) is supplied. Air plasma mixes up with the water solution in the reaction chamber. The obtained material was examined on the X-ray diffractometer, ИК-Fourier spectrometer and by scanning election microscope with the element analysis attachment.

**SPECTRAL MANIFESTATIONS OF SILVER NANOPARTICLES FORMED BY THE ION EXCHANGE METHOD IN POTASSIUM - ALUMINA - BORATE GLASSES**  
**СПЕКТРАЛЬНЫЕ ПРОЯВЛЕНИЯ НАНОЧАСТИЦ СЕРЕБРА, СФОРМИРОВАННЫХ МЕТОДОМ ИОННОГО ОБМЕНА, В КАЛИЕВО - АЛЮМО - БОРАТНЫХ СТЕКЛАХ**

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This work is focused on the study of spectral manifestations of silver nanoparticles formed by the low-temperature ion exchange method in potassium - alumina - borate glasses. In the study, it was shown that silver nanoparticles can be centers of nucleation of CuCl nanocrystals.

**NUCLEATION OF CRYSTALS IN GLASS BASED ON BLAST-FURNACE SLAG**  
**ЗАРОЖДЕНИЕ КРИСТАЛЛОВ В СТЕКЛАХ НА ОСНОВЕ ДОМЕННЫХ ШЛАКОВ**

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Using development method the nucleation of crystals in glass obtained by blending metallurgical slag with silicon dioxide has been studied. The type of crystallization is revealed for each of nine compositions of synthesized glass. The fundamental characteristics of homogeneous (for a catalyzing phase, perovskite) and heterogeneous (for a catalyzed phase, melilite) of crystallization are determined: the steady state nucleation rate  $I_{st}$ , time of unsteady state nucleation  $\tau$ , crystal growth rate  $U$ .

**DECORATIVE GLASS-CERAMIC MATERIALS**  
**ДЕКОРАТИВНЫЕ СТЕКЛОКРИСТАЛЛИЧЕСКИЕ МАТЕРИАЛЫ**

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The work (article) is intended to summarize some data of investigations of chromatic and opal glass-crystalline materials, elaboration of technologies of electric melting and an attempt to define the dependence of colours on dye strength based on the chromaticity indicators.

**A COMPREHENSIVE SPECTROSCOPIC STUDY OF ACTIVATED  
FTORALUMINIUM GLASSES WITH SMALL ADDITIONS OF PHOSPHATES  
КОМПЛЕКСНОЕ СПЕКТРОСКОПИЧЕСКОЕ ИССЛЕДОВАНИЕ  
АКТИВИРОВАННЫХ ФТОРАЛЮМИНАТНЫХ СТЕКОЛ С МАЛЫМИ  
ДОБАВКАМИ ФОСФАТОВ**

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The work summarizes the results of studies of forming a structural mesh of the glassy matrix formed by the two stekloobrazovanie, one of which is the phosphate component, with the involvement of various optical and spectroscopic studies.

**USING GLASS IN METALLIZATION OF CERAMICS  
BASED ON ALUMINUM NITRIDE  
ИСПОЛЬЗОВАНИЕ СТЕКЛА В МЕТАЛЛИЗАЦИИ КЕРАМИКИ  
НА ОСНОВЕ НИТРИДА АЛЮМИНИЯ**

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Ceramics based on aluminum nitride is a perspective material used in electronics as housings and substrates. More than 90% of aluminum nitride ceramics market are presented by metallized ceramic products, therefore it is necessary to develop metallization pastes intended for ceramics based on aluminum nitride. In this article are presented results of research of different glass compositions for possibility of their application in metallization pastes intended for aluminum nitride ceramics.

**GLASS AND GLASS-LIKE MATERIALS FOR SOLAR ENERGY  
СТЕКЛА И СТЕКЛООБРАЗНЫЕ МАТЕРИАЛЫ ДЛЯ СОЛНЕЧНОЙ  
ЭНЕРГЕТИКИ**

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Intensive growth of solar energy arises question: on basis of what material demand on efficient solar modules could be realized? Dye-sensitized and organic cells are not attractive for

application in energetics because of low efficiency and issues of long-term stability. Most of the market volume of solar energetics today is realized with crystalline silicon (41%) and polycrystalline silicon (45 %) solar cells. The rest of the market is based on thin-films of a-Si, CIS and CdTe solar modules.

### **GROWTH OF CuBr NANOCRYSTALS IN FLUOROPHOSPHATE GLASSES РОСТ НАНОКРИСТАЛЛОВ CuBr ВО ФТОРОФОСФАТНЫХ СТЕКЛАХ**

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The CuBr nanocrystals in the fluorophosphates glasses with compositions the  $x\text{Ba}(\text{PO}_3)_2-(0,9-x)\text{NaPO}_3-0,1\text{AlF}_3$  were studied. Data of the x-ray and absorption spectroscopy demonstrate that heat treatment results in CuBr nanocrystals growth. It was found that the additional absorption band with a maximum at  $\lambda = 571$  nm in the glass doped with Cu, Cl and Br was observed. It was suggested that this band corresponds to the surface plasmon resonance of the metal Cu nanoparticles with the CuBr(Cl) shell.

### **EXCITONIC LUMINESCENCE OF CUCL NANOCRYSTALS IN INORGANIC GLASSES**

### **ЭКСИТОННАЯ ЛЮМИНЕСЦЕНЦИЯ НАНОКРИСТАЛЛОВ ХЛОРИДА МЕДИ В НЕОРГАНИЧЕСКОМ СТЕКЛЕ**

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The results of the study of the exciton luminescence induced in CuCl nanocrystals by UV pulsed laser. The effect of the luminescence intensity rise with the increase of the number of the excitation pulses was revealed. Under continuous excitation the CuCl luminescence demonstrates a saturation effect with no fading after it.

### **TWO WAYS TO EQUILIBRIUM IN THE SrO-SiO<sub>2</sub> SYSTEM: CRYSTALLIZATION OF GLASSES AND SOLID-PHASE REACTIONS ДВА ПУТИ К РАВНОВЕСИЮ В СИСТЕМЕ SrO-SiO<sub>2</sub>: КРИСТАЛЛИЗАЦИЯ СТЕКОЛ И ТВЕРДО-ФАЗНЫЕ РЕАКЦИИ**

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Crystallization of strontium silicate glasses in powder and monolithic state passes over metastable states and reaches the phase equilibrium much faster than it does by solid-phase reactions in the corresponding mixture of strontium carbonate and silica. The formation of extremely stable strontium orthosilicate in the capacity of an intermediate phase inhibits the attainment of equilibrium by solid-phase reactions.

**ION EXCHANGE FORMATION OF POROUS GLASS MATRIXES FOR  
MAKING OF FUNCTIONAL COMPOSITES  
ИОНООБМЕННОЕ ФОРМИРОВАНИЕ ПОРИСТЫХ СТЕКЛООБРАЗНЫХ  
МАТРИЦ ДЛЯ СОЗДАНИЯ КОМПОЗИТОВ ФУНКЦИОНАЛЬНОГО  
НАЗНАЧЕНИЯ**

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The process of formation of a porous structure in glasses of  $K_2O$ -BaO-SiO<sub>2</sub> and  $K_2O$ -FeO-Fe<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub> system was studied, as a result of ion exchange of alkaline glass cations to cations of salt melt with a smaller ionic radius. It is established that the preliminary heat treatment of KFS glass and its subsequent ion-exchange treatment leads to the formation of a porous magnetic glass.

**PLASMA TECHNOLOGIES FOR OBTAINING GLASSES  
WITH SPECIFIED PROPERTIES  
ПЛАЗМЕННЫЕ ТЕХНОЛОГИИ ПОЛУЧЕНИЯ СТЕКОЛ  
С ЗАДАНЫМИ СВОЙСТВАМИ**

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Plasma discharges, high-frequency plasma technology, equipment are used to produce new materials with unique properties, for obtaining microspheres of glass, especially pure materials, processing powders of refractory composite materials, metal oxides, special ceramic composite materials.

**INFLUENCE OF Y<sub>2</sub>O<sub>3</sub> DOPANT ON MECHANICAL PROPERTIES  
OF MgO-Al<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub> GLASS-CERAMIC NUCLEATED WITH TiO<sub>2</sub>  
ВЛИЯНИЕ ОКСИДА ИТТРИЯ НА МЕХАНИЧЕСКИЕ СВОЙСТВА  
СТЕКЛОКЕРАМИК МАГНИЕВОАЛЮМОСИЛИКАТНОЙ СИСТЕМЫ,  
НУКЛЕИРОВАННЫХ ДИОКСИДОМ ТИТАНА(IV)**

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Elastic and shear moduli of the MgO-Al<sub>2</sub>O<sub>3</sub>-SiO<sub>2</sub>-Y<sub>2</sub>O<sub>3</sub> glass-ceramic nucleated with TiO<sub>2</sub> were studied. It is shown that the glass-ceramic containing Y<sub>2</sub>Si<sub>2</sub>O<sub>7</sub> and cordierite crystals exhibits the highest values of elastic and shear moduli. Such material could be used in aircraft and missile radomes manufacturing.

## **WRITING OF LUMINESCENT OPTICAL WAVEGUIDE IN PTRGLASSBYUV RADIATION ЗАПИСЬ УФ ИЗЛУЧЕНИЕМ ЛЮМИНЕСЦЕНТНОГО ОПТИЧЕСКОГО ВОЛНОВОДА В ФТР СТЕКЛЕ**

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We have written optical waveguides by ultraviolet light irradiation in silver containing photo-thermo-refractive (PTR) glass. Luminescence measurements indicate that subnanosized silver clusters are responsible for the waveguide formation. The experimental study is complemented with *ab initio* calculations that show that the refractive index change is mainly dominated by neutral silver clusters polarizability.

## **CRYSTALLIZATION OF GLASS OBTAINED FROM BURAL-SARDYK QUARTZITE ИССЛЕДОВАНИЕ ПРОЦЕССОВ КРИСТАЛЛИЗАЦИИ СТЕКЛА, ПОЛУЧЕННОГО ИЗ КВАРЦИТОВ МЕСТОРОЖДЕНИЯ БУРАЛ-САРДЫК**

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We presents the results of a comprehensive study of silica glass resistance to crystallization during thermal treatments. SiO<sub>2</sub> glasses are synthesized from quartz raw materials from the Bural-Sardyk deposit. The method for producing silica glass is described. The optical quality of glasses was determined from the absorption spectra. Different methods for assessing the resistance to crystallization of various types of SiO<sub>2</sub> glass samples are provided.

## **FEATURES OF CHEMICAL INTERACTION OF INDUSTRIAL GLASSES WITH FLUORINE-CONTAINING REAGENTS ОСОБЕННОСТИ ХИМИЧЕСКОГО ВЗАИМОДЕЙСТВИЯ ПРОМЫШЛЕННЫХ СТЕКЛ С ФТОРХЛОРСОДЕРЖАЩИМИ РЕАГЕНТАМИ**

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The article studies the composition and structure of surface layers of industrial glasses, subjected to thermochemical treatment with fluorine-containing reagents. Physical and chemical properties of industrial glassware, modified by fluorine-containing reagents have been determined, in addition to the composition of reaction products, released as a result of the interaction between industrial glasses and fluorine-containing gases.



**CRITERIA FOR ESTIMATING THE INTENSITY OF DEALKALIZATION OF INDUSTRIAL GLASSES WITH ACID GASES**  
**КРИТЕРИИ ОЦЕНИВАНИЯ ИНТЕНСИВНОСТИ ВЫЩЕЛАЧИВАНИЯ ПРОМЫШЛЕННЫХ СТЕКОЛ КИСЛЫМИ ГАЗАМИ**

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The article characterizes the criteria, necessary to estimate the intensity of dealcalization of industrial glass for various purposes with gaseous reagents: the extraction rate of alkaline metal cations from glass, thickness of reaction products on the sample surface, the change in the chemical composition of glass, the thickness and the degree of dealcalization of glass surface layers, microhardness increase.

**NOVEL TRANSPARENT GLASS-CERAMICS BASED ON ZnO NANOCRYSTALS DOPED WITH RARE-EARTH IONS**  
**НОВЫЕ ПРОЗРАЧНЫЕ СТЕКЛОКРИСТАЛЛИЧЕСКИЕ МАТЕРИАЛЫ НА ОСНОВЕ ОКСИДА ЦИНКА, АКТИВИРОВАННЫЕ РЕДКОЗЕМЕЛЬНЫМИ ИОНАМИ**

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Glasses of the  $K_2O$ - $ZnO$ - $Al_2O_3$ - $SiO_2$  system doped with oxides of Yb, Er, Tm, Pr and Eu (0.1 to 3 mol%) were prepared by the melt-quenching. Their structure, which strongly depends on the RE content, and its transformation with heat-treatments were studied by TEM, XRD, DSC and Raman spectroscopy. Their optical properties were characterized by absorption and luminescence spectroscopy. GCs are of interest for phosphor applications based on the energy transfer between ZnO nanocrystals and RE ions.

**APPLICATION OF POLYOXOMOLYBDATE FOR THE CREATION OF THE  
BIOACTIVE MEMBRANE FILTER ON THE BASIS  
OF THE HIGH-SILICA POROUS GLASSE  
ПРИМЕНЕНИЕ ПОЛИОКСОМОЛИБДАТА ДЛЯ СОЗДАНИЯ БИОАКТИВНОГО  
МЕМБРАННОГО ФИЛЬТРА НА ОСНОВЕ ВЫСОКОКРЕМНЕЗЕМНОГО  
ПОРИСТОГО СТЕКЛА**

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The present work is devoted to the creation of a new generation membrane filter for water purification from microorganisms. According to the filtering technique, the filter refers to osmotic filters. The membrane is a composite which based on the high-silica porous glass, which was modified with silicon polyoxomolybdate, the fungicidal properties of which had previously been established with respect to the Gram-negative bacterium *Escherichia coli* and Gram-positive bacteria *Listeria monocytogenes*.

**THE STRUCTURE AND PROPERTIES OF THE SOL-GEL-DERIVED SILICATE  
'SPIN-ON GLASS' FILMS DOPED BY INORGANIC COMPOUNDS  
СТРУКТУРА И СВОЙСТВА ТОНКИХ СТЕКЛОВИДНЫХ СИЛИКАТНЫХ  
ПЛЕНОК, ЛЕГИРОВАННЫХ НЕОРГАНИЧЕСКИМИ СОЕДИНЕНИЯМИ**

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Features of phase separation, crystallization, nano-, meso- and macrostructure, dopant concentration distribution, a change in the RI and film thickness, which are characteristic for thin tetraethoxysilane- and titanium alkoxides-derived 'spin-on glass' films, will be considered depending on the nature and inorganic dopants concentration in sols, sol aging time and heat treatment modes. A comparison of these phenomena with ones occurring in glass-forming melts will be carried out.

**SPARK PLASMA SINTER AS AN INNOVATIVE APPROACH IN FABRICATION OF  
THE NEW GENERATION OF NANOSTRUCTURED CERAMICS  
ИСКРОВОЕ ПЛАЗМЕННОЕ СПЕКАНИЕ КАК ИННОВАЦИОННЫЙ ПОДХОД В  
СОЗДАНИИ НАНОСТРУКТУРИРОВАННЫХ КЕРАМИК НОВОГО ПОКОЛЕНИЯ**

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Innovative technology of spark plasma sintering (SPS) has revealed wide prospects for powder metallurgy in the field of new industrially important ceramics with unique operational

characteristics and functional properties. The concept of SPS is more advanced compared to conventional sintering routines due to fast heating by low-voltage pulsing current allows efficient densification without active grain growth.

## **THE ELECTRO-PHYSICAL PROPERTIES OF THE GLASS S87-2, S78-4, S78-5 ЭЛЕКТРОФИЗИЧЕСКИЕ СВОЙСТВА СТЕКОЛ С87-2, С78-4, С78-5**

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The regularities of changes in the electrical properties of glasses S87-2, S78-4, and S78-5 used in vacuum electronics. A correlation between structural change and electrical conductivity. A comparative analysis of the influence of an electric current passed on formation of a new phase and the time to reach the phase equilibrium in the glass.

## **INVESTIGATION OF ALKALI BORONGERMANATE GLASSES STRUCTURE BY INFRARED AND RAMAN SPECTROSCOPY ИССЛЕДОВАНИЕ СТРУКТУРЫ ЩЕЛОЧНОБОРОГЕРМАНАТНЫХ СТЕКОЛ МЕТОДАМИ ИНФРАКРАСНОЙ И РАМАНОВСКОЙ СПЕКТРОСКОПИИ**

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Structure and degree of polymerization of a borogermanium network depending on type of a cation and its contents was studied. Glasses with composition  $xM_2O-xB_2O_3(100-2x)GeO_2$ , where  $M = Li, K$  and  $x = 3, 5, 7, 10, 20$  and  $30$  mol. % have been synthesized. Research of the samples structure was carried out by the FTIR and Raman spectroscopy.

## **EFFECT OF HIGH-SILICA POROUS GLASS COMPOSITION ON THE SURFACE FUNCTIONAL COMPOSITION AND POROUS STRUCTURE ВЛИЯНИЕ СОСТАВА ВЫСОКРЕМНЕЗЕМНОГО ПОРИСТОГО СТЕКЛА НА СОСТАВ ПОВЕРХНОСТНЫХ ФУНКЦИОНАЛЬНЫХ ЦЕНТРОВ И ПОРИСТУЮ СТРУКТУРУ**

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Porous glass is a high-silica nanoporous material with a sponge-corpuscular structure. Its unique porous structure and adsorption properties were adjusted by composition modifications (particularly, molybdenum addition) as observed by significant changes in porosity studied

using nitrogen adsorption-desorption isotherms and in the contents of Lewis (siloxane oxygen) and Brönsted (silanol groups) surface centers measured by adsorption of acid-base indicators.

**PROSPECTS DEVELOPMENT PLASMA TECHNOLOGIES IN THE  
PRODUCTION CONSTRUCTION MATERIALS DIFFERENT DESIGNATION  
ПЕРСПЕКТИВЫ РАЗВИТИЯ ПЛАЗМЕННЫХ ТЕХНОЛОГИЙ  
ПРИ ПРОИЗВОДСТВЕ СТРОИТЕЛЬНЫХ МАТЕРИАЛОВ РАЗЛИЧНОГО  
НАЗНАЧЕНИЯ**

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In this paper, plasma technologies developed at the Department of Applied Mechanics and Materials Science of the Tomsk State University of Architecture and Building. These technologies include the technology of creating protective and decorative coatings on silicate materials using low-temperature plasma energy, the technology of obtaining mineral fibers from high-temperature silicate melts, plasma technology for producing quartz glass and microspheres.

**THE SYNTHESIS OF FOAMED SLAG GLASS BASED ON THE GLYCEROL PORE-  
FORMING MIXTURE  
СИНТЕЗ ПЕНОШЛАКОСТЕКЛА НА ОСНОВЕ ГЛИЦЕРИНОВОЙ  
ПОРООБРАЗУЮЩЕЙ СМЕСИ**

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The synthesis of the samples based on the glycerol pore-forming mixture was conducted at various temperatures. The structure and properties of the obtained samples were defined, the relationship between amount of the glycerol pore-forming mixture and changes in the structure and properties of the samples were established. The best ratio of the components of the glycerol pore-forming mixture for the synthesis of foamed slag glass has been selected.

**INVESTIGATION OF THE PHYSICOCHEMICAL PROPERTIES OF  
BOROSILICATE GLASSES FOR THE PRODUCTION  
OF FIBERGLASS MATERIALS  
ИССЛЕДОВАНИЕ ФИЗИКО-ХИМИЧЕСКИХ СВОЙСТВ БОРОСИЛИКАТНЫХ  
СТЕКЛ ДЛЯ ИЗГОТОВЛЕНИЯ СТЕКЛОВОЛОКНИСТЫХ МАТЕРИАЛОВ**

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Glass-fiber materials are a multifunctional material, have a number of valuable physical and chemical properties. Borosilicate glasses were studied. The chemical composition was selected.

The physicochemical properties of the additive method were calculated. Glasses were synthesized and researched.

**NUCLEATION AND GROWTH OF CRYSTALS IN SODA-LIME-SILICA GLASSES  
OF THE METASILICATE SECTION  
ЗАРОЖДЕНИЕ И РОСТ КРИСТАЛЛОВ В  
НАТРИЕВОКАЛЬЦИЕВОСИЛИКАТНЫХ СТЕКЛАХ  
МЕТАСИЛИКАТНОГО РАЗРЕЗА**

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Soda-lime-silica glasses of the metasilicate section are convenient objects for studying the nucleation and growth of crystals. The nucleation of crystals in glasses at low temperatures, the temperature and concentration dependences of the nucleation rate of crystals are discussed. The growth of crystals on the surface and in the bulk of the glass is compared. An alternation of layers of crystals of two phases is established during their growth in glass of non-stoichiometric composition.

**THE EFFECT OF HETEROGENEOUS STRUCTURE OF GLASS-FORMING  
LIQUIDS ON CRYSTAL NUCLEATION  
ВЛИЯНИЕ ГЕТЕРОГЕННОЙ СТРУКТУРЫ СТЕКЛООБРАЗУЮЩИХ  
ЖИДКОСТЕЙ НА ЗАРОЖДЕНИЕ КРИСТАЛЛОВ**

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A model for the description of crystal nucleation is proposed incorporating into classical nucleation theory concepts of spatial heterogeneity of glass-forming liquids. It is assumed that nucleation may proceed with detectable rates only in liquid-like regions and are suppressed in solid-like parts. Determining appropriately the fraction of these regions in dependence on temperature this approach allows one to achieve a satisfactory agreement between classical nucleation theory and experiment.

**TEM OF AMORPHOUS Sb, Sb@Se NANOISLANDS  
IN EVAPORATED GRADIENT FILMS  
ПЭМ АМОРФНЫХ НАНОСТРОБКОВ Sb, Sb@Se  
В ВАКУУМНО ОСАЖДАЕМЫХ ГРАДИЕНТНЫХ ПЛЁНКАХ**

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Different samples Sb и Sb-Se films evaporated in vacuum on the amorphous substrate where studied by transmission electron microscopy. Primarily we studied the structure of the films and amorphous-crystalline areas.

**SYNTHESIS AND STUDY OF MODIFIED FLUOROZIRCONATE GLASSES  
AND GLASS-CERAMICS ON THEIR BASIS  
СИНТЕЗ И ИССЛЕДОВАНИЕ МОДИФИЦИРОВАННЫХ  
ФТОРЦИРКОНАТНЫХ СТЕКОЛ И СТЕКЛОКЕРАМИКИ НА ИХ ОСНОВЕ**

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The crystallization behavior of the fluorozirconate glasses modified by “heavy” ions is examined by DTA and XRD. The glasses are shown to be characterized by  $T_g$  decrease and by separation of fine crystallite chloride phases at temperatures below  $T_c$  of the similar fluoride glasses. The influence of the Cl(Br)F ratio and cooling rate of the melt on the crystallization behavior is studied. The temperature-time conditions for the formation of the transparent glass-crystallite phases are determined.

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