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Contents

1. NANOPHYSICS

1.1. Phenomena and Effects

2.1.1.1. Electron transport mechanism in composites based on polybenzimidazole matrix with graphite nanoparticles. /V.A. Kuznetsov, A.N. Lavrov, B.Ch. Kholkhoev, V.G. Makotchenko, E.N. Tkachev, V.F. Burdukovskii, A.I. Romanenko/. Proceedings of NAS RA. Physics. – 2020. – vol. 55. – #1. – pp. 78-85. – rus.; abs.: rus., arm., eng.

The paper presents an experimental study of the electron transport in composite samples based on an insulating matrix of polybenzimidazole with graphite nanoparticles as a conducting filler. Based on a qualitative analysis of the temperature dependences of electrical resistance obtained for the samples with different filler concentrations, it was established that the electron transport occurred by tunneling between conducting filler particles, with the variable-range hopping conduction taking place at low temperatures. Fig. 4, Ref. 17.

Keywords: electron transport, composite samples, insulating matrix, graphite nanoparticles, electrical resustance

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2.1.1.2. Quantum model of a trapezoidal limiting potential profile in a spherical nanocrystal. /H.S. Nikoghosyan, S.L. Harutyunyan, V.F. Manukyan, G.H. Nikoghosyan/. Proceedings of NAS RA. Physics. – 2019. – vol. 54. – #4. – pp. 471-477. – rus.; abs.: rus., arm., eng.

Considered is a limiting potential model for a spherical quantum dot with three variation parameters - well depth, external and internal radii. The stationary s-states are calculated by the exact solution and in the WKB approximation. For states with $l \neq 0$, an approximate consideration is applied, subject to the conditions of semiclassicality. As a result, the energy values of the lower bound states are presented at fixed external and varying internal radii in wells of various depths. The dependence of the energy gap between the levels in the well on the variation parameters is demonstrated. Fig. 1, Ref. 14.

Keywords: limiting potential model, spherical quantum dot, external nd internal radii, lower bound states, energy gap

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2.1.1.3. Nucleation mechanism and nanostructures' total energy calculation in CdTe-ZnTe-HgTe material *system.* /A.K. Simonyan, K.M. Gambaryan, V.M. Aroutiounian, M.K. Gambaryan, G.A. Avetisyan/. Proceedings of NAS RA. Physics. – 2019. – vol. 54. – #4. – pp. 478-484. – rus.; abs.: rus., arm., eng.

The continuum elasticity model is applied to quantitatively investigate the growth features and nucleation mechanism of quantum dots, nanopits, and joint QDs-nanopits structures in CdZnHgTe quasiternary material system. It is shown that for the CdZnHgTe solid solution deposited on CdTe substrate, at the critical strain of $\varepsilon^* = 0.006$ and $\varepsilon^* = 0.009$, the sign of island's critical energy and volume is changed. It is assumed that at $\varepsilon = \varepsilon^*$ the mechanism of the nucleation is changed from the growth of quantum dots to the nucleation of nanopits. Obviously, at small misfits ($\varepsilon < \varepsilon^*$) the bulk nucleation mechanism dominates. However, at $\varepsilon > \varepsilon^*$ when the energy barrier becomes negative as well as a larger misfit provides a low-barrier path for the formation of dislocations, the nucleation of pits becomes energetically preferable. Fig. 5, Ref. 15.

Keywords: continuum elasticity model, nucleation mechanism, quntum dots, critical strain, energy barrier

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2.1.1.4. Rashba spin-orbit interaction in semiconductor nanostructures (review). /B.G. Ibragimov/. Azerbaijan Journal of Physics. – 2020. – vol. 26. – #2. – pp. 3-9. – eng.; abs.: eng.

The work reviews the theoretical and experimental issue related to the Rashba spin-orbit interaction [1] in semiconductor nanostructures. The Rashba spin-orbit interaction has been a promising candidate for controlling the spin of electrons in the field of semiconductor spintronics. The work focuses on the study of the electrons spin and holes in isolated semiconductor quantum dots and rings in the presence of magnetic fields. Spin-dependent thermodynamic properties with strong spin-orbit coupling inside their band structure in systems are investigated. Additionally, specific heat and magnetization in two-dimensional, one-dimensional ring and quantum dot nanostructures with spin-orbit interaction are discussed. Fig. 4, Ref. 68.

Keywords: spin-orbit interaction, Rashba effect, two-dimensional electron gas, one-dimensional ring, quantum wire, quantum dot, semiconductor nanostructures

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1.2. Properties of Materials and Structures

2.1.2.1. Rheological properties of nanocomposites based on bifunctional clinoptilolite and ethylene/ hexene copolymer. /I.V. Bayramova/. Azerbaijan Chemical Journal. – 2020. – #2. – pp. 83-89. – eng.; abs.: eng., az., rus.

The results of a study of the influence of temperature and shear stress on the rheological properties of ethylene/hexene copolymer and its clinoptilolite-filled nanocomposites are presented. Rheological measurements were carried out in the temperature range of 190–250 ^{0}C. The dependence of shear rate on shear stress, effective melt viscosity on shear rate, and melt viscosity on temperature in Arrhenius coordinates is studied. Using the universal temperature-invariant viscosity characteristics of nanocomposites allows make approximate calculations of effective viscosity close to the conditions of their processing by extrusion and injection molding by extrapolation to the region of high shear rates. Fig. 4, Tab. 1, Ref. 12.

Keywords: viscosity, shear rate, shear stress, nanocomposites, polymer melt, clinoptilolite

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2.1.2.2. Zinc-containing nanocomposites based on high-pressure polyethylene. /T.M. Guliyeva/. Azerbaijan Chemical Journal. – 2020. – #2. – pp. 34-38. – eng.; abs.: eng., az., rus.

The effect of nanofiller additives containing nanoparticles of zinc oxide stabilized by a polymer matrix of maleinated polyethylene, obtained by a mechanochemical method, on the properties of composites based on high-pressure polyethylene was studied by X-ray phase and thermographic analyzes. The improvement of the strength, deformation and rheological parameters, as well as the thermo-oxidative stability of the obtained nanocomposites was revealed, which is apparently due to the synergistic effect of the interaction of zinc-containing nanoparticles with maleic maleinated polyethylene groups. It is shown that polyethylene based nanocomposites can be processed both by pressing and by injection molding and extrusion, which expands its application field. Fig. 2, Tab. 2, Ref. 15.

Keywords: polyethylene, zinc-containing nanofillers, maleinized polyethylene, physicol - mechanical properties, X-ray phase and thermographic analyzes

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2.1.2.3. Effect of bentonite concentration on properties and regularity of crystallization of nanocomposite materials based on the mixtures of high and low-density polyethylene. /F.A. Mustafayeva, N.T. Kakhramanov, N.B. Arzumanova, N.Ya. Ishenko, I.A. Ismayilov/. Azerbaijan Chemical Journal. – 2020. – #1. – pp. 53-58. – eng.; abs.: eng., az., rus.

The results of research of the effect of bentonite concentration on the regularity of crystallization and the nature of changes of ultimate tensile strength, tensile yield strength and elongation at break of nanocomposite materials basrf on the mixtures of high and low density polyethylene are presented. Fig. 2, Tab. 2, Ref. 9.

Keywords: crystallization, dilatometry, specific volume, polymer blend, high-density polyethylene, lowdensity polyethylene, bentonite

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2.1.2.4. Metal-containing nanocomposites based on isotactic polypropylene and ethylene-propylene-diene rubber. /N.A. Alimirzayeva/. Azerbaijan Chemical Journal. – 2020. – #1. – pp. 41-45. – eng.; abs.: eng., az., rus.

The work summarizes the data of studies on the effect of nanofiller additives containing copper oxide nanoparticles stabilized by a high-pressure polyethylene matrix obtained by the mechanochemical method on the physico-mechanical, rheological properties and crystallization of thermoplastic mixed elastomers on the basis of isotactic polypropylene and ethylene propylene diene rubber. The work presents the prospects of using these additives to elastomers that provides for producing a fine-spherical layered structure of the composition characterized by improved melt flow rates, rheological, physicomechanical properties, and thereby expand the scope of application obtained nanocomposites. Fig. 3, Tab. 1, Ref. 12.

Keywords: metal-containing nanocomposites, isotactic polypropylene, ethylene propylene diene rubber, copper oxide nanoparticles, physico-mechanical, rheological properties, crystallization

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2.1.2.5. Influence of single-walled carbon nanotubes on dielectric relaxation and electric conductivity of a smectic A liquid crystal with positive dielectric anisotropy. /T.D. Ibragimov, A.R. Imamaliyev, G.F. Ganizade/. Azerbaijan Journal of Physics. – 2020. – vol. 26. – #3. – pp. 3-6. – eng.; abs.: eng.

The effect of single-walled carbon nanotubes (SWCNTs) on the dielectric and conductivity properties of a smectic A liquid crystal 4-nitrophenyl-4'-decyloxybenzoic acid has been studied. It is shown that the additive of SWCNTs with concentration of 0.5% leads to a decrease in the order parameter of 5CB. In this case, the clearing point is raised, the longitudinal component of the dielectric permittivity decreases while the transverse component increases. The incipient percolation effect promotes to the dominance of hopping electron conductivity over ionic conductivity, leading to an increase in specific conductance. Fig. 3, Ref. 9.

Keywords: smectic A liquid crystal; single-walled carbon nanotubes, dielectric permittivity; electric conductivity

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2.1.2.6. Dielectric, conductivity, and electro-optic properties of liquid crystal 5cb doped by single-walled carbon nanotubes. /T.D. Ibragimov, A.R. Imamaliyev, G.F. Ganizade/. Azerbaijan Journal of Physics. – 2020. – vol. 26. – #2. – pp. 10-14. – eng.; abs.: eng.

The effect of single-walled carbon nanotubes (SWCNTs) on the dielectric, conductive, and electro-optic properties of nematic liquid crystal 4-cyano-4'-pentylbiphenyl (5CB) has been studied. It is shown that the additive of SWCNTs with concentration of 0.5% leads to strong interaction between SWCNTs and molecules, which increases the order parameter of 5CB. As a result, the clearing point is raised, the longitudinal component of the dielectric permittivity increases while the transverse component decreases. The incipient percolation effect promotes to the dominance of hopping electron conductivity over ionic conductivity, leading to an increase in specific conductivity. In this case, the elastic splay constant of 5CB is enhanced and, accordingly, the threshold voltage of the S-effect increases. A decrease in the Van-der-Waals interaction between molecules decreases viscosity. As a result, the flip-flop motion of molecules becomes easier and the switching time reduces. Fig. 9, Tab. 1, Ref. 8.

Keywords: liquid crystal, single-walled carbon nanotubes, dielectric relaxation, electric conductivity, threshold voltage

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It is shown that g-factor values for PTFE/CdS nanocomposites at the dose 5kQr correspond to free electrons. The nonlinear dependence of signal intensity on craze number is observed with an increase of craze cycle in EPR spectra. Fig. 4, Tab. 1, Ref. 23.

Keywords: γ-irradiation, nanocomposites, polytetrafluoroethylene, magnetic field, EPR-spectra, dielectric properties, dielectric loss, dielectric constant, crazing, g-factor

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3. NANOBIOLOGY

3.2. Biophysics

2.3.2.1. Structural and magnetic properties of ailver oleic acid multifunctional nanohybrids. /S. Khutsishvili, P. Toidze, M. Donadze, M. Gabrichidze, T. Agladze, N. Makhaldiani/. Annals of Agrarian Science. – 2019. – vol. 17. – #2. – pp. 242-250. – eng.; abs.: eng.

Sols of core-shell silver NPs are synthesized by an electrochemical method. The method provides for the ability to adjust the particle size by changing both the concentration of oleic acid and the residence time W_0 in the organic phase. We synthesized silver nanoparticles with oleic acid concentration of 0.25% (Ag&0.25%OA) and 0.75% (Ag&0.75%OA). The silver nanoparticles have been studied using modern physical–chemical methods: Transmission Electron Microscopy (TEM); Fourier Transform Infrared Spectroscopy (FT-IR); Dynamic Light Scattering (DLS); Thermogravimetric and Differential Thermal Analysis (TGA and DTA); Electron Paramagnetic Resonance (EPR). DTA curves indicate the chemical nature of bond ligand in the secondary shell. This conclusion is supported by quantum chemical simulation using the quantum-chemical software HyperChem-8 and semi-empirical calculation method ZINDO. In the EPR spectra of silver-containing sols Ag&0.25%OA and Ag&0.75%OA a complex wide asymmetric signal with several resonant lines is recorded, which is consistent with a wide-size distribution of nanoparticles. It is important to note that a change in the oleic acid layers of the nanoparticles seems to affect the dimension of the nanocrystallites that are being formed. The presence of the FMR resonance line in Ag&0.75%OA may indicate the presence of Ag-cubic cells in nanoparticles with internal magnetic fields significantly larger than the Zeeman field, the available EPR in the X-band range. Fig. 5, Tab. 2, Ref. 30.

Keywords: Core-shell, nanoparticles, oleic acid, ligand, charge, activation energy

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3.3. Biochemistry

2.3.3.1. Revealing a Nonergodic Mechanistic Pattern for Electron Exchange between Azurin and Electrodes Coated by Nanofilms under the Glassy Environmental Conditions. /T. Dolidze, R. van Eldik, D. Khoshtariya/. Bulletin of the Georgian National Academy of Sciences. – 2019. – vol. 13. – #4. – pp. 97-103. – eng.; abs.: eng., geo.

Fast-scan protein-film voltammetry was applied to explore interfacial biomimetic electron exchange under the environmental glass forming conditions. Gold electrodes were coated with 1-pentanethiol SAM–azurin (Az, blue cupredoxin) assemblies and placed in contact with a water-doped and buffered protic ionic melts of choline dihydrogen phosphate ([ch][dhp]), served as electrolyte media, allowing for a necessary cell conductivity under the virtually solid, semi-solid and liquid electrolyte conditions over 273–353 K, within which the electron exchange rate was studied as a function of the water amount and temperature. Exposure of the Az films to the semi-solid electrolyte greatly affected the protein's conformational dynamics, hence the ET rate, via the mechanism occurring in the extra complicated dynamically-controlled regime. Results are compared to the earlier studies on the reference system with a conventional electrolyte, allowing for the disclosure of mutually-entangled mechanistic motifs. Under the "standard" condition (with no [ch][dhp] added), the Az biomolecule may reside in an apparently ergodic state, whereas upon adding of [ch][dhp] to allow water content ranging between 6 to 15 waters per [ch][dhp], system displays anomalous temperature dependences, suggesting that the reactive system crosses a broad, well-manifested nonergodic zone which arises from the continuous interplay (freezing/unfreezing) of ET-coupled highly cooperative conformational modes of the Az protein, inherently linked to the electrolyte's slowest collective relaxation(s). Above this [ch][dhp] concentration, allowing the water content between 1.65 to 3.7 waters per ion pair, the system returns to a series of new, quasi-ergodic states, with each displaying virtually linear Arrhenius patterns yet with distinct parameters. Fig. 2, Tab. 3, Ref. 22.

Keywords: redox protein, electron exchange, interphase, self-assembly, nonergodicity

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2.3.3.2. A new generation of biocompatible nanoparticles made of resorbable poly(ester amide)s. /T. Kantaria, T. Kantaria, G. Titvinidze, S. Kobauri, M. Ksovreli, T. Kachlishvili, N. Kulikova, D. Tugushi and R. Katsarava/. Annals of Agrarian Science. – 2019. – vol. 17. – #1. – pp. 49-58. – eng.; abs.: eng.

A new generation of resorbable nanoparticles (NPs) were prepared on the basis of amino acid-based biodegradable (AABB) poly (ester amide)s (PEAs) for drug delivery application. The NPs were fabricated by cost-effective polymer deposition/solvent displacement (nanoprecipitation) method on the basis of three different AABB PEAs recently developed by our group: (i) PEA composed of amino acid leucine as a basic component, (ii) cationic PEA composed of amino acid arginine for imparting positive charge, and (iii) functional PEA composed of amino acid leucine and lateral poly(ethylene glycol) groups acting as surfactant as well as PEGylating agent. The mean particle diameter (MPD), polydispersity index (PDI) and zeta-potential (ZP) were determined by Dynamic Light Scattering (DLS). Moreover, the stability (resuspendability) of the NPs over time at low temperature was investigated. The NPs were studied for *in vitro* cell compatibility using four different stable cell lines: A549 (human), U937 (human), RAW264.7 (murine), Hepa 1-6 (murine). The produced nanoparticles exhibit high stability and cell compatibility and have potential for the application as drug delivery devices. Fig. 2, Ref. 37.

Keywords: Biodegradable polymers; nanoprecipitation; nanoparticles; biodegradable surfactant; PEGylation; *in vitro* cell compatibility

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4. NANOTECHNOLOGY

4.1. Materials and Structures

2.4.1.1. The Inelastic/Elastic and Tribological Properties of PTFE-Based Nanocomposites Filled with Co Cluster-Doped CNTs. /E. Kutelia, G. Darsavelidze, T. Dzigrashvili, D. Gventsadze, O. Tsurtsumia, L. Gventsadze, T. Kukava, L. Rukhadze, L. Nadaraia, I. Kurashvili, S. Bakhtiyarov/. Bulletin of the Georgian National Academy of Sciences. – 2020. – vol. 14. – #1. – pp. 57-63. – eng.; abs.: eng., geo.

The elastic/inelastic behavior and tribological properties of new PTFE-based nanocomposite materials filled with 5wt% and 10wt% Co atomic cluster-doped carbon nanotubes (CNTs) were investigated using low-frequency amplitude-independent (AIIF) and amplitude-dependent (ADIF) internal friction measurements, compressive deformation and tribological test methods. It is shown that the Co atom cluster-doped CNTs filler provides a considerable positive effect on the physicomechanical characteristics of the respective PTFE-based nanocomposite materials used for tribological applications. The obvious effectiveness of the externally applied gradient magnetic field in the process of mixture preparation has been established for sintering of the PTFE-based nanocomposite materials modified by carbon nanotubes doped with the ferromagnetic atom (Co) clusters, finally resulting in the improvement of wear- and creep resistance of the obtained nanocomposites. Fig. 2, Tab. 2, Ref. 13.

Keywords: PTFE, co cluster-doped CNTs, nanocomposite, internal friction, wear

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2.4.1.2. The Influence of Cycling Deformation and Annealing on the Elastic/Inelastic Properties of PTFE-Based Nanocomposite Filled with 7.5wt% Fe Cluster-Doped CNTs. /E. Kutelia, G. Darsavelidze, T. Dzigrashvili, L. Rukhadze, D. Gventsadze, I. Kurashvili, L. Nadaraia, O. Tsurtsumia, L. Gventsadze, I. Losaberidze, S. Bakhtiyarov/. Bulletin of the Georgian National Academy of Sciences. – 2020. – vol. 14. – #2. – pp. 36-41. – eng.; abs.: eng., geo.

For the development of PTFE-based nanocomposites with the regulated technological mechanical and parameters, it is necessary to reveal a correlation between their structural and dynamicalmechanical properties. The researches in this direction were performed using a low-frequency internal friction technique. The behavior of the elastic/inelastic properties of PTFE-based nanocomposite material filled with the optimal (7.5 wt%) concentration of Fe atom cluster-doped carbon nanotubes (CNTs), depending on high amplitude cycling deformation and post-deformation annealing was investigated using amplitude-independent (AIIF) and amplitude-dependent (ADIF) internal friction measurements. The characteristics of dynamical-mechanical strengthening of the Fe cluster doped PTFE-based polymeric materials were determined for the first time, and the possible mechanisms of strengthening have been analyzed. It was shown that high-amplitude cyclic deformation leads to a considerable reduction in activation energy (H, kcal/mole) of β(crystalline) and α(amorphous) relaxation processes, the magnitude of critical amplitudes (ε_c) of microplastic deformation beginning and shear modulus ($G \sim f^2$) in comparison to those for the initial sample before cyclic deformation. It was also found that the post-deformation annealing of the cyclically deformed sample at 150˚C/30 min ensures a complete restoration of the above parameters to the values exceeding those for the initial sample. Fig. 2, Tab. 1, Ref. 16.

Keywords: PTFE, nanocomposite, Fe cluster-doped CNT, internal friction, shear modulus

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2.4.1.3. Study of the physico-chemical properties of silver nanoparticles stabilized with oleic acid using theoretical calculation. /P. Toidze, M. Gabrichidze/. Ceramics and Advanced Technologies. – 2019. – vol. 21. – #1(41). – pp. 14-20. – geo.; abs.: geo., eng.

Inorganic-organic core–shell nanoparticles are considered to be common building blocks for synthesis of multifunctional hybrid nanocomposites, which are promising materials for biomedical and catalytic application. Knowledge of the metal nanoparticle-ligand interaction mechanism is crucial for design strategy of such materials. In the present study silver-oleic acid capped nanoparticles are used as a model for mono- and bilayer ligand chemisorption. HyperChem software generates molecules (the builder), perform structural optimizations, and analyze molecular orbitals and its relation to functionality. Molecular modeling involves the development of mathematical models of molecules that can be used to predict and interpret their properties. A quantum mechanical model of the electronic structure of a molecule, which involves solving the Schrödinger equation. Quantum mechanics can be used to predict electronic properties of molecules, such as dipole moments and spectroscopy. Quantum chemical simulation leads farther insight into the mode of bonding and structure of adsorbed layer. OA interaction with Ag atoms results in charge density increase at metal surface and creation of negative electrostatic potential at carboxyl group owing to covalent bonding. Formation of secondary layer accompanied by redistribution of charge density: slight decrease in metal surface charge density, double decrease of charge density at C=C bond and strong increase in negative charge of carboxyl group of secondary layer. The absence of a double bond in the molecule of stearic acid affects the quality of stabilization of the surface of silver nanoparticles. Controlled release of biologically active silver from nanosilver can be regulated by the surface ligands. The capabilities of nanosilver in inhibiting bacteria were ascribed to the surface ligand-mediated silver ion release from both extracellular process and intracellular manner.The studies AgNPs showed that internalized AgNPs caused cell damage through binding with chain-related proteins and interrupting the electron transfer process. The HyperChem program allows quantum-chemical calculations to explain the role of oleic acid in the formation of mono- and bilayers, the catalytic effect of nano-silver in the oxidation of oleic acid with permanganate and conformational changes in the peptide fragment. Quantum-mechanical calculations allow one to establish the bond lengths in the molecule, the values of the effective charges, and the distribution of the electrostatic potential. Fig. 6, Ref. 17.

Keywords: effeqtive charges, eleqtrostatic potential, oleic acid, stearic acid, lipid-II, nanocomposite

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4.2. Obtaining Technologies

2.4.2.1. Obtaining of bionanoceramic super paramagnetic materials for the creation of local controlled hyperthermia for malignant cancer therapy. /Z. Kovziridze, N. Nijaradze, N. Darakhvelidze/. Ceramics and Advanced Technologies. – 2019. – Vol. 21. – #1(41). – pp. 21-37. – geo.; abs.: geo., eng.

The article seals with such matters as a comparative study of anticancer properties of hyperthermia induced by hematite nanoparticles and the mechanisms of their impact; creation of principally new drug of high anticancer effect; preparation-concentration of a drug containing hematite nano-particles, control of activity; a comparative study of anticancer activity of the drug; the determination-development of optimal regime and schemes; an analysis of powder of the obtained hematite nanoparticles showed homogeneous spreading of particles according to their dimensions and correspondingly – good stability. By further treatment of ferric ions obtained in Zeta potential device above Curie (769oC) temperature (800oC) the hematite nanoparticles of 80 nm size were obtained in oxidizing medium at the regime 4-5C/min. Tab. 1, Fig. 12, Ref. 24.

Keywords: nanoparticle, hematite, hyperthermia, stability

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2.4.2.2. Electrosynthesis and application of nanomagnetite for purification of water previously contaminated by phenol. /M. Donadze, N. Makhaldiani/. Ceramics and Advanced Technologies. – 2020. - vol. 22. – #1(43). – pp. 15-22. – geo.; abs.: geo., eng.

The aim of the study is the electrosynthesis of Fe_3O_4 nanomagnetite and the purification of precontaminated water from phenol using a filter containing nanomagnetite. The main component of the filter is magnetite nanoparticles stabilized with oleic acid, obtained by electrosynthesis in a two-layer bath. An aluminum arc was used as a rotating cathode and optimal electrolysis parameters were determined. A porous filter was obtained after impregnation of bohemite with magnetic nanoparticles and its subsequent burning at 450°C. In a two-layer bath, a monodispersed sol of magnetite in hexane was obtained. The optimal parameters of electrolysis are determined. The resulting nanomagnetite was characterized by X-ray analysis (XRD), infrared spectroscopy (FT-IR), elementary analysis and scanning microscopy (SEM-EDS). Particle size determined by dynamic light scattering (DLS Malvern). A filter based on nanomagnetite shows a significant effect in the process of purifying drinking water from phenol. Monodisperse organosole of nanomagnetite was obtained by electrolysis in a two-layer bath. A porous filter containing nanomagnetite can be used to purify water contaminated with phenol at the place of consumption. Fig. 8, Ref. 17.

Keywords: nanomagnetite, electrosynthesis, boehmite, Fenton mechanism, phenol

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2.4.2.3. Synthesis and application of the hybrid nanocomposite - Ag@MnOx for purification with bacteria (e.coli) and heavy metals contaminated water. /N. Makhaldiani, M. Donadze/. Ceramics and Advanced Technologies. – 2020. - vol. 22. - #1(43). – pp. 23-36. – geo.; abs.: geo., eng.

The aim of the study was the synthesis of the Ag@MnOx nanocomposite and the purification of water from bacteria and heavy metal ions using filter containing a hybrid nanocomposite. The main filter component is silver nanoparticles stabilized with oleic acid, obtained by electrosynthesis in a two-layer bath. An aluminum arc was used as a rotating cathode and optimal electrolysis parameters were determined. Hybrid nanocomposite obtained by oxidation of oleic acid with potassium permanganate. A porous filter was obtained by coating of honeycomb structure cordierite with a primary layer-washcoat (γ-Al_2O_3) and its subsequent impregnation with a hybrid nanocomposite. The use of an arc instead of a disk-shaped cathode in a two-layer bath reduces the size of silver particles and increases the degree of monodispersity. A filter based on a hybrid nanocomposite shows a good antibacterial effect in the process of purification of drinking water from E.coli bacteria; good sorption effect for copper ions and sorption and oxidative effect for manganese ions. A porous honeycomb structure filter containing a nanohybrid composite Ag @MnO_x can be used to purify water contaminated with bacteria and heavy metals at the place of consumption (well water, exotic tourism zone, etc.). Tab. 1, Fig. 14, Ref. 16.

Auth.

Keywords: nanosilver, hybrid nanocomposite, cordierite, heavy metals, coli index

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2.4.2.4. Obtaining metal-containing nanoparticles in polyethylene matrix by mechano-chemical method and study of their properties. /S.K. Ragimova/. Azerbaijan Chemical Journal. – 2020. – #2. – pp. 20-25. – eng.; abs.: eng., az., rus.

Metal-containing nanoparticles in the matrix of high-pressure polyethylene are obtained by the mechanochemical method without the use of organic solvents by high-speed thermal decomposition of salts of organic acids under conditions of high shear deformations. The phase composition and structure of the obtained nanocomposites were studied by X-ray phase, scanning electron microscope, and thermogravimetric analyzes. It is shown that the formation of nanoparticles of metal oxides in the polymer matrix, contribute to the stabilization of the composite, raising the temperature of the onset of its thermaloxidative degradation. Micrographs of the obtained nanocomposites indicate the formation of layered structures that possess high fracture toughness. Fig. 8, Tab. 1, Ref. 12.

Keywords: metal-containing nanoparticles, high pressure polyethylene, mechano-chemical method, Xray phase, scanning electron microscope and thermogravimetric analyzes

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2.4.2.5. Synthesis, conversion and antimicrobial activity of derivatives of 2-hydroxy-1-haloidphenoxy-ethers of nonanol-2. /S.A. Mammadov, A.A. Mahmudova, G.G. Mammadova, V.S. Hasanov, N.P. Ladokhina, L.F. Zeynalova/. Azerbaijan Chemical Journal. – 2020. – #1. – pp. 59-65. – eng.; abs.: eng., az., rus.

Reactivity of hydroxyl group 1-haloid-phenoxy-2-hydroxynonanes to nucleophilic substitution with acetoxymethylchloride was studied. It was found that regardless of the nature of haloids and their position in aryloxy radical, the yields of acetoxymethyl ethers make nearly 70% that proves high reactivity of hydroxyl group. Indeed, during the reaction with isocyanates phenoxynonanol-2 forms urethanes with yield 69–70%. Initial synthon was prepared by the reaction of 1-bromine-nonanol-2 with substituted phenols. Study of synthesized polyethers and urethanes as antimicrobial additives to lubricating oils gave positive results. It was determined that urethanes exhibit stronger antimicrobial effect than polyethers. Fig. 2, Table. 3, Ref. 12.

Keywords: phenoxyethers, urethanes, polyethers, acetoxymethyl, antimicrobial additives

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2.4.2.6. Deposition of nanodrop phase from emitter tip on nearby mobile surface. /I.S. Gasanov , S.A. Aliyev, I.I. Gurbanov, E.M. Akberov, F.E. Mamedov, A.H. Kerimova/. Azerbaijan Journal of Physics. – 2020. – vol. 26. – #1. – pp. 40-43. – eng.; abs.: eng.

The formation processes of low-sized structures by means of a fine-dispersed phase of liquid metal ion source (LMIS) are considered. The emitting tip is located in close distance from moved surface with the aim of deposition of narrow stripes. At distance tip – surface near 80 µm on the axis of thin and wide traces of (İn+ , Sn+) ions the massive continuous paths by width of several microns are obtained. The structure of deposited stripes by the length more than 10 mm is the grain structure. At further approach of tip to surface, the path melts because of high density of ion current and heterogeneous profile of its cross-section become smooth. For deposition of narrower structures, the effective cooling of conducting mobile substrate is necessary. Fig. 5, Ref. 8.

Keywords: liquid metal ion source, field emission, nanoparticle

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4.3. Processing Technologies

2.4.3.1. Nanotechnologies or technological advances of the future. /I. Phutkaradze/. Chemistry Accounts. – 2019. – vol. 3. – #1. – pp. 16-19. – geo.; abs.: geo.

Nanotechnologies are the technology of the future. It is a multidisciplinary field, which includes chemistry, biology, physics, computer science, medicine and engineering. Its main task is to manage processes at the molecular level for which purpose it uses the smallest nanoparticles sized from 1 to 100 nanometers. In the field of technologies nanomaterial chips, processors and other means of communication are noteworthy, which according to scientists, will make a nanorevolution in the world. Fig. 3, Ref. 5.

Keywords: nanotechnology, nanoparticle, nanosystem, nanomolecule, nanomedicine, nanorevolution

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2.4.3.2. Results of laboratory and industrial tests of IKHLAS-1 nanodemulsifier on the Akkulka Oil Field and the new mechanism of destruction of oil emulsions. /T.K. Dashdiyeva/. Azerbaijan Chemical Journal. – 2020. – #3. – pp. 34-45. – eng.; abs.: eng., az., rus.

The article presents the results of laboratory and industrial tests of the IKHLAS-1 nanodemulsifier for the Akkulka Oil Field of the LLC Tetisaralgaz of the Republic of Kazakhstan. According to the test results, it was found that the IKHLAS-1 nanodemulsifier under all technological conditions of primary oil preparation shows significant advantages compared to the basic DMO-86520 demulsifier. Therefore, IKHLAS-1 was recommended for widespread introduction of the Akkulka Oil Field at the Group Installation of primary preparation of oil. Implementation results (since October 2017) also confirms the high efficiency of the IKHLAS-1 nanodemulsifier. The article sets out also a new mechanism for the destruction of oil emulsions. Tab. 9, Ref. 15.

Keywords: nanodemulsifier IKHLAS-1, oil field nanotechnology, oil production, nanotechnology in oil and water preparation, new mechanism, destruction of oil emulsions

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5. NANOENGINEERING

5.1. Devices and Sensors

2.5.1.1. The effect of surface recombination on the open circuit voltage of a solar cell based on a single nanowire with a radial p-n-junction. /S.G. Petrosyan, V.A. Khachatryan, S.R. Nersesyan/. Proceedings of NAS RA. Physics. – 2020. – vol. 55. – #3. – pp. 343-357. – rus.; abs.: rus., arm., eng.

An analytical model is proposed for studying the effect of surface recombination on the characteristics of a solar cell based on a nanowire with a radial p-n junction formed between its 'core' and 'shell' of different types of conductivity. When varying over a wide range of shell widths, the effect of surface recombination on such important parameters of a solar cell as short circuit current, open circuit voltage, and the efficiency of solar energy conversation into electrical energy is considered. It is shown that the relatively low open circuit voltage, often observed experimentally in such solar cells, can be caused by significant surface recombination on the sidewall of the nanowire, the role of which increases with decreasing nanowire diameter and increasing surface to volume ratio. Fig. 6, Ref. 27.

Keywords: analytical model, solar cell, conductivity, short circuit current, open circuit voltage, solar energy

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2.5.1.2. Detection of iron nanoparticles in aqueous solutions by microwave sensor. /L. Odabashyan, N. Margaryan, G. Ohanyan, M. Manvelyan, D. Hambaryan, T. Abrahamyan, R. Khachatryan, A. Babajanyan/. Proceedings of NAS RA. Physics. – 2020. – vol. 55. – #2. – pp. 251-258. – rus.; abs.: rus., arm., eng.

The aqueous solution with iron nanoparticles is investigated by a microwave stripline sensor based on the optimized double quadratic-shape design. Due to real-time near-field electromagnetic interaction between microwaves and sample S11, the reflection coefficient of the sensor changed depending on iron nanoparticles concentration in the aqueous solution at resonant frequency. Thes work examined the iron nanoparticles concentration in the 0–20 μg/l concentration range at an operating frequency at about 1.7 GHz. The measured minimum detectable signal was 0.035 dB/(μg/l) or and 0.25 MHz/(μg/l) and the measured minimum detectable concentration was 1.4 μg/l and 0.2 μg/l, respectively. The microwave response of sensor systems can be explained by the additional structural changes of water clusters due to the metal nanoparticles ablation. This implemented method has approachable development process and the accuracy of measurement is high, thus it can be applied as a physicochemical sensor for non-invasive monitoring of metal nanoparticles in complex liquids. Fig. 4, Ref. 14.

Keywords: iron nanoparticles, microwave stripline sensor, minimum detactable signal, ablation, physicochemical sensor

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2.5.1.3. Gas nanosensors made from semiconductor metaloxides. /V.M. Aroutiounian/. Proceedings of NAS RA. Physics. – 2019. – vol. 54. – #4. – pp. 485-501. – rus.; abs.: rus., arm., eng.

Usually, semiconductor gas sensors made from metal oxides require high pre-heating of the work body. Advantages for nanoscale sensors are the possibility to work at remarkable lower than 300°C temperature of its work body up to room temperature (practically without preheating of the sensor). Today's experimental results obtained for gas sensors made from metal oxides are reported in this review. Fig. 1, Ref. 100.

Keywords: semiconductor, gas sensor, metal oxide, work body, nanoscale sensors, preheating

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2.5.1.4. Electronic and transport properties of boron nitride nanodevice (BNNT). /I.M. Danglyan, E.M. Kazaryan, D.B. Hayrapetyan/. Armenian Journal of Physics. – 2019. – vol. 12. – #4. – pp. 344-348. – eng.; abs.: eng.

Boron nitride nanotubes are valued due to their physical and chemical properties. They can be applied in the field of design and developing of optoelectronic devices of new generation. In this paper, the transport and electronic properties of both pure boron nitride and boron nitride nanotube with embedded carbon atoms have been calculated in the framework of the Density Functional Theory (DFT). The results show that a nanodevice with embedded carbon atoms has wider transmission spectrum than the pure one. Transmission eigenvalues for both nanodevices were computed. A nanodevice with impurity has higher transmission eigenvalues than the pure one. Fig. 4, Tab. 1, Ref. 6.

Keywords: Boron Nitride nanotube, transmission spectrum, eigenvalue, eigenstate

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2.5.1.5. Semiconductor gas sensors using Arduino nano. /V. Aroutiounian, A. Hovhannisyan/. Armenian Journal of Physics. – 2019. – vol. 12. – #4. – pp. 325–328. – eng.; abs.: eng.

A programmable board with its own processor and Arduino Nano memory was used. The board has a couple of dozen contacts, to which all kinds of components (displays, light emitting devices (LEDs), sensors, motors, routers, magnetic locks, etc.) can be connected. A gas detector using Arduino Nano circuit was proposed. Fig. 3, Ref. 9.

Keywords: gas detector, semiconductor, Arduino Nano

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2.5.1.6. Numerical study of Josephson nanostructures using parallel computing. /I.R. Rahmonov, E.V. Zemlyanaya, M.V. Bashashin, P. Atanasova, A.R. Rahmonova, Yu.M. Shukrinov/. Armenian Journal of Physics. – 2019. – vol. 12. – #3. – pp. 233-239. – eng.; abs.: eng.

The phase dynamics of the stack of long JJs, the length of which exceeds the Josephson penetration depth λJ, taking into account the inductive and capacitive couplings between junctions and diffusion current is investigated. Numerical simulation of current-voltage characteristics of the stack is based on numerical solution of a system of nonlinear partial differential equations by the fourth order Runge-Kutta method and finite-difference approximation. The calculations are performed using the MPI technique for parallel implementation. The methodical calculations on multi-processor cluster (LIT JINR) with a different number of parallel MPI-processes are carried out. It is shown that the developed parallel algorithm provides about 7-fold acceleration in comparison with serial simulation. Fig. 2, Tab. 1, Ref. 22.

Keywords: Josephson junction, inductive coupling, capacitive coupling

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6. NANOMEDICINE

6.2. Medical Chemistry

2.6.2.1. Impact of Ag nanoparticles on microorganisms, causative agents of purulent-inflammatory processes. /M. Mishina, A. Syrova, V. Abramenko, V. Makarov, O. Hopta/. Georgian Medical News (GMN). – 2019. – #4. – pp. 139-143. – eng.; abs.: eng., rus., geo.

Determination of the Ag nanoparticles' impact on microorganisms causative agents of purulent-inflammatory processes was carried out It was stated that the greatest significance of growth inhibition zone was found in Staphylococcus aureus and Streptococcus pyogenes with sample length from 1 to 6 mm and Escherichia coli with 5–6 mm sample length. The investigated strains in an amount 10^4–10^6 CFU/ml were sensitive to Ag nanoparticles activity, but at concentration 108 CFU/ml and more all strains were

found persistent to samples of various length. The ability to form biofilms with planktonic cells of microorganisms under Ag nanoparticles activity sufficiently reduced from 3.4 (Candida albicans) to 5.5 (Klebsiella pneumonia) in investigated strains. The disorganization of daily biofilms was found in determining of Ag nanoparticles impact on formed biofilms of microorganisms. Fig. 7, Ref. 17.

Keywords: Ag nanoparticles, silver nanoparticles, antimicrobial effects, catheter-associated infections, biofilms, reference strains of microorganisms

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2.6.2.2. Formulation of biodegradable polymeric nanoparticles containing cytotoxic substance of plant origin. /L. Ebralidze, A. Tsertsvadze, E. Sanaia, D. Berashvili, A. Bakuridze/. Georgian Medical News (GMN). – 2020. – #2. – pp. 137-142. – eng.; abs.: eng., rus., geo.

Formulation of novel drug delivery system is one of the approaches for improvement of pharmacological activity of drugs. This implies encapsulation of the API into the biocompatible polymeric material. Objective of the research was the formulation of biodegradable amino acid-based polyesteramide nanoparticles composing cytotoxic substance of plant origin. The research materials and methods included:

biodegradable polyesteramide (PEA), alkaloids from Vinca Minor, surfactants (Tween 80, polyvinyl pirolidone, polyvinyl alcohol, Poloxamer 188). NPs size (mean particle diameter) and size distribution (polydispersity index, PDI), and zeta-potential (ZP) were measured by dynamic light scattering (DLS) using a Zetasizer Nano ZS (Malvern Instruments, U.K.) at 25°C, UV spectrophotometer was used for %EE study. Amino acid-based PEA particles were fabricated by the modified emulsification method. Based on the studies optimal composition and fabrication condition of PEA NPs was determined. The conditions of the NPs fabrication were as follows: the O/W ratio: 1:10; the solvent: DMSO; polymer concentration in the organic phase: 50.0 mg/mL; surfactants (PVA) concentration in aqueous phase 0.5%,the stirring rate: 1000 rpm. The influence of the various factors such as organic solvents, surfactants, as well as a polymer concentration in the organic phase,surfactant concentration in the aqueous phase,the organic/water phase ratio on the NPs fabrication was studied. The NPs were characterized by size (mean particle diameter & size distribution (polydispersity index, PDI), and zeta-potential (ZP). Increase concentration of the surfactant (polyvinyl alcohol) from 0.1% to 0.5% decrease average particle size from 568±63 to 169±1.66 respectively. EE% was obtained to be around 50%. Tab. 7, Fig. 3, Ref. 8.

Keywords: Nanoparticle, entrapment, polymer, biodegradable, alkaloids

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