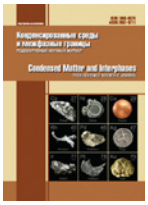

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Аннотации на английском языке

Original articles

Research article

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Atomic composition, microstructure, and electromagnetic properties of schungite micropowder

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Abstract

The goal of the work was to study the microstructural, elemental, and electromagnetic properties of the samples of micropowder made from a natural mineral schungite. It was found that according to an X-ray spectral microanalysis, the carbon content in the studied samples of the mineral schungite was from 44 to 54 wt% while the iron content did not exceed 3.9 wt%. The iron content increased up to 6.1 wt% in the produced schungite micropowder.

It can be presumed that in the schungite, micropowder iron exists in the form of ferrimagnetic nanoparticles of magnetite and pyrite, which is formed when grinding schungite particles in ball mills with a steel body and a milling bowl. The produced schungite micropowder also showed the presence of weak ferrimagnetic properties according to the measurements of magnetic permeability performed by vector analysis of the impedance of electrical circuits.

In accordance with its electromagnetic characteristics, schungite micropowder made from shungite mineral is an effective radio-absorbing filler for building materials for cellular communication frequency bands.

Keywords: Schungite, Elemental composition, Microstructure, Electromagnetic characteristics, Building materials

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Research article

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Solubility of calcium and strontium fluorides in a sodium nitrate melt and choosing a crucible material for working with their solution melts

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Abstract

Sodium nitrate is a promising medium for the preparation of nanoparticles of some inorganic fluorides and for studying low-temperature phase equilibria in fluoride systems. In our study, we investigated the possibilities of carrying out long-term (hundreds of hours) experiments with MF_2–$NaNO_3$ (M = Ca, Sr).

We performed an experimental evaluation of the solubility of calcium (CaF_2) and strontium SrF_2 fluorides in a melt of sodium nitrate $NaNO_3$ in the temperature range of 320–500 °C. The article demonstrates that for both fluorides it is low, but the solubility of SrF_2 is almost an order of magnitude higher than the solubility of CaF_2 and is about 1 g/100 g of $NaNO_3$ at 500 °C. The absence of perceptible oxidative processes and the low solubility of CaF_2 and SrF_2 fluorides in sodium nitrate make it possible to synthesize solid solutions based on them in this medium. The article also considers the possibility of using crucibles made of glazed ceramics, glass-carbon, and aluminium for working with MF_2–$NaNO_3$ (M = Ca, Sr) melt solutions. It is shown that glass-carbon and aluminium react with the $NaNO_3$–SrF_2 melt solution to form strontium carbonate and several oxide phases, respectively.

It is recommended to use glazed ceramics as a crucible material for long-term solution-melt processes. The aluminium crucible showed high resistance to the $NaNO_3$ melt without dissolved fluorides.

Keywords: Calcium fluoride, Strontium fluoride, Sodium nitrate, Solubility, Solution melt, Powder X-ray diffraction analysis

Funding: The study was supported by the Ministry of Science and Higher Education of the Russian Federation in the framework of the government order of the Crystallography and Photonics Federal Research Centre (CPFRC) of the Russian Academy of Sciences using the equipment of the Centre for Shared Use of Scientific Equipment, CPFRC.

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Аннотации на английском языке

Research article

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Molecular beam epitaxy of metamorphic buffer for InGaAs/InP photodetectors with high photosensitivity in the range of 2.2–2.6 um

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Abstract

The present work is concerned with finding optimal technological conditions for the synthesis of heterostructures with a metamorphic buffer for InGaAs/InP photodetectors in the wavelength range of 2.2–2.6 um using molecular beam epitaxy. Three choices of buffer structure differing in design and growth parameters were proposed.

The internal structure of the grown samples was investigated by X-ray diffraction and transmission electron microscopy. Experimental data analysis has shown that the greatest degree of elastic strain relaxation in the InGaAs active layer was achieved in the sample where the metamorphic buffer formation ended with a consecutive increase and decrease in temperature. The said buffer also had InAs/InAlAs superlattice inserts.

The dislocation density in this sample turned out to be minimal out of three, which allowed us to conclude that the described heterostructure configuration appears to be the most appropriate for manufacturing of short wavelength infrared range pin-photodetectors with high photosensitivity.

Keywords: Molecular beam epitaxy, Metamorphic buffer, Short wavelength infrared range photodetectors, X-ray diffraction analysis, Transmission electron microscopy

Funding: This research was supported by the Russian Science Foundation grant № 22-79-00146.

For citation: Vasilkova E. I., Pirogov E. V., Sobolev M. S., Ubiyvovk E. V., Mizerov A. M., Seredin P. V. Molecular beam epitaxy of metamorphic buffer for InGaAs/InP photodetectors with high photosensitivity in the range of 2.2–2.6 um. *Condensed Matter and Interphases*. 2023;25(1): 20–26. https://doi.org/10.17308/kcmf.2023.25/10972

Research article

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Dispersed copper (I) oxide particles encapsulated by polylactide

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Abstract

One of the approaches for the production of polymer composite materials with a biocidal effect is based on the use of dispersed particles of some metal oxides as a filler (for example, copper oxide or zinc oxide). Such an approach allows not only providing a biocidal effect, but also increasing such mechanical characteristics as the modulus of elasticity, hardness, and abrasion resistance. The mechanical characteristics of such polymer composite materials can be controlled by formation of a sheath (for example, from polylactide) of a given thickness on the surfaces of dispersed particles. Polylactide is a biodegradable polymer, widely used as coating material for particles with biocidal properties. The parameters of the methods for forming a polylactide sheath are determined by the sheath's thickness and the sheath's adhesion to the particle surface. The purpose of the study was to determine the parameters of the polymer sheath's formation on the surfaces of dispersed submicron copper oxide (I) particles during coacervation of polylactide from the solution.

The encapsulation of copper (I) oxide particles was carried out by the coacervation process in a solution. Polylactide was displaced from the solution in benzene by hexane in the presence of copper (I) oxide particles. It was shown that a sheath thickness of about 250 nm can be obtained by using the polylactide sheath formation method. The recommended parameters of the polylactide sheath formation method were determined: solution temperature of 35÷38 °C, hexane volume not more than 30±2 ml. The sheath had weak adhesion to particle surfaces: adhesion was determined by the roughness of the particle surface.

The mechanical characteristics of the epoxy resin ED-20 polymer composition filled with the encapsulated particles were considered in the study. The increase in the mechanical properties of the polymer composition with encapsulated particles in comparison with the samples of polymer composition with non-encapsulated particles was revealed. That can indicate the increased adhesion of encapsulated particles to such polymer matrix.

Keywords: Encapsulation, Dispersed particles of copper (I) oxide, Polylactide

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Аннотации на английском языке

Research article

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Synthesising dispersed powders of CoZn ferrites for microwave absorption

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Abstract

An important task of chemical materials science is to obtain materials with set parameters and to provide a reliable prediction of their properties. At the moment, an important task is to develop promising absorbing coatings based on dispersed magnetic materials. To ensure more effective use of dispersed powders of cobalt-zinc ferrite for fillers absorbing microwave radiation, we studied the changes in their magnetic properties and morphology depending on the conditions of the sol-gel synthesis.

In our study, we synthesised $Co_{0.65}Zn_{0.35}Fe_2O_4$ ferrite powders of various degree of dispersion using the sol-gel method. The samples were analysed using X-ray diffractometry. The microstructure and the morphology of the nanoparticles were studied by means of scanning electron microscopy. The ratio of the concentration of metal atoms in ferrite powders and the features of their distribution on the surface of the particles were determined by energy dispersive X-ray spectroscopy. Magnetometry was used to determine the specific saturation magnetization and the coercive force.

The study demonstrated that the main factor resulting in low values of the saturation magnetization of the cobalt ferrite nanopaticles is the formation of the magnetic dead layer on their surface. This layer is formed due to a number of factors including noncollinearity of spins, disordering of cations, defectiveness, amorphous state, and the difference in the composition occurring because the processes of reciprocal diffusion of cations during and the formation of the spinel structure during the synthesis are not complete.

The study determined the ways to reduce the size of the inactive magnetic layer by controlling the parameters of the sol-gel synthesis in order to find effective methods of obtaining ferrite powders with increased magnetization, degree of crystallinity and the intermediate particles size between a superparamagnetic and a multidomain state. Such materials can be used as fillers for coating absorbing microwave radiation.

Keywords: Cobalt-zinc ferrite, Microwave absorption, Sol-gel synthesis, Nanoparticles

For citation: Ivashenko D. V., Urbanovich D. A., Palyn I. U., Bushinsky M. V., Trukhanov A. V., Pankov V. V. Synthesising dispersed powders of CoZn ferrites for microwave absorption. *Condensed Matter and Interphases*. 2023;25(1): 37–46. https://doi.org/10.17308/kcmf.2023.25/10646

Research article

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Phase equilibria in the Cu_2SnSe_3–Sb_2Se_3–Se system

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Abstract

Complex copper-tin and copper-antimony chalcogenides are of great interest for the development of new environmentally friendly and inexpensive thermoelectric materials. Recently, these compounds have been drawing more interest due to the possibility of increasing their thermoelectric performance with various cationic and anionic substitutions. In this article, we continued the study of multi-component systems based on the copper chalcogenides and presented the results of the study of phase equilibria in the Cu_2SnSe_3–Sb_2Se_3–Se system. The study was conducted using differential thermal analysis and powder X-ray diffraction.

Based on the experimental data, a projection of the liquidus surface and three polythermal cross sections of the phase diagram were plotted. We determined the regions of primary crystallisation of the phases and the nature and temperatures of non-variant and monovariant equilibria.

It was established that the liquidus surface consisted of two primary crystallisation regions based on Cu_2SnSe_3 and Sb_2Se_3 phases. The primary crystallisation region of elementary selenium was degenerate. A large immiscibility region of two liquid phases was found in the system.

Keywords: Phase diagram, Liquidus surface, Copper-antimony-tin selenides

Funding: The study was conducted as part of the scientific programme of the international laboratory "Promising materials for spintronics and quantum computing", created at the Institute of Catalysis and Inorganic Chemistry of Azerbaijan National Academy of Sciences (Azerbaijan) and the Donostia International Physics Center (Spain).

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Аннотации на английском языке

Research article

https://doi.org/10.17308/kcmf.2023.25/10974

Thermochemical characteristics of the formation of aqueous solutions of imino acids

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Abstract

The calorimetry methods are an important source of thermodynamic information in the physicochemistry of solutions of biologically active substances, including amino acids. The goal of the work was to prepare a thermodynamic description of the formation of an aqueous solution of heterocyclic imino acids, proline and hydroxyproline, that have different structures and sizes of the side radical, in a wide range of concentrations, which can be used for a qualitative analysis of changes occurring in their solutions.

Thermochemical measurements of the formation of an aqueous solution of imino acids in the concentration range $1.0 \cdot 10^{-3}$ – $40.0 \cdot 10^{-3}$ mol/kg was performed on a MID-200 differential heat-conducting microcalorimeter at 293 K. The equilibrium moment in the solution formation was determined by the output of the thermokinetic curve to the zero line. The enthalpy of the formation of an aqueous solution of imino acids was calculated by the integration of the time dependence of thermal power.

It is shown that the increase in the equilibrium time, the increase in the maximum heat flow, and the decrease in the rate of change of the heat flow during the dissolution of hydroxyproline is due to the formation of intra and intermolecular bonds in the Hypro structure with the participation of the OH group. The difference in the structure of imino acids is reflected in the sign of the thermal effect and the form of the concentration dependence of the enthalpy of formation of aqueous solutions. The exoeffect of proline dissolution is due to the stabilisation of the water structure influenced by imino acid.

Keywords: Imino acids, Aqueous solutions, Thermochemical characteristics

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Research article

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Formation during glycine-nitrate combustion and magnetic properties of $YFe_{1-x}Ni_xO_3$ nanoparticles

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Abstract

The synthesis of FeO_3 and $YFe_{1-x}Ni_xO_3$ (x = 0.1; 0.15; 0.2; 0.3; 0.5) nanocrystals was performed under the conditions of a self-propagating wave of glycine-nitrate combustion and their characterization and determination of the effect of Ni^{2+} doping of yttrium ferrite on the magnetic properties of nanopowders.

The technology for the synthesis of yttrium orthoferrite nanoparticles (with and without doping with Ni^{2+} ions) by the glycine-nitrate combustion method at a ratio of G/N = 1 and 1.5 without adding a gelling agent to the reaction mixture and using ethylene glycol/glycerol is described. For the characterization of nanopowders based on $YFeO_3$, the following were determined: phase composition and crystal structure (X-ray diffraction (XRD) method); size and structure of nanocrystal particles (transmission electron microscopy (TEM)); elemental composition of the samples (local X-ray spectral microanalysis (LXSMA)); magnetic characteristics (field dependences of specific magnetization).

Thermal annealing of the synthesized samples at 800°C for 60 min led to the formation of the o-$YFeO_3$ main phase. Undoped samples of yttrium orthoferrite were characterized by a particle diameter in the range of 5-185 nm, depending on the gelling agent used. $YFe_{1-x}Ni_xO_3$ particles had a predominantly round shape with a size of 24 to 31 nm; the non-monotonic dependence of the average particle diameter on the dopant content was revealed: as the amount of dopant added increased, the average crystallite size tended to decrease. Nanopowders of undoped yttrium orthoferrite exhibit antiferromagnetic behaviour of magnetic susceptibility with temperature. The change in the magnetic properties of the nickel-doped $YFeO_3$ nanocrystalline powders was due to the incorporation of Ni^{2+} into the Fe^{3+}position, which led to the formation of a material with more pronounced soft magnetic properties at a substitution degree of 0.1. Samples with high degrees of substitution (x = 0.15 and 0.3) were also characterized by paramagnetic behaviour at temperatures above 100 K.

Keywords: Nanocrystals, Yttrium orthoferrite, Nickel, Doping, Glycine-nitrate combustion

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Аннотации на английском языке

Research article

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Activity and stability of PtCo/C electrocatalysts for alcohol oxidation

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Abstract

This study considers the liquid-phase synthesis of PtCo/C catalysts based on CoO_x/C composite carriers with different mass fractions of metals and Pt:Co ratios. The purpose of the article is to study the activity of PtCo/C electrocatalysts of various compositions in the oxidation reactions of methanol and ethanol and to compare their characteristics with their commercial PtRu/C and Pt/C analogues.

PtCo/C catalysts were synthesised with Pt:Co ratios of 1:1 and 3:1. The specific active surface of the obtained PtCo/C materials was determined, their activity in the oxidation reactions of methanol and ethanol and their resistance to poisoning by intermediate products of alcohol oxidation were studied. The structural and electrochemical characteristics of the obtained PtCo/C catalysts were studied by X-ray diffraction, cyclic voltammetry, and chronoamperometry. It was found that PtCo/C materials with a mass fraction of platinum close to 20% are the most active and stable as compared to their commercial PtRu/C and Pt/C analogues.

The presented results show that PtCo/C catalysts are a promising material for direct alcohol fuel cells.

Keywords: Methanol fuel cells, Ethanol fuel cells, Electrocatalysis, Ethanol oxidation reaction, Methanol oxidation reaction, Bimetallic catalysts

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Research article

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Hydrogen permeability of the Pd–Pb system foil of various composition

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Abstract

The purpose of the study was identification of the role of the chemical composition of Pd, Pb-alloys based of palladium in the processes of injection and extraction of atomic hydrogen.

The objects of study were Pd-Pb alloy foils with a lead content of 3, 5, 7, 9, and 11 at. %, representing the β-phase of the solid solution. Samples with a thickness of 40 to 62 μm were obtained by cold rolling. Hydrogen permeability was studied by cyclic voltammetry and two-stage cathode-anode chronoamperometry in deaerated solutions of 0.1 M H_2SO_4. The obtained results were processed according to a mathematical model developed for electrodes of semi-infinite thickness.

The dependence of the hydrogen permeability coefficient, as well as the rate constants of the processes of injection and extraction of atomic hydrogen, on the chemical composition of the alloy has been revealed. It was found that the Pd–Pb alloy with a lead content of 5 at.% demonstrates the highest values of hydrogen permeability compared with samples of the same crystal structure, since the rate constant of atomic hydrogen injection is very sensitive to the alloy structure. The latter confirms that the phase-limiting transition of atomic hydrogen into the alloy is the rate-determining stage, at least in the initial period of time.

Keywords: Solid solution of Pd-Pb systems, Atomic hydrogen, Phase boundary transition, Alloy structure, Hydrogen permeability, Cathode injection, Anode extraction

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Research article

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Simulation of the molecular dynamics of the passage of liposome with cinnarizine through the blood-brain barrier

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Abstract

Liposomal preparations have a number of advantages: they protect the cells of the body from the toxic effects of drugs; prolong the action of the drug introduced into the body; protect medicinal substances from degradation; promote the manifestation of targeted specificity due to selective penetration from blood into tissues; change the pharmacokinetics of drugs, increasing their pharmacological effectiveness; make it possible to create a water-soluble form of a number of medicinal substances, thereby increasing their bioavailability. In this work, studies were carried out for the development of the method for determining the degree of inclusion of cinnarizine used as a corrector of cerebrovascular accidents into liposomes from soy lecithin. The aim of this study was to determine the distance between the membranes of endotheliocytes, which is critical for the passage of a liposome through the blood-brain barrier.

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A simulation of changes in the structure of a liposome with cinnarizine located between two cell membranes was carried out using the molecular dynamics method at various distances between the membranes. A square planar fragment of a bilayer phospholipid membrane was assembled using the Internet service Charmm-GUI->Input Generator->Martini Maker->BilayerBuilder (http://www.charmm-gui.org/?doc=input/mbilayer). Geometry optimization and molecular dynamics simulation were performed in Gromacs 2019 using Martini 2.2 force field. According to the results of the simulation of coarse-grained molecular dynamics, a liposome from purified soy lecithin with cinnarizine adsorbed on its inner and outer surface is able to maintain integrity, being between the membranes of endotheliocytes at a distance between membranes of more than 8 nm. When the distance between the membranes of endothelial cells is less than 8 nm, the liposome with cinnarizine located between the endotheliocytes can lose its structural integrity due to fusion with the endothelial cell membrane.

As a result of the studies, the distance between the membranes of endotheliocytes was established, at which point the liposome with cinnarizine, located between endotheliocytes, can lose its structural integrity due to fusion with the endothelial cell membrane.

Keywords: Molecular dynamics, Liposomes, Cinnarizine, Blood-brain barrier

For citation: Polkovnikov Yu. A. Simulation of the molecular dynamics of the passage of liposome with cinnarizine through the blood-brain barrier. *Condensed Matter and Interphases* 2023; 25(1): 95–102. https://doi.org/10.17308/kcmf.2023.25/10982

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Research article

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Study of semi-polar gallium nitride grown on m-sapphire by chloride vapor-phase epitaxy

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Abstract

In this study, we analyzed the result of the influence of the non-polar plane of a sapphire substrate on the structural, morphological, and optical properties and Raman scattering of the grown epitaxial GaN film.

It was found that selected technological conditions for the performed chloride-hydride epitaxy let us obtain the samples of structurally qualitative semi-polar wurtzite gallium nitride with (11¯22) orientation on m-sapphire. Using a set of structural and spectral methods of analysis the structural, morphological, and optical properties of the films were studied and the value of residual bi-axial stresses was determined. A complex of the obtained results means a high structural and optical quality of the epitaxial gallium nitride film.

Optimization of the applied technological technique in the future can be a promising approach for the growth of the qualitative GaN structures on m-sapphire substrates.

Keywords: GaN, AlN, m-Al_2O_3, chemical vapor-phase epitaxy

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Research article

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Studying the effect of modifying additives on the hydration and hardening of cement composites for 3D printing

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Abstract

The development and application of multicomponent multifunctional additives for cement composites is an important research area since the use of such additives allows controlling both the rheological properties of fresh mixtures and the physical and mechanical properties of the hardened composite.

In our study, we used several additives, including metakaolin and xanthan gum together with tetrapotassium pyrophosphate and a SiO_2 based complex additive, to modify cementitious sand- based materials. We studied the peculiarities of the influence of these additives on the technological characteristics of mixtures (plasticity and shape retention) and the processes of setting, hydration, and hardening of the composite materials.

The optimal values of plasticity, for stability, acceleration of hardening were demonstrated by sand-based systems modified with a complex nanosized additive and metakaolin. The hydration products in the such systems are mainly formed from low basic hydroxides. Metakaolin also results in the formation of ettringite. These systems demonstrate the optimal time of the beginning of setting and the maximum strength gain of the modified cementitious sand- based materials at 28 days.

The optimal ratio of indicators of plasticity and shape retention of cement mixtures and the strength of composites based on them obtained by using the studied additives allows us to recommend using these additives in the innovative technologies for 3D-build printing.
Keywords: cement hardening systems, modification, modifying additives, hydration process, rheological properties, compressive strength
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Research article
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The equilibrium shape of rolled out meniscus

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Abstract
The paper considers the issue of the equilibrium shape of the rolled out capillary meniscus in a homogeneous gravitational field. The approach used in this work differs from the earlier ones, as it takes into account the size dependence of the surface tension. With the help of such models, it will be possible to understand better the behaviour of small capillary bodies and to reveal the effects caused by the size dependence of physical parameters. For the purpose of the study, we propose to use an analogue of the well-known Tolman formula expressing the size dependence of the surface tension for the case of an interface with an arbitrary geometry. Taking into account the size dependence of the surface tension gives us equations which are predictably more complicated than the classical ones. Because of their complex nonlinearity, they cannot be solved by elementary functions, hence numerical methods are applied. The mathematical model of the meniscus is presented in a form that is better suited for numerical modelling of the profiles. We carried out computational experiments to determine the degree and nature of the effect of the parameter responsible for the size dependence of the surface tension on the equilibrium shape of the meniscus. We analysed the special cases when the exact solution of the Laplace equation and the exact relations between the meniscus profile coordinates can be obtained.
Keywords: Capillary meniscus, Surface tension, Size dependence, Capillary surface, Laplace equation, Capillary phenomena, Interfaces
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X-ray photoelectron spectroscopy of hybrid 3T3 NIH cell structures with internalized porous silicon nanoparticles on substrates of various materials

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Abstract
The work is related to the study of a biohybrid material based on mammalian 3T3 NIH mouse fibroblast cells with immobilized porous silicon particles including nanocrystals about 10 nm in size by photoelectron spectroscopy. The influence of the surface material of the substrate on which the biohybrid material is grown on the possibility of conducting studies of the physico-chemical state of the developed surface is studied.
Nickel as well as gold and titanium, known for their biocompatibility, were used as surface materials for cell growth and subsequent internalization of silicon particles. The method of optical microscopy in the reflected light mode was used to assess the distribution of cells on surfaces. It is shown that the nickel surface is not suitable for the synthesis and subsequent studies of biohybrid structures. At the same time, on the surface of gold and titanium, cellular material and structures based on it are available for measurements, including by photoelectron spectroscopy, a high-precision method for studying the atoms charge state and the physico-chemical state of the surface as a whole. The X-ray photoelectronic spectra show all the main components expected to be detected after drying and subsequent vacuuming of the studied objects: the surface material of the substrates and arrays of cell cultures grown on the substrates. No signal from silicon atoms was detected on the nickel surface. In the case of a gold surface, the proximity of the binding energies of the gold core levels (substrate) and silicon (internalized particles) leads to the fact that the signal of gold atoms, which is significant in its intensity, does not allow detecting a signal from silicon atoms, which is weaker in intensity. The signal of silicon atoms in biohybrid structures is reliably detected only when using titanium substrates, including for a control sample containing porous silicon nanoparticles without incubation in cells. Thus, it is shown that the surface of the titanium foil can be used for studies by photoelectron spectroscopy of a biohybrid material based on mammalian 3T3 NIH mouse fibroblast cells with immobilized porous silicon particles.
The obtained result is important for high-precision diagnostics of the physico-chemical state of biohybrid materials and structures based

on them with a low content of silicon atoms when solving problems of studying the compatibility and possibilities of using silicon nanomaterials for medical, including therapeutic and other applications.

Keywords: Biohybrid material, Porous Silicon Nanoparticles, X-ray photoelectron Spectroscopy, Mammalian Cells

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Research article

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The effect of current density on the structure of nickel electrolytic foams and their catalytic properties during hydrogen production

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Abstract

The effect of current density on the regularities of nickel foam deposition processes has been studied. Porous nickel foams were obtained by electrochemical deposition in the galvanostatic mode at current densities of 0.3, 0.6, 0.9, and 1.2 A cm^{-2}. The obtained deposits were characterized by high porosity and well adherence to the substrate material. The electrolytic foams had macro- and micropores.

The features of the formation of the macropore system have been studied. It has been established that at low hydrogen evolution rates, a gradual formation of a porous structure occurs. While at higher rates, the formation of the matrix structure ends in the first minutes of electrolysis. It was shown that the log-normal distribution can be used to describe the formation of a hydrogen template as a system of macropores in electrolytic nickel foams over a wide range of current densities. A technique for the estimation of nickel foam macroporosity based on the data on the fraction of the surface occupied by macropores is proposed. The total porosity of deposits was calculated based on the data on the mass and volume of electrolytic foams. The catalytic activity of the obtained porous electrodes towards the hydrogen evolution reaction was analysed in an alkali solution. The value of depolarization at a current density of 0.3 A·cm^{-2} was used as a criterion for the efficiency of nickel foams. The value of depolarization for the obtained deposits varies in a wide range from 170 to 400 mV and strongly depends on the conditions of foam synthesis and their thickness.

It has been established that nickel foams obtained at 1.2 A·cm^{-2} exhibit the best catalytic properties due to their uniform structure characterized by a large number of macropores evenly distributed throughout the foam volume. This ensures maximum access of the reacting particles to the electrode surface.

Keywords: Porosity, Nickel, Electrodeposition, Catalytic properties, Depolarization

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