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## **SELF-ORGANIZING AS THE DETERMINED CHOICE DIRECTIONS OF CHEMICAL PROCESS PART II. INFORMATION AND FRAKTAL ASPECTS**

***Zhabrev V.A., Chuppina S.V., Margolin V.I.***

Self-organization processes in nano-dimensional systems are regarded as essentially fundamental nanostate initiating collective behavior of particles in the system. The different versions of the information on the effects of nano-dimensional systems, including fractal and multifractal. From these positions through the process of synthesis of substances through the formation of chemical bonds.

*Key words:* self-organization, information, information impact, nanocomposite, fractal, fractal dimension, the chemical bond.

## **ОПИСАНИЕ ПРОЦЕССОВ ФОРМИРОВАНИЯ НАНОСТРУКТУРНЫХ МАТЕРИАЛОВ С ИСПОЛЬЗОВАНИЕМ НЕЛИНЕЙНЫХ БАЗОВЫХ МОДЕЛЕЙ ХИМИЧЕСКОЙ ДИНАМИКИ**

***Поляков С.А., Быков В.И., Черторыльский И.С.***

Methodic foundation of description of processes of produced of nanostructure materials by nonlinear models of chemical dynamic in connection with selforganization of deformation and adaptation are considered.

*Key words:* nanostructure materials; selforganization; nonlinear models of chemical dynamic.

## **OBTAINING AND STUDYING PROPERTIES OF ORGANIC POLYMER/METAL NANOSIZED LAYER STRUCTURES**

***Vantsyan M.A., Popova G.V., Kopylov V.M., Poleyev A.B., Korygoidsky A.R.,  
Stepanova T.V., Mozgrin D.V., Khodachenko G.V., Besedin S.P., Volkov V.V.***

In this paper we consider nanosized layered structures polymer/metal prepared by ion-plasma deposition. These structures are based on conventional films of silicon-organic polymer containing special fragments. An atomic force microscopy study revealed either grained or curvature (or terrace) structure for metal layer with the grain size of 0,2- 20 nm and terrace size 1–5 nm. It was found by small-angle x-ray scattering that samples may contain or two fractions of particles with particle size from 2,6 nm to 23,4 nm.

*Keywords:* silicon-organic polymers, ion-plasma deposition, metal, atomic force microscopy, small-angle x-ray scattering.

## **EXPERIMENTAL INVESTIGATION INTO THE SURFACE PROPERTIES OF OPAL-BASED METAL-DIELECTRIC NANOSTRUCTURES**

***Alekseeva N., Veisman V., Lukin A., Pan'kova S., Solovyev V., Yanikov M.***

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Synthetic opals covered by vacuum deposited thin metal films were studied by scanning probe microscopy (SPM) and Bragg reflectance spectroscopy. Opal sphere diameters obtained from SPM-images and those calculated from Bragg reflectance spectra for uncoated and metal-coated opal samples coincide with each other within the experimental error. Thus, the outer surface of thin metal layer covering opal sample is periodically profiled like the opal-metal interface.

*Key words:* opals, corrugated thin metal films, scanning probe microscopy (SPM), Bragg reflectance spectroscopy.

## THE INFLUENCE OF INOCULATION BY THE MAGNESIUM AND BY THE NANOPOWDER OF BORON NITRIDE ON THE NODULAR IRON MACHINABILITY BY CUTTING

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It is shown that as a result of inoculation the nodular cast iron by the magnesium and by the nanopowder of boron nitride the cutting tool is practically not worn off

*Key words:* nodular cast iron, inoculation by the magnesium and by the nanopowder of boron nitride, wear cutting tool

## ISOTOPE-INDUCED BAND-GAP OPENING IN GRAPHENE

**Plekhanov V.G., Zhuravleva L.M.**

Isotope substitution in many semiconductors and insulators have renormalized the energy of elementary excitations: electrons and phonons. In this paper for the first time we describe the isotope-induced band-gap opening in graphene. Investigations of this process to allow not only the control the strong (nuclear) interactions (quantum chromodynamics) but to renormalize the electromagnetic interaction (quantum electrodynamics).

*Key words:* Graphene, neutron transmutation doping, semimetal, semiconductors, isotope

## THE STUDY OF BIOCOMPATIBLE VOLUMETRIC NANOCOMPOSITE MATERIALS, PRODUCED FROM AQUEOUS DISPERSION OF ALBUMEN WITH CARBON NANOTUBE

**Gerasimenko A.Yu.<sup>1</sup>, Dedkova A.A.<sup>1</sup>, Ichkitidze L.P.<sup>1</sup>, Podgaetsky V.M.<sup>1</sup>, Ponomareva O.V.<sup>2</sup>, Tavrizova M.A.<sup>2</sup>**

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The studies of the stability, density, hardness, and the internal structure of the volumetric nanocomposites (VNC) were performed. Nanocomposites were produced by evaporation of the liquid component of the aqueous dispersion of albumin with carbon nanotubes. In the first series of experiments, these dispersions were heated in thermostat or were subjected to ultrasonic effect. In the second series of experiments on the dispersions were subjected to radiation of light-emitting diodes in different spectral regions (UV, visible and near-IR). In the third series of experiments, the dispersions were irradiated by infrared diode laser. VNC derived in the first and second series of experiments have decomposed into separate smaller fragments during a few hours. The process is similar to scaly-shaped decay of dried up dispersion of albumin. In contrast, the nanocomposites obtained by laser radiation in the third series of experiments, remained stable for several years. The density of VNC produced by different methods was close to the density of water. This is a consequence of high porosity of materials. The hardness of stable nanocomposites obtained by the laser method (~ 300 MPa) was higher than the hardness of unstable VNC. A characteristic feature of the atomic force (AFM) images of stable nanocomposites was their clusters quasi-ordering. Stabilizing properties of the laser nanoforcing VNC could be associated with the possibility of producing a nanotube frame in the nanocomposites by electric field of directed laser radiation. This creates conditions for self-assembly of biological tissues. Results of the studies of nanocomposites volumetric properties obtained by laser method point to the possibility of their use as filling material of widely used surgical implants.

*Keywords:* bioengineering, albumin, carbon nanotubes, composite nanomaterial, stability, laser radiation

## ESTIMATION OF MAGNETIC NANOPARTICLES POLYDISPERSITY BY OPTICAL MEASUREMENTS

**Yerin C.V., Golota A.F., Ischenko V.M.**

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Particles size distribution of magnetite nanoparticles from magnetic birefringence and dynamic light scattering are measured. Aggregates of nanoparticles 30–80 nm diameters was found. Estimation of particles size distribution in magnetic colloidal nanosystems from magnetic birefringence data essentially depends on the type of magnetic moments particles and aggregates.

*Keywords:* magnetic nanoparticles, particles sizes distribution, magnetic birefringence, dynamic light scattering, aggregates of nanoparticles.

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## ON THE INFLUENCE OF THE MAGNETIC NANOPARTICLES CONCENTRATION IN MAGNETIC FLUID ON THE ACOUSTOGRANULOMETRIC RESULTS

*Storozhenko A.M., Polunin V.M., Tantsyura A.O., Ryapolov A.N.*

The improved technique of estimation of magnetic fluid nanoparticle sizes is described. The technique is based on the analysis of the field dependence of amplitude of emf induced in the oscillatory circuit by the acoustic wave propagating in the magnetized fluid. It is shown that the field dependence of magnetic susceptibility of the measuring inductance coil can be ignored when analyzing the results of measurements. The estimated values of magnetic nanoparticles linear dimensions in the concentrated sample of MF obtained by the acousto-granulometric method and the method based on the magnetization curve analysis, are compared with each other.

*Key words:* the magnetic fluid, the magnetic field, nanoparticles, the resonance, the oscillatory circuit.

## STUDYING OPERATION OF ELECTRO CHEMICAL CAPACITOR WITH ELECTRODES BASED ON HIGHLY DISPERSED CARBON MATERIAL

*Nikitina L.V., Kolokolova Ye.V.*

One of the promising directions in the development of supercapacitors is the use of distributed heterogeneous structures as electrodes. In this study we investigated the usage of volume-distributed electrodes on the basis of the composite, which is a mixture of ionic and electronic conductors. As an ionic conductor we used proton-conductivity electrolytes and as electronic conductor was a carbon nanomaterial.

*Keywords:* condenser, volume-distributed electrode, high-dispersion electrode, proton-conductivity electrolyte.

## ADSORPTION AND PHOTO-CATALYTIC PROPERTIES OF MODIFIED POTASSIUM POLYTITANATES

*Tretyachenko E.V., Gorokhovskiy A.V., Vikulova M.A., Kovaleva D.S., Mantsurov A.A.*

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Nanosized heterostructured nanopowders based on layered amorphous potassium polytitanate (PPT). It was shown, that the main feature of the nanocomposite materials, obtained by chemical modification of PPT powders in the aqueous solutions of transition metal salts with regulated pH values, was related to unique combination of physico-chemical properties. It was recognized, that the potassium polytitanates modified by transition metal ions had high adsorption ability accompanied with high photocatalytic activity under irradiation in visible range of solar radiation. High photocatalytic properties of the synthesized nanocomposites were considered as a result of obtaining multiple *p-n*-nanojunctions in the contacts of the PPT particles with nanoscale particles of the Me(OH)<sub>2</sub>/MeOOH/MeO system. The influence of the transition metal type on adsorption and photocatalytic properties of the modified PPT's under irradiation with UV and visible light.

*Key words:* layered potassium titanates; chemical modification; photocatalytic properties; oxidation and degradation of organic dyes.

## Ag/Ag<sub>2</sub>S NANOSTRUCTURE FORMATION FOR RESISTIVE MEMORIES ELEMENTS ON THE SiO<sub>2</sub> AND CU/C SURFACES

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*National Research University of Electronic Technology, Zelenograd, Russia*

In order to create resistive memory cells elements on the SiO<sub>2</sub> and Cu/C surfaces, Ag/Ag<sub>2</sub>S structures are possessed of resistive switching properties was formed. It was established that the silver sulfide layer formation can occur at room temperature, depends on the cluster diameter. The optimal sulphidation time for a silver cluster with 12 nm diameter was defined. The correlation between the sample surface and the time of structure Ag/Ag<sub>2</sub>S creating was established.

## INTERACTION OF NERVE CELLS AND CARBON NANOTUBES BASED CONDUCTIVE FILMS INVESTIGATION

*Bobrinetskiy I.I., Nevolin V.K., Romashkin A.V., Seleznev A.S.*

The techniques of forming an interface for electrical connection of the nerve cells and electronic circuits using carbon nanotubes were developed. Correlated optical and topographical studies of nerve cells on the conductive carbon nanotube film were made. We suggested the technique to identify the formation of the electrochemical interface between the cells and carbon nanotubes by atomic force microscopy and Raman spectroscopy.

*Key words:* nanotubes, neuroblastoma, atomic-force microscopy, Raman spectroscopy

## THE PHOTO-TRANSFORMING PHOTOCHROME PROTEIN BACTERIORHODOPSIN DERIVED FROM PHOTOORGANOHETEROTROPHIC HALOBACTERIUM HALOBACTERIUM HALOBIUM

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It is developed the micro-preparative microbiological synthesis of natural photo-transforming photochrome protein bacteriorhodopsin (output 8–10 mg), which is capable to transform light energy to electro-chemical energy of generated protons H<sup>+</sup> and ATF that is important for nano-industry of new modern domestic photo-transforming nanomaterials and molecular bioelectronics. Protein was allocated from cell membranes of photoorganoheterotrophic halobacterium Halobacterium halobium by lysis of cells by distilled water, processing of bacterial biomass by ultrasound, alcohol extraction of low and high-weight molecular impurities, cellular RNA, carotenoids and lipids, with the subsequent solubilization of final product with 0,5% SDS-Na and low-temperature fractionation by methanol. The homogeneity of the synthesized product was proved by combination of preparative and analytical physico-chemical protein methods including electrophoresis in 12,5% PAAG with 0,1% SDS-Na, gel filtration chromatography on Sephadex G-200 and reconstitution of apomembranes with 13-trans retinol.

*Key words:* Halobacterium halobium, bacteriorhodopsin, molecular bioelectronics

## KOLLODIUM SELENIUM FOR PLANT GROWING

**Folmanis G.E, Kovalenko L.V.**

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The most rational method of preparing an aqueous colloidal solution of selenium is its introduction into the aquatic environment by injection under the influence of the laser pulse of high power. The results showed valuable properties of colloidal selenium. Colloidal selenium has a prolonged systemic effect; at concentrations physiologically relevant to plants, has a positive effect on the seeds of agricultural crops and has no significant effect on the culture of fungi pathogens, treatment of ground parts of plants during the growing season colloidal selenium increases the content of all plant parts .

*Key words:* selenium, a colloidal solution, the laser pulse, a positive effect, the plants, the content of selenium.

## PLATINUM NANOPARTICLES ACCUMULATION IN PLANTS OF WHEAT AND PEA AND FEATURES OF THEIR MORPHOLOGICAL CHANGES

**Morgalev YU.N.<sup>1,3</sup>, Astafurova T.P.<sup>1</sup>, Borovikova G.V.<sup>1</sup>, Zotikova A.P.<sup>1,2</sup>, Zaitseva T.A.<sup>1</sup>, Postovalova V.M.<sup>1</sup>, Verkhoturova G.S.<sup>1</sup>, Morgaleva T.G.<sup>1,3</sup>**

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The accumulation and distribution of platinum nanoparticles ( $\Delta_{50} = 5$  nm) in the organs of aquatic and soil cultures of mono- and dicotyledonous plants – wheat and pea were studied. The plants were grown for 10 days in aqueous dispersed system nanoparticles (DS) with a concentration of 10 mg/l and in the soil by the DS watering. It was established that the ten-day aquatic cultures of wheat and pea were accumulated more amounts of nanoparticles of platinum than the soil ones, and roots – considerably more than stem and leaves. In wheat aquatic culture the capacity to accumulate nanoparticles was more expressed than in analogical plants of pea, but the plants of wheat of soil culture, by contrast, accumulated (absorbed) of nanoparticles of platinum with less intensity than soil culture of pea.

The morphological changes in the organs of plants (growth and weight parameters) were dissimilar and did not depend on the concentration of accumulated nanoparticles.

*Keywords:* nanoparticles of platinum, accumulation, Triticum aestivum L., Pisum sativum L., aquatic and soil cultures, morphometry.

## NEW CONSTRUCTION INDENTATION AND SCLEROMETRY PROBE FOR NANOSCAN SPM

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Totally new construction indentation and sclerometry probe is described. Deflected mode physico-mathematical model is considered. Base hypotheses and assumptions are stated. Load factors, angle and linear movement absolute values distribution diagrams are shown. Calculation methods are mentioned. Sample test probe metrological characteristics are defined.