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## CLASSICAL NUCLEATION THEORY AS THE BASIS FOR TECHNOLOGIES OF OBTAINING NANODISPERSE SYSTEMS. ON SOME «UNDERWATER REEFS», WHICH ARE DANGEROUS FOR MODERN NANOTECHNOLOGIES

**G.N. Kovalyov, N.S. Snegiryova, V.Yu. Naumenko**

Classic thermodynamic nucleation theory valid for describing initiation, «maturing» and growth of nanoparticles is considered. It is proposed to use «the first and the second critical points» concept for describing growth of nanoparticles. It is demonstrated that many «new» issues in modern publications are «well forgotten old» ones. Examples of using nucleation theory and nanotechnologies based on it for preparing new pharmaceutical dosage forms are given.

*Keywords:* thermodynamic theory, nucleations, adsorption, sensor structures, chemisorption

## INVESTIGATION OF CU–C COMPOSITES WITH CONTROLLED NANOSTRUCTURE

**Ph.I. Vysikaylo<sup>1</sup>, V.N. Denisov<sup>1</sup>, A.N. Kirichenko<sup>1</sup>, A.V. Ejov<sup>1</sup>, V.S. Mitin<sup>2</sup>,  
A.V. Mitin<sup>2</sup>, N.N. Krasnobaev<sup>2</sup>, L.M. Krukova<sup>2</sup>, E.A. Makalkina<sup>3</sup>**

<sup>1</sup>*Technological Institute of Superhard and Novel Carbon Materials, Moscow, RF*

<sup>2</sup>*A.A. Bochvar All-Russia Research Institute of Inorganic Materials, Moscow, RF*

<sup>3</sup>*National University of Science and Technology «MISIS», Moscow, RF*

Studied Cu–C-composite. Coatings were produced by high ion plasma magnetron sputtering (HIPMS) using a composite mosaic target. It is shown experimentally that the HIPMS method can effectively spraying with the same steady rate of such diverse materials as copper and carbon in predetermined proportions. In this case, is formed by the flow of copper and carbon, is homogeneously mixed with each other at the atomic level. The flow of copper and carbon is deposited on the substrate in the form of two-component composite coating of given composition at the macro level. Studies have shown that at the nanoscale on the substrate is formed nanophases and related nanostructuring of the composite. The phase and elemental composition, microstructure, surface topography, microhardness, friction coefficient and other characteristics of the nanostructured coating shows that the copper and carbon in the process of deposition on a substrate heated to 350 – 450° C, at the nanoscale are not mutually mixed and not chemically interact. On the surface of the substrate coating is formed, consisting of copper and carbon nano-size range of phases. The crystal dispersion coating varies depending on the content of carbon in the composite. The carbon concentration has a significant influence on surface roughness, adhesion and mechanical, electrical and tribological properties. So if they contain 10–15% (at.) carbon is observed decline in the dry-friction coating to 0,1–0,15.

## GAS-MIXES RECOGNITION BASED ON ANALYSIS OF TEMPERATURE DEPENDENCES OF SENSITIVITY NANOSTRUCTURED OF THIN FILMS TIN DIOXIDE TO GASES-REDUCERS

**V.V. Simakov, L.V. Nikitina\*, S.D. Syakina, I.V. Sinev**

*Saratov State University named after N.G. Chernyshevsky*

*\*Saratov State Technical University, Saratov, Russia*

In work present experimental results of research impurity influence of various gases in environment on temperature dependences of thin-film tin dioxide conductivity and recognition possibility of gases-reducers.

*Keywords:* nanostructuring, morphology, texturizing, adsorption

## DEVICES FOR MEASURING NANOPARTICLES IN NANOTECHNOLOGIES

**V.I. Kalechits**

In this article the interrelation of nanotechnologies and cleanroom technologies are resulted, main action principles of devices for nanometer measurement are described, the basic technical parameters of similar devices are presented.

*Keywords:* nanotechnologies, nanoparticles, cleanrooms, condensation nucleus counter, differential mobility analyzer, scanning nanoparticle spectrometer, nanometer aerosol sampler

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## NANOCRYSTALLINE SILICON POWDERS DISPERSITY CONTROL BY X-RAY DIFFRACTION ANALYSIS

**G.V.Fetisov<sup>1</sup>, A.A. Ischenko<sup>2</sup>, V.A.Tafeenko<sup>1</sup> and D.J. Liaw<sup>3</sup>**

<sup>1</sup>Moscow M.V. Lomonosov State University, Department of Chemistry, Moscow, Russia

<sup>2</sup>Moscow M.V. Lomonosov State Academy of Fine Chemical Technology, Moscow, Russia

<sup>3</sup>National Taiwan University of Science and Technology / Chemical Engineering, Taipei

Production of nanocrystalline silicon (nc-Si) and effective practical application of its unique electro-optical properties requires careful particle size control, which gives the particle size density distribution function (PDDF). Typically, all available methods for determining powders PDDF required special sample preparations procedure, that affect on the measurement result. In the present study of nc-Si dispersion without manipulation test and determine PDDF used X-ray diffractometry nc-Si and a method of modeling the full diffraction profile (WPPM). Physical mechanisms of X-ray scattering by crystals were taken into account and implemented in a computer program PM2K. With this method, three nc-Si samples with different dispersion, synthesized by plasmachemical technique were studied. These PDDF are consistent with nc-Si size histograms, built on HRTEM micrographs, and adequately describes the powders dispersion.

*Keywords:* nanocrystals, dispersivity, diffractometry, plasma chemistry

## METHOD OF CONCENTRATION OF NANODIAMON HYDROSOLS WITH THE HELP OF TUBULAR FLUOROPLASTIC MEMBRANE FILTERS

**D.Yu. Glazev<sup>1</sup>, V.A. Kunichan<sup>1</sup>, I.S. Larionova<sup>2</sup>, L.I. Poleva<sup>2</sup>, N.M. Kutakova<sup>2</sup>**

<sup>1</sup>Polzunov's Technological Institute, Biysk

<sup>2</sup>Federal State Unitary Enterprise Federal Research & Production Center ALTAI, Biysk

Technological features and the regularity of the concentration process of diamond sols using two kinds of filters: tubular fluoroplastic, and fluoroplastic with an insert turbulizing flow have been studied. The comparative analysis of the received results has been performed and the choice of efficient regimes of ultrafiltration concentration of nano size diamond sols has been validated.

*Keywords:* diamond sols, ultra filtration, fluoroplastic polymer

## INFLUENCE OF THE NANODIAMOND CONCENTRATION IN HYDROSOL ON THE OPTICAL LIMITING OF LASER POWER

**T.N. Mogileva, A.P. Puzyr<sup>\*</sup>, V.V. Vanyukov,  
G.M. Mikheev, K.V. Purtov<sup>\*</sup>, V.S. Bondar<sup>\*</sup>**

*Institute of Applied Mechanics, Ural Branch, Russian Academy of Sciences, Izhevsk, Russia*

*\*Institute of Biophysics, Siberian Branch, Russian Academy of Sciences, Krasnoyarsk, Russia*

The influence of the nanodiamond (ND) concentration in hydrosols on the optical limiting (OL) of laser power has been experimentally studied. Concentration of nanoparticles has been varied from 0.01 wt% to 3 wt%. The OL in the hydrosols has been studied using the modernized z-scanning scheme, which allows simultaneous measuring of the energy of incident, transmitted and 90<sup>0</sup>-scattered pulses by scanning optical cell with a suspension along the focused beam of laser. The measurements have been performed using YAG:Nd<sup>3+</sup> - laser at a wavelength of 1064 nm and a pulse duration of 17 ns. The results indicate that the OL in the ND hydrosol of all the studied concentrations is due to the nonlinear light scattering. It has been found that under a specified geometry of the experimental set-up and fixed input energy of laser pulses, there is the optimal nanoparticles concentration for which the efficiency of the OL is at maximum. This optimal concentration has been determined.

## HYDROLYSIS OF ALUMINUM NITRIDE COMPOSITE NANOPOWDERS

***E.A. Glazkova, O.V. Bakina, V.V. Domashenko,  
A.S. Lozhkomoev, N.V. Svarovskaya, M.I. Lerner***

*Institute of Strength Physics and Material Science, Tomsk, Russia*

Hydrolysis of nanopowders of aluminonitride compound Al/AlN was studied by method of continuous registration of pH changes. It was established that the AlN content in the compound affects the basic macrokinetic reaction parameters. The reaction between Al nanopowder and water proceeds with long induction period in one stage. Increase in AlN content in the composition causes reduction of induction period. However when the AlN content is more than 60%, the hydrolysis of Al/AlN proceeds without induction period in two macrokinetic stages.

*Keywords:* aluminum nitrides, macrokinetics, hydrolysis, induction period

## APPLICATION OF NANOCRYSTALLINE BOEHMITE IN TECHNOLOGY OF SUBSTRATES OF MICROCIRCUITS

***Yu.A. Masalov, A.V. Fedotov, A.V. Dunaev, N.I. Bityutski, I.A. Kurganski***

Results of work on creation of Nanotsentra of the GNU GOSNITI are resulted. The Nanotsentra is equipped by the modern equipment allowing to carry out researches nanomaterials and to develop nanotechnologies at modern level both for institute divisions, and for the foreign organisations. On an example of research of powders nanocrystalline oxide and hydroxide aluminium possibilities of Nanotsentra are shown.

## CRITERION OF ECOLOGICAL SAFETY OF MANUFACTURE AND USE NANODISPERSE SUBSTANCES.

***I.V. Melikhov, V.N. Rudin***

*Moscow State University, Chemical Department, Moscow, Russia*

In work the criterion of safety of manufacture and use of nanodisperse substances is offered. The mathematical model considering intensity of technological emissions nanoparticles, probability of their separation by clearing devices, moving of the thrown out particles to environment and their interactions with biosystems is offered. The given model is focused on working out of techniques of complex definition of quantitative characteristics of the listed processes for the purpose of the forecast of maximum permissible emissions.

*Keywords:* safety criteria, biosystems, technological emission, nanodisperse substances

## STRATEGY OF GENOTOXICITY STUDYING OF NANOMATERIALS

***L.P. Sycheva, V.S. Zhurkov***

*Research Institute of Human ecology and environmental health named by A.N.Sysin of RAMS,  
Moscow, Russian Federation*

International strategy of studying of nanomaterials is presented in «Preliminary Review of OECD Test Guidelines for their Applicability to Manufactured Nanomaterials» and Russian – in guideline «Toxicological-hygienic assessment of nanomaterials safety». This strategies are commented in some aspects and problem of testing of nanomaterials mutagenic activity are discussed.

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## THE ANALYSIS OF NANOPRODUCT SAFETY FOR HEALTH OF THE PERSON FROM ECOTOXICOLOGY POSITIONS: PROBLEMS AND PROSPECTS

**Yu.N. Morgalev<sup>1,2</sup>, N.S. Hoch<sup>2</sup>, T.G. Morgaleva<sup>1</sup>**

<sup>1</sup>*Tomsk State University*

<sup>2</sup>*Siberian State Medical University, Tomsk, Russia*

Were investigated the sensitivity of 33 types of test organisms major systematic groups (soil bacteria, fungi, plants, animals) for binary nanoparticles in a wide range of concentrations and sizes. Identified potential damage to aquatic communities and communities of agricultural purpose, changes in the quality of plant foods and products of fish farming and animal husbandry. It is shown that the noncritical use of Toxicology molecular solutions can distort the results of the assessment of toxicity due to spontaneous modification test-systems during bioassay techniques. The principle of the repeated breeding to safety level does not apply to assessment of the ecotoxicological studies. Assessment of environmental safety requires an examination of the test reactions together test organisms from different systematic groups depending on potential risk area of placement, use and utilization of nanoproducts.

*Keywords:* test organisms, binary particles, biocenoses, toxicology, ecological safety

## DEVICES ON THE BASIS OF SURFACE-IONIZATION NANORETICULATED MATERIALS FOR DETECTING TOXIC SUBSTANCES

**A.S. Sigov, V.I. Kapustin, K.O. Nagornov**

*Moscow state technical university of radioengineering, electronics and automation, 119454, Moscow, Vernadsky ave., 78.*

The breadboard models of the devices for detecting explosive, narcotic and poison gases on a basis of micro doped, nano-reticulated molybdenum alloys and oxide bronze of alkaline metals are developed. The developed devices can be used in areas of examination technics, analytical chemistry, and at environment ecological monitoring.

*Keywords:* nanostructuring, micro doped alloys, surveillance technique, detecting

## USE OF THE SPECIFICALLY INDUCED LUX-BIOSENSORS FOR DETERMINATION OF TOXICAL EFFECT OF NANOPARTICLES

**G.B. Zavilgelsky, V.Yu. Kotova, I.V. Manukhov**

*State Institute of Genetics and Selection of Industrial Microorganisms (GOSNIIGENETIKA), 1st Dorozhnii pr. 1, Moscow 117545, Russia, e-mail: zavilgel@genetika.ru; manukhov@genetika.ru.*

The specifically induced lux-biosensors were used to investigate the mechanism of the bactericidal effect of nanoparticles. It was shown that UV-light ( $\lambda$  360 – 390 nm) treatment of nanoparticles with biosensor cells induces the H<sub>2</sub>O<sub>2</sub> formation in bacteria, which, in turn, triggers the oxidative stress. The oxidative stress is detected by the Escherichia coli MG1655 (pKatG-lux) biosensor. The adsorption of nanoparticles on bacterial cells is necessary for the induction of oxidative stress.

*Keywords:* bactericidal impact, lux-biosensors, adsorption of nanoparticles

## THE USE OF AMPEROMETRIC DNA-SENSOR FOR TOXICITY ESTIMATION AND DETERMINATION OF NANOCONCENTRATIONS OF HEAVY METALS

**S.S. Babkina, N.A. Ulakhovich**

An amperometric DNA-sensor was developed for a toxicity estimation and determination of nanoconcentrations of heavy metals. Immobilized DNA molecules interaction with heavy metals was studied for the development and optimizing of bio-affinity methods based on DNA-sensor. High affinity of the heavy metals to DNA of the sensor was established and matrix components influence was estimated. This allows use of amperometric DNA-sensor for heavy metals assay in river, drinking water, milk and human blood serum and for estimation of their possible genotoxicity. The results of analysis were compared with the one of reference methods. Heavy metal ions can be determined with the DNA-sensor in real samples at the level of maximum permissible concentration and even lower. The lower limit of detectible concentrations was found to be from  $10^{-8}$  to  $10^{-11}$  M.

**INFLUENCE OF CARBON NANOMATERIAL –  
A PERSPECTIVE VECTOR OF MEDICAL PREPARATION  
ON FUNCTION OF REPRODUCTIVE SYSTEM OF MALE MICE**

***A.A. Gusev, I.A. Polyakova, A.G. Tkachev, A.V. Emel'yanov,  
O.N. Zayceva, A.V. Fedorov, T.V. Vasilyeva***

*Tambov State University named by G.R. Derzhavin, Tambov, Russia*

*Tambov State Technical University, Tambov, Russia*

*Moscow State University named by M.V. Lomonosov, Moscow, Russia*

Studied the influence industrial produced carbon nanomaterial (multiwalled carbon nanotubes) on reproductive activity of male mice. It is shown that perorally introduced colloidal water solution of nanomaterial in average daily dosage 150 mg/kg and 30 mg/kg causes spermatotoxic effect.

*Keywords:* carbon nanostructured material, reproductive activity, sperm toxic effect