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## A B S T R A C T S

*A.Yu. BASHARIN, I.Yu. LYSENKO, B.V. SPITSYN*

**SUPERRCOOLED LIQUID CARBON TRANSITION INTO METASTABLE SOLID CARBON: EXPERIMENT, THERMODYNAMICS AND MECHANISMS, APPLICATION FOR DIAMOND OBTAINING**

The review of the works related to problem of the diamond obtaining from the supercooled liquid carbon at the pressure close to graphite-liquid-vapor triple point is presented. The thermodynamics and kinetics of such transformation and critical estimation of determination of carbon triple point parameters and results of diamond identification in the substance of pulse-laser remelted graphite were considered. The new results on identification of diamond and nano diamond in the substance of remelted disperse graphite covered on natural diamond substrate are given. These results can be the base of future technologies of liquid-phase laser welding of diamond.

**Key words:** metastable states, the supercooled liquid carbon, diamond, nano diamond, carbon phase diagram

*D.M. SEDLOVETS, A.N. REDKIN, V.I. KOREPANOV, G.V. BONDARENKO*

**GAS-PHASE PRECIPITATION OF THIN CARBON FILMS FROM ETHANOL-WATER VAPOR**

A simple, low-cost and safe method for obtaining the thin carbon films was described. Deposition of graphene films on dielectrics, excluding the process of transfer from a metal surface, is of special interest. The aim of the paper is to examine the role of water addition on the process of carbon precipitation from ethanol vapor as well as on the properties of obtained films. The electrical and optical properties of materials were studied. Raman spectra were obtained. On the base of presented results the films can be recommended for testing as transistors and sensors.

**Key words:** carbon, thin films, vapor deposition, ethanol-water mixture

*I.A. BUBNENKOV, Yu.I. KOSHELEV, O.Yu. SOROKIN, T.V. OREKHOV, N.I. POLUSHIN, N.N. STEPAREVA*

**STUDIES OF INTERRACTION OF SILICON MELT AND CARBON MATERIALS**

In this paper experimental results on the reaction between silicon melt and heat-treated carbon materials are presented. Deconvolution of the x-ray diffraction line profile (002) into its structural components of carbon materials was experimentally proved to be indispensable. The reaction between silicon melt and carbon materials was found to be strongly dependent on the ratio of the structural components in carbon materials.

**Key words:** carbon, structural components, siliconizing, graphitization degree, reactivity

*N.S. BRIGADNOVA, G.F. POTAPOVA, R.I. DAVYDOV, E.V. KASATKIN, A.V. MANTUZOV, E.V. KUZNETSOV*

**MODIFIED CARBON-GRAPHITE FIBER MATERIALS FOR ELECTROSYNTHESIS OF HYDROGEN PEROXIDE**

The surface modification of carbon graphite fiber materials (UGVM) is the most important area of regulation of their properties and obtaining electro catalysts with new functional parameters. At modification of the UGVM surface with the liquid phase oxidation the composition, amount of oxygen-containing surface functional groups on the surface UGVM are changed. As the result, the UGVM catalytic parameters are changed that allows to control with the electro synthesis process of hydrogen peroxide.

**Key words:** carbon graphite fiber materials, hydrogen peroxide, electro synthesis, surface modification, oxygen-containing surface functional groups

*A.G. KOLMAKOV, P.A. VITYAZ, M.L. KHEIYFETS, V.T. SENYUT*

**ANALYSIS OF SCHUNGITE MINERALS ON MICRO-AND MESOSTRUCTURAL LEVELS AFTER TREATMENT AT CONDITIONS OF HIGH PRESSURES AND TEMPERATURES**

The samples of schungite rock with the content of carbon of 96–98 % were studied after high pressure and high temperature treatment in a high pressure apparatus in a range of 1.0–3.5 GPa at temperature more than 1000°C. The high-temperature annealing was shown to influence actively on a structure of schungite carbon: merging of globules with formation of larger ones, increase in the sizes of crystallites of schungite carbon and partial destruction of globules and its graphitization were observed. The decrease in an index of the structural order of a fracture surface of schungite after annealing and high pressure and high temperature treatment was established by the multifractal analysis method.

**Key words:** schungite carbon, high pressures and temperatures, modifying, annealing, multifractal parameterization

**A.A. KHOMICH, V.G. RALCHENKO, A.V. KHOMICH, I.I. VLASOV, R.A. KHMELNITSKIY, A.E. KARKIN**  
**FORMATION OF NEW COLOR CENTERS IN CHEMICAL VAPOR DEPOSITED DIAMONDS**

The effect of isochronal vacuum annealing at temperatures up to 1680°C on the process of defect transformations after fast neutron irradiation or implantation with hydrogen isotopes ions (ion energy is 350 keV, dose is  $2 \div 12 \cdot 10^{16} \text{ cm}^{-2}$ ) of CVD diamonds was studied. It was found that the grain boundaries in polycrystalline diamond did not significantly influence on the processes of radiation defect annealing and graphitization. In the photoluminescence spectra the new bands with maxima at 580 nm, 730 nm, and a number of bands in the range of 760-795 nm were observed and investigated. The inhomogeneous distribution of color centers along the surface of the implanted layer was shown to connect with the lateral diffusion of hydrogen (deuterium) in the area of radiation damage.

**Key words:** diamond, photoluminescence, color centers, ion implantation, neutron irradiation, annealing

**V.S. URBANOVICH, D.V. KUIS, G.P. OKATOVA, N.A. SVIDUNOVICH, V.M. OIYCHENKO, L.V. BARAN**  
**EFFECT OF CONDITIONS OF THERMOBARIC TREATMENT OF NANOCARBON UNDER HIGH PRESSURE ON FORMATION AND FINE STRUCTURE OF SUPERHARD PHASE**

The highly hard carbon amorphous-nanocrystalline C-10%Fe composite with the dispersity of nano crystallites from 2.5 to 14.5 nm in amorphous matrix, with micro hardness of inclusions of superhard phase up to 107 GPa, phase "basis" up to 21.6 GPa and density of 2.14-2.18/cm<sup>3</sup> was obtained by the method of thermo baric treatment of fullerene soot after exhaustive extraction fullerenes from it with addition of 10 % of iron under high pressure.

**Key words:** nano carbon, fullerenes, thermo baric treatment, nano composite, micro hardness, X-ray diffraction pattern, super hard phase, globular structure, nano-crystallites, glass-like carbon

**R.Kh. BAGRAMOV, G.A. DUBITSKIY, N.R. SEREBRYANAYA, I.V. PAKHOMOV, E.V. POLYAKOV,**  
**K.S. KRAVCHUK, V.D. BLANK**

**ONION LIKE STRUCTURES PRODUCED FROM FULLERITES C<sub>60</sub>, C<sub>70</sub> AND NANODIAMONDS**

A two-step production method for compact onion-like carbon was proposed: 1) starting materials are produced by the high isostatic pressure treatment of the C<sub>60</sub>, C<sub>70</sub> fullerites or by the vacuum thermal treatment of the nanodiamonds; 2) treatment of the starting materials in the high-pressure devices. The structure and mechanical properties of the compact samples were investigated. The onion-like structure of the samples was found to retain up to 15 GPa and 1400°C.

**Key words:** fullerite, nano carbon, onion-like structure, high pressures and temperatures, elastic recovery

**L.V. KASHKINA, O.P. STEBELEVA, E.A. PETRAKOVSKAYA, O.A. BAYUKOV**  
**INFLUENCE OF HYDRODYNAMIC CAVITATION ON STRUCTURE AND PROPERTIES OF SOOT PARTICLES**

In given article the results of studies on micro and macro level of the structure and properties are presented for cavitation activated carbon-containing material (CACM). Materials were obtained at hydrodynamic dispersing of wood soot due to high energetic cavitation effects appearing in water. The hydrodynamic generator of rotor type (super cavitation mixer) was used. It was experimentally proved that the CACM can operate as a nano modifier not less efficiently than fullerenes in cement and concrete.

**Key words:** hydrodynamic cavitation, fullerenes, soots, nano modifiers

**N.N. TROFIMOVA, I.A. PORODZINSKIY, E.G. CHEBLAKOVA, V.M. SAMOIYLOV**  
**QUANTITATIVE X-RAY ANALYSIS OF SILICON CARBIDE CERAMICS**

X-ray diffraction (XRD) study of silicon carbide ceramics samples produced by RBSC technology was carried out. To assess the correctness of the determination of SiC and Si in the materials measurements on samples with the pre-specified composition were carried out. XRD results were compared with those obtained via chemical analysis. SiC content in test samples was changed in the range of 75–85 % and Si - 15–25 %. Test samples density ranged from 2.6 to 3.0 g/cm<sup>3</sup>.

**Key words:** X-ray analysis, Rietveld method, ceramics, silicon carbide, SiC, ceramics

**A.N. SEMENOV, B.A. KULNITSKIY, I.A. PEREZHOGIN, L.A. IVANOV, Yu.S. BURANOVA, V.D. BLANK**  
**STUDY OF TWISTED PRISMATIC CARBON-BORON NITRIDE NANOTUBES GROWN IN HIGH ISOSTATIC PRESSURE APPARATUS**

Nano tubes and nano fibers composing from boron, nitrogen and carbon were obtained in high isostatic pressure apparatus. Transmission and scanning electron microscopy studies along with the electron energy loss spectroscopy and characteristic X-ray analysis have shown the presence of aluminum oxide filling in the nano tubes. Nano tubes with diameter from 50 to 500 nm and with length of tens of microns turned out to be faceted, twisted and sometimes deformed. It is shown that the nano tubes with the filling are less undergone to the twisting comparing to those without.

**Key words:** nanotube, carbon, boron nitride

*A.V. NOZHKINA, V.I. KOSTIKOV, Yu.A. KLYUEV, A.M. NALETOV, V.B. DUDAKOV*  
**STRUCTURAL TRANSFORMATIONS IN DIAMONDS UNDER THERMAL ACTION**

This paper presents experimental data on the transformation of intrinsic and extrinsic defects at the thermal action on the diamond crystals, and phase transformation of diamond to non-diamond carbon on the surface of single crystals of natural, synthetic diamonds and nano diamonds in the presence of oxygen.

**Key words:** defects, thermal action, diamond, carbon, phase transformation

*R.M. NIKONOVA, M.A. MERZLYAKOVA, V.V. MUKHGALIN, V.V. AKSENOVA, V.I. LADYANOV*  
**THERMAL STABILITY OF C<sub>60</sub> FULLERITES**

The results of studies of structural changes in fullerites during thermal (up to 1050°C) are presented. The temperature range of destruction of C<sub>60</sub> was determined as 975°C. The thermal degradation of C<sub>60</sub> was shown to be irreversible due to the destruction of the fullerene molecules.

**Key words:** fullerite, fullerene, temperature, stability, degradation

*Yu.M. NIKOLENKO, A.M. ZIATDINOV*  
**INVESTIGATION OF CHEMICAL BONDS AND STRUCTURE OF OXYGEN- AND OXYGEN-FLUORINE-CONTAINING COMPOUNDS OF GRAPHITE BY X-RAY PHOTOELECTRON SPECTROSCOPY**

Chemical bonds and structure of oxygen- and oxygen-fluorine-containing compounds of graphite were investigated by X-ray photoelectron spectroscopy. The excess of the upper limit of carbon lattice oxidation (followed by a change in the type of chemical bonds between the matrix and intercalates) was found to occur on the step of hydrolysis of compounds. The inhomogeneous electronic structure of the initial carbon matrix (or its fragments) was shown to be a necessary condition for the formation of bonds between carbon and fluorine so-called «semi-ionic» type and extended layered carbon structure is not necessary for the formation of such bonds.

**Key words:** graphite, graphite intercalation compounds, chemical bonds, structure, oxygen, fluorine, X-ray photoelectron spectroscopy

*A.F. ILYUSHCHENKO, G.V. SMIRNOV, A.A. KOMORNIY, I.V. PETROV, A.P. KORZHENEVSKIY, O.A. DZICHKOVSKIY*  
**SHOCK-WAVE SYNTHESSES AND CONSOLIDATION OF ULTRA DISPERSED DIAMONDS**

In given article the questions of the shock-wave syntheses and consolidation of the ultradispersed diamonds are discussed. Diamond powders are obtained with grains from 5 up to 100 nm using as the raw materials for syntheses the composite high explosives on the base of the trotyl and cyclonite. The experimental results on the hot shock-wave consolidation of ultra and nano dispersed powder diamonds are presented.

**Key words:** nano scale powders, diamonds, detonation, syntheses, consolidation, explosives

*G.A. SOKOLINA, S.A. DENISOV*  
**ELECTROCONDUCTIVITY AND PERMITTIVITY OF NANODIAMOND-ADSORBED WATER SYSTEM NEAR PERCOLATION THRESHOLD**

The effects of water adsorption on the conductivity (G) and the dielectric constant ( $\epsilon$ ) of detonation nano diamond powders were studied. The relationship between water quantity and electrical parameters of the system nano diamond-adsorbed water is analyzed in the framework of percolation theory. The  $\epsilon$  values for wet powders exceed  $\epsilon$  for dry samples by  $10^4$ – $10^5$  times (the giant dielectric polarization phenomenon). It was shown that the chemical modification of diamond surface causes the change in percolation threshold.

**Key words:** nano diamond, water adsorption, electrical conductivity, giant dielectric permittivity, heterogeneous system

*I.V. EKHMENINA, E.P. SHESHIN*  
**RESEARCH OF CHARACTERISTICS OF FIELD EMISSION LAMPS WITH CATHODES FROM NANOSTRUCTURED CARBON MATERIALS**

In this paper the main characteristics of field emission sources of radiation, such as the spectral composition, light efficiency, operating anode voltage and current were studied.

**Key words:** field emission, cathodophosphor, radiation, efficiency, lamp

*I.A. MANSUROVA, O.Yu. KOPALINA, S.V. FOMIN, G.A. KHLEBOV, V.E. VAGANOV, T.P. DYACHKOVA-MASHKOVA*  
**INFLUENCE OF STRUCTURE AND CHEMISTRY OF SURFACE OF CARBON NANOSTRUCTURES ON PROPERTIES OF ELASTOMERIC COMPOSITIONS ON BASE OF BUTADIENE-NITRILE RUBBER**

The influence of a structure and chemistry of surface of carbon nano tubes and nano fibers on the properties of filled rubber mixtures and vulcanizates on the basis BNKS-28 was investigated. It was established that modification of low active carbon black CB 803S with the carbon nano tubes favors the increase in interfacial interactions of rubber - filler

and modification with the nano fibers, on the contrary, the increases in level of interaction in the structure of the filler . Than specific surface is more than interaction level is higher.

**Key words:** elastomeric compositions, filler, nano tubes, nano fibers

***T.P. DYACHKOVA, S.V. MISHCHENKO, A.G. TKACHEV, S.Yu. GORSKIY, A.V. MELEZHYK, I.V. ANOSOVA***  
**STUDY OF REGULARITIES OF PROCESSES OF FUNCTIONALIZATION AND MODIFICATION OF CARBON NANOTUBES**

The regularities of the liquid-phase and gas-phase oxidation of multi-layer carbon nano tubes with different morphologies of graphene layers were studied. Original and oxidized carbon nano tubes were modified with polyaniline. The effect of the method and degree of pre-functionalization of the carboxyl groups on the efficiency of oxidative polymerization of aniline in the modification of carbon nano tubes was shown.

**Key words:** carbon nano tubes, functionalization, modification, polyaniline

***A.A. ARTYUKH, V.A. DEMIN, L.A. CHERNOZATONSKIY***  
**STRUCTURE AND STABILITY OF STRUCTURE FROM CARBON NANOTUBE AND FULLERENE C<sub>60</sub>**

A new class of compounds based on single-layer carbon nanotubes and fullerenes, so-called "corn" consisting of nano tubes coated with close-packed fullerenes C<sub>60</sub> was proposed. Calculations proving the stability of considered materials were carried out. Their electronic properties were investigated.

**Key words:** fullerene, carbon nano tube, composite

***N.Yu. BEYLINA***  
**PHYSICOCHEMICAL ASPECTS OF DEVELOPING COMPOSITE FILLERS POSSESSING NEW PROPERTIES FOR STRUCTURAL AND FUNCTIONAL CARBON-BASED MATERIALS**

Regularities of properties formation of composition fillers for manufacturing of structural graphites, electrodes, anodes and cathodes were established. In the present study common trends of these composite carbon fillers properties' formation were established. Technical requirements for filler cokes, special quality tar pitches used for producing carbon composite materials, as well as methods for their production were developed.

**Key words:** coke, tar pitch, structure, structural graphite, composite materials, wetting, adsorption, adhesion

***E.I. ANDREIYKOV, Yu.A. DIKOVINKINA, O.V. KRASNIKOVA, M.A. DOLBILOV***  
**LIGNIN-BASED MODIFICATION OF COAL TAR PITCH**

The characteristics of coal tar pitches modified by heat treatment with lignin were studied. Quinoline soluble substances are dominant products of lignin thermal degradation in coal tar pitch medium. Modification increases in the coke yield from pitches and has an effect on structure of cokes.

**Key words:** coal tar pitch, hydrolytic lignin, modification, heat treatment

***E.E. PETYUSHYK., T.E. EVTUKHOVA, D.I. KLEVCHENYA, V.E. ROMANENKOV, N.A. AFANASIEVA, T.I. PINCHUK***  
**COMPOSITE PERMEABLE MATERIAL BASED ON CARBON FIBER**

The results of studying the structure and properties of permeable material obtained by hydration hardening of industrial dispersed aluminum with carbon fiber 'Busofit' as an inert filler were presented. In the process of hardening the surface of carbon fiber was established to modify providing the formation of a mechanically strong material with hierarchical porous structure including micro-, meso- and ultra macro pores.

**Key words:** volume permeable adsorbent, carbon fibre material, aluminum powder, hydration hardening, SEM, low-temperature nitrogen adsorption, mechanic hardness, RFA

***N.I. POLUSHIN, A.V. ELYUTIN, M.N. SOROKIN, A.I. LAPTEV, A.A. ERMOLAEV***  
**SYNTHESIS OF DIAMOND POWDERS FROM NATURAL CARBON-CONTAINING MATERIALS**

Natural carbon materials, natural graphite and thermoantratsite subjected to heat treatment in vacuum at various temperatures were used for synthesis of diamond powders. Synthesis was carried out at static pressure and the temperatures corresponding to thermodynamic area of diamond stability. As the catalyst the nickel alloy with manganese was used. For synthesis of diamond micro powders was established to possibly apply the natural graphites which preliminary thermo treated at temperature not below 900°C. The use for diamond synthesis of thermoanthracite is impossible.

**Key words:** synthesis, pressure, temperature, catalyst, diamond powders, natural graphite, thermoanthracite

***S.Yu. PETRUNIN, V.E. VAGANOV, L.V. ZAKREVSAYA, B.G. KIM***  
**COMPRESSIVE STRENGTH AND MICROSTRUCTURE OF CEMENT COMPOSITE WITH CARBOXYLATED CARBON NANOTUBES ADDITIVE**

The paper deals with the research of chemically functionalized carbon nanotubes (CNT) additives influence on strength characteristics and structuring processes of cement composite. Functionalization degree of CNT depending on

operation conditions of the process was investigated. According to scanning electron microscopy and X-ray phase analysis of concrete with CNT's additive the structure change in cement stone which can explain its strength characteristics enhancement was established.

**Key words:** carbon nano tubes, cement composite, fictionalization, compressive strength, structure formation

*M.V. MEDVEDEVA, S.L. ZABUDKOV, A.S. KOLCHENKO, A.I. FINAENOV*

#### **ELECTRO-CHEMICAL OBTAINING THERMO-EXPANDED GRAPHITES WITH HIGHER SPECIFIC SURFACE**

The possibility of obtaining thermo-expanded compounds by means of anode intercalation in sulphuric and nitric acids was shown. This compound possessed ability to form the carbon foam structure with the specific surface up to 150÷200 m<sup>2</sup>/g at fast heating.

**Key words:** thermo-expanded graphite, anodic intercalation, over oxidation, specific surface, apparent density, thermo treatment, micro wave irradiation

*S.L. ZABUD'KOV, M.V. MEDVEDEVA, A.A. MOKROUSOV, A.I. FINAENOV*

#### **ELECTRO CHEMICAL SYNTHESIS OF THERMOEXPENDED GRAPHITE COMPOUNDS IN USED SOLUTIONS OF NITRIC ACID FOR ETCHING**

The application possibility of used nitric acid solution of etching instead of pure nitric acid was experimentally based for anode obtaining of thermo expanded compounds of graphite with high degree of foaming.

**Key words:** thermoexpanded graphite compounds, thermoexpanded graphite, graphite intercalated compounds, anode intercalation

*A. V. ZAIYKOVSKIY, A.O. ZAMCHIY, O.A. NERUSHEV, S.A. NOVOPASHIN, S.Z. SAKHAPOV, D.V. SMOVZH*  
**ARC DISCHARGE METHANE CONVERSION**

Kinetics of methane decomposition in the arc AC reactor was studied experimentally. The pressure in reactor and mass flow rate of gas was shown to be the determining parameters of the process. The method of methane conversion to nanocrystalline carbon with the typical size of particles of 20–50 nm was implemented. The efficiency of this method is up to 80 %. Conversion of hydrocarbons was studied using the mixtures, which model the composition of associated petroleum gas. It was shown that admixtures of N<sub>2</sub>, CO<sub>2</sub>, C<sub>3</sub>H<sub>8</sub>, C<sub>4</sub>H<sub>10</sub> weakly effect methane conversion to the mixtures and synthesis products.

**Key words:** hydrocarbons thermal conversion, arc discharge, carbon nanostructures

*R.D. DZHATIEVA, T.N. BELYAEVA, A.G. TKACHEV*

#### **POLYMER COMPOSITIONS CONTAINING CARBON NANO STRUCTURAL MATERIAL**

The results of research of polymer compositions containing the carbon nano structural material (CNM) "Taunit" as filler are given. Dependences of their electric properties on the filler content are presented. Compositions were investigated by thermal methods of the analysis.

**Key words:** carbon nano structural material, polymer compositions, specific volume electrical resistance, dielectric permeability

*A.L. MASLOV, N.I. POLUSHIN, V.V. ZHURAVLEV, N.N. STEPAREVA, N.Yu. TABACHKOVA*  
**COMPOSITE MATERIALS HARDENED WITH NANO DIAMONDS ON EXAMPLE  
OF GALVANIC LIGAMENT OF DIAMOND TOOL**

In the article is shown the study of the influence on the microhardness of the galvanic coating, and also shown test results of galvanic tool without nanodiamond and galvanic tool with nanodiamond.

**Key words:** galvanic coatings, nano diamonds, wear resistance, dispersion strengthening