

Summaries

UDC 546.56-121:544.778.4:544.016.2:543.573

Korshunov A.V., Ilyin A.P.
FEATURES OF COPPER NANOPOWDERS OXIDATION AT HEATING IN THE AIR

Features of oxidation process of copper nanopowders produced by the method of wires electric explosion at heating in the air in the conditions of linearly changing temperature and in isothermal mode have been studied. The dependence of phase composition of powder oxidation products on heating mode and characteristics of the original samples was shown. The influence of features of powder dispersivity and degree of their oxidation on temperature values of the beginning of oxidation, value of process temperature interval, values of its maximal rate was examined. The influence of powder disperse composition on staging of their oxidation process was shown.

UDC 541.16.182

Amelkovich Yu.A., Ilyin A.P.
OBTAINING NITRIDE-CONTAINING CERAMIC COMBUSTION PRODUCTS OF ALUMINUM NANOPOWDER MIXTURES WITH TITANIUM AND ZIRCONIUM DIOXIDES IN THE AIR

Combustion products of mixtures of aluminum nanopowder with titanium and zirconium dioxides in the air have been studied. It was shown that at combustion of these mixtures in the air the crystal phases TiN and ZrN were stabilized. In this case maximal content of TiN (29,4 %) in combustion products of the original mixture containing 52 % of aluminum nanopowder was achieved; at the same time maximal yield of ZrN (28,6 %) was observed for the original mixture containing 35 % of aluminum nanopowder.

UDC 541.16.182

Ilyin A.P., Tolbanova L.O., Mostovschikov A.V.
COMPOSITION OF INTERMEDIATE COMBUSTION PRODUCTS OF ALUMINUM NANOPOWDER

It is known that at combustion of aluminum nanopowder in the air the end products contain more than 50 wt. % of aluminum nitride. The intermediate products of combustion in the air of aluminum nanopowder and its mixtures with chromium powders, nanopowders of Mo and W were studied in the paper. Interruption of combustion at maximal temperature achievement showed that in intermediate combustion products the yield of aluminum nitride (ratio AlN:Al₂O₃) is almost the same with the ratio – 3,2:1,0 in the end products. The studied admixtures increase the ratio AlN:Al₂O₃ in intermediate products up to 5,0:1,0 (9,1 wt. % Cr), 5,5:1,0 (28,6 wt. % Mo), 4,3:1,0 (9,1 wt. % W). The increase of yield of chemically bound air nitrogen is explained, obviously, by catalytic effect of admixture of d-elements of chromium subgroup.

UDC 537:54-11:538.931

Mokrousov G.M., Zarubina O.N.
FORMATION OF SURFACE AND NEAR-SURFACE LAYERS AT SEMICONDUCTORS OF THE TYPE A^mBⁿ

Possible mechanism of formation, composition and structure of surface phase and near-surface damage crystal layers of semiconductor compounds depending on electrode potential value and water system pH has been examined by the example of gallium arsenide. Taking into account the deviation degree from stoichiometric composition (homogeneity region) of a compound and diffusive representations the thickness of near-surface layer was estimated for the first time in connection with conditions of chemical treatment the material.

UDC 66.012

Baydaly S.A., Dyadik V.F., Liventsov S.N.
STUDYING THE MATHEMATICAL MODEL OF CATCHING DEVICE IN DUST SUSPENSION FOR CONTROL ALGORITHM SYNTHESIS

Mathematical model of catching device of valued components of «end» process gases of uranium hexafluoride production has been developed. Mean parameters of technological catching process were detected. The structure of the device control system was suggested.

UDC 621.039.342.001.53,541.128.5

Skorynin G.M., Orlov A.A., Senchenko V.V.
STUDYING THE POSSIBILITY OF CARRYING OUT ISOTOPE EXCHANGE IN CARBON DIOXIDE IN GAS CENTRIFUGE CASCADES

Application of isotope exchange reactions obtaining highly enriched carbon isotopes in gas centrifuge cascades operating on carbon dioxide has been studied and pilot reactor of isotope exchange with nickel catalyst has been tested. The possibility in principle of applying the reactions and isotope exchange reactor for obtaining highly enriched carbon isotopes in gas centrifuge cascade was showed.

UDC 614.876

Brus I.D.
KINETICS OF DEACTIVATION PROCESS OF METAL STRUCTURAL MATERIALS CONTAMINATED WITH RADIOACTIVE SUBSTANCES IN CHEMICALLY ACTIVE MEDIA AND ACOUSTIC FIELDS

It was shown that the process of deactivation of equipment from radioactive deposits was well described by a generalized equation of Erofeev-Kolmogorov. Ultrasonic field of cavitation intensity accelerates all mass transfer processes between cleaning solution and deactivated surface. Deactivation process in ultrasonic field occurs in kinetic reaction region and to be more precise in pseudo-kinetic one as the layer of radioactive deposits is removed not only due to its dissolution but also owing to dispersion with annihilation cavitation cavities.

UDC 614.876

Brus I.D., Turaev N.S.
PROBABLE MECHANISM OF EQUIPMENT DEACTIVATION PROCESS IN CHEMICALLY ACTIVE MEDIA AND ULTRASONIC FIELDS OF CAVITATIONAL INTENSITY

Mechanism of forming radioactive deposits on surface of reactor plant equipment has been described. It was shown that decrease and damage of diffuse layer is observed as a result of hydraulic shocks at cavitation cavity collapse; mechanical cracking of a part of hard deposits is also observed that increases sharply deactivation speed.

UDC 543.544.45

Slizhov Yu.G., Kalichkina L.E., Kuzmina A.G., Pershina O.N., Gavrilenko M.A.
DETERMINING OXYGEN-CONTAINING COMPONENTS OF WINE ON CHELATE-CONTAINING SORBENTS

The possibility of selective concentration of volatile aromatic components of wine on sorbents with adsorptive layer of metal chelate has been shown. Nickel acetylacetonone, copper alizarinate and zinc dimethylglyoximate were compared in sorption selectivity of individual classes of oxygen-containing compounds. Optimal conditions of concentration of

volatile compound ethers, aldehydes and ketones were determined and vapor phase of commercial kinds of French wines was analyzed.

UDC 547.539.04

Funk A.A., Chaykovskii V.K.
**QUANTUM-CHEMICAL CALCULATION OF GIBBS ENERGY
 DEPENDENCE OF IODARENE DIODATION REACTION ON pK_a
 ACIDS AND ON σ^+ -GAMETE CONSTANT**

With the help of DFT (B3LYP/3-21G(d,p)) method the thermodynamics of diiodation reaction of para-substituted arenes with acids has been calculated. The dependence close to linear one was detected by comparing parameters calculated by Gibbs free energy and geometric parameters with experimental value σ^+ of Gammete para-constant. It was shown that ΔG depends linearly on acid value of proper acid.

UDC 547.759.39:679.56

**Rovkina N.M., Batyrova L.M., Gorbatenko N.D.,
 Ivankova N.V., Mustafaev D.N.**
**ON INTERACTION OF CARBAZOLYTIIRAN
 WITH CARBOXYLIC ACIDS**

Interaction of carbazolytiiran with carboxylic (acetic, acrylic, methacrylic) and dicarboxylic (adipinic, sebacic, phthalic) acids has been studied. It was shown that the main interaction products were oligomers. The compounds of acetic acid addition to carbazolytiiran identified as 2-mercapto-3-(9'-carbazolyl)-1-acetoxy-propan was extracted as well as acetic acid excess along with oligomer. The conditions of obtaining all oligomeric products were found, their properties were studied, possibilities of application were shown.

UDC 541.128:541.182

**Kobotaeva N.S., Skorokhodova T.S.,
 Mikubaeva E.V., Sirotkina E.E.**
**CUMENE OXIDATION WITH MOLECULAR OXYGEN
 USING METAL NANOPOWDERS**

Cumene oxidation with molecular oxygen with metal nanopowders (Co, Cu, Ag, Fe, Ni, Zn, Al) obtained by electroblasting of proper conductor in nitrogen atmosphere has been studied. It was shown that oxidation reaction occurs at 60 °C without initiator and oxygen absorption rate and oxidation product composition depend on metal nanopowder type and oxygen adsorption energy on metal: nanopowders Co, Ag, Cu with oxygen adsorption energy less than 400 kJ/mole catalyze cumene oxidation reaction and decomposition reaction of cumene hydroperoxide; nanopowders Fe, Ni, Zn, Al, the oxygen adsorption energy on which is more than 400 kJ/mole oxidize cumene selectively up to hydroperoxide.

UDC 541.64:547.759.32

Lyapkov A.A., Ionova E.I., Sutyagin V.M., Nikonova N.A.
**KINETIC LAWS OF CATIONIC POLYMERIZATION
 OF 9-VINYLCARBAZOLE UNDER THE INFLUENCE
 OF TITANIUM TETRACHLORIDE**

Using adiabatic device the laws of cationic polymerization of 9-vinylcarbazole under the influence of titanium tetrachloride in toluene solution have been studied. It was supposed that the most probable type of growing particles were solvately separated ion pairs. Active centers are formed due to direct attachment of titanium tetrachloride by monomer vinyl bond. Effective values of a constant of catalyst salivation rate and chain growth were calculated.

UDC 541.64:547.759.32

Sutyagin V.M., Lyapkov A.A., Ionova E.I., Nikonova N.A.
**THERMAL EFFECTS OF CATIONIC POLYMERIZATION
 OF 9-VINYLCARBAZOLE UNDER THE INFLUENCE
 OF TITANIUM TETRACHLORIDE**

Thermodynamic features of cationic polymerization of 9 vinylcarbazole under the influence of titanium tetrachloride in toluene solution have been studied with the help of adiabatic calorimeter. It was shown that heat release at 9-vinylcarbazole polymerization was deter-

mined by a contribution of at least two components: polymerization thermal effect directly and initiator solvation heat contribution of which may be rather high.

UDC 621.833

Yangulov V.S., Belyaev A.E.
**ELEMENTS OF COMPUTING HARDNESS OF WAVE GEAR
 WITH INTERMEDIATE SOLIDS OF REVOLUTION**

Features of construction of main parts of wave gears with intermediate solids of revolution have been considered, dependences for computing their deformation have been given. The technique for determining deformations in contact region of wave gears with transfer parts was developed. Algorithm of computing transfer hardness subject to its feature was suggested. The results of computing the kinematic chain hardness and the way of its increase were given.

UDC 621.833

Yangulov V.S., Belyaev A.E.
**COMPUTING LOST MOTION OF WAVE GEARS
 WITH INTERMEDIATE SOLIDS OF REVOLUTION**

The influence of possible gaps in kinematic chain on transfer lost motion has been analyzed. Structural and technological techniques of decreasing influence of some of them on lost motion value were considered. The design technique of gaps due to operating surface wear was given. The design technique of lost motion of wave gears with intermediate solids of revolution was suggested. The results of works in decreasing transfer lost motion were given.

UDC 620.621.669.762

Savitskiy A.P., Vagner M.I., Shin S.-K., Jo Y.-G.
SLIDE BEARINGS ON THE BASIS OF ALUMINUM

Antifriction alloys on the basis of aluminum which possess sufficient plasticity for calibration of sintering slide bearings and useful for thermal treatment have been made by the method of power metallurgy. Hardness, friction factor, wear resistance and roughness of counterbody before and after frictional tests of bearings in conditions of restricted lubrication were studied. Bearing production engineering was tested in conditions of experimental-industrial production at South Korean enterprise LuBo Industries Inc.

UDC 621.762

Matrenin S.V., Ilyin A.P., Slosman A.I., Tolbanova L.O.
TUNGSTEN ACTIVATED SINTERING

The results of studying processes of pressing and sintering mixtures of tungsten coarsely dispersed powder alloyed with nickel with nanodispersed electroblasting tungsten powder and sintered batch on the basis of nanodispersed tungsten powder containing nanodispersed nickel admixtures have been given. It was shown that admixture up to 10 wt. % of tungsten nanopowder to coarsely dispersed one activates the pressing sintering process. It was determined that addition of nickel nanodispersed powder into unalloyed tungsten powder in the amount up to 1 wt. % activates more efficiently sintering process than preliminary alloying of tungsten powder with nickel. The influence of content of nanodispersed powder admixture on a structure and properties of sintered material was analyzed.

UDC 621.785:669.14.08.29

Ovcharenko V.E., Ivanov Yu.F.
**LAWS OF HEATING, NANOSTRUCTURED MODIFICATION
 AND STRENGTHENING OF SURFACE LAYER
 OF POWDER METALLURGICAL ALLOY
 AT PULSE ELECTRON-BEAM RADIATION**

The results of studying the influence of pulse electron-beam radiation of the surface of powder metallurgical alloy on the basis of titanium carbide with nickel chrome band on temperature profile of alloy heat penetration from the surface of its radiation on microstructure of surface layer and resistance of powder metallurgical alloy in metal cutting mode have been presented. It was shown that electron-beam ra-

diation of powder metallurgical alloy forms structural-nonequilibrium states of components of powder metallurgical composition in surface layer. Transfer of metal binding into nanostructured state along with other factors of modification of powder metallurgical alloy microstructure determines multiple increase of powder metallurgical alloy resistance in metal cutting mode.

UDC 621.785:669.14.08.29

Ivanov Yu.F., Kolubaeva Yu.A., Ovcharenko V.E.
MECHANISMS OF STRENGTHENING SURFACE LAYER OF
HARD ALLOY TiC-NiCrAl AT ELECTRON-BEAM RADIATION

Physical nature of increasing strength properties of metaloceramics treated by electron beam has been analyzed. It was shown that formation of material operating characteristics has multiple-factor character. Each factor contribution into metaloceramics strengthening is a controlled variable and depends significantly on parameters of material treatment with electron beam.

UDC 669.018:620.186.8

Vekman A.V.
ENERGY OF INCLINATION GRAIN BOUNDS
IN METALS AND ALLOYS WITH FCC LATTICE

Dependences of energy of inclination grain bounds on next grain boundary angle in fcc metals and ordered alloys with superstructure L12 have been calculated. Energy jump at 42° connected with the change of base unit type was detected at dependences of grain-boundary energy on boundary angle in metals and ordered alloys. In ordered alloys at boundary angles $\Theta > 30^\circ$ local order in grain boundary kernel is disturbed and it is accompanied by sharp change of boundary energy.

UDC 669.046.53

Evtushenko A.T.
SELF-PROPAGATING HIGH-TEMPERATURE
SYNTHESIS OF TOOL STEEL

The process of developing alloy of high hardness with the help of self-propagating high-temperature synthesis at combustion of thermite of cinder and aluminum powders and carbide titanium powder has been studied. The influence of mass fraction of carbide titanium powder and admixtures of powders of titanium boride, molybdenum and alloyed cast iron as well as batch dispersion and thermal treatment mode on combustion process, chemical composition, structure and hardness of the obtained alloy was estimated.

UDC 536.46

Brazovskiy V.V., Kashkarov G.M.,
Lebedeva O.A., Tubalov N.P.
MATERIALS OBTAINING BY REDUCTION
FROM MANUFACTURING WASTES APPLYING
HIGH-TEMPERATURE SYNTHESIS

On the basis of analyzing possible ways of wastes utilization a complex energy-saving technology of recycling metal powders and

oxides into bank filters for refining various solutions of suspended particles by dispersion from 30 to 500 mkm has been suggested.

UDC 621.43:068.4

Brazovskiy V.V., Evstigneev V.V.,
Kashkarov G.M., Tubalov N.P.
STUDYING THE PROCESSES OF DISCHARGE GAS CLEANING
BY THE METHOD OF DIGITAL HOLOGRAPHY

The method of holographic recording condensed phase in discharge gases of diesel engine has been developed. The peculiarity of the method is a use of high-speed digital camera with direct input into PC and immediate computer processing of the obtained results for hologram recording. Refining processes in three-stage catalytic neutralizer were studied. Characteristics of disperse composition of discharge gases of diesel engine KamAZ 740 at various operation modes and disperse composition at refining were measured.

UDC 628.93.000.25

Nikitin V.D., Pashnik K.P.
ERRORS AT TRADITIONAL DESCRIPTION
OF LIGHT FIELD OF TWO-DIMENSIONAL RADIATORS

The error is estimated if light field of two-dimensional radiator with cosine-power indicatrix (element) $I_\alpha = I_0 \cos^m \alpha$ is described by the formula of Higbie or by their graphic or other analogues intended for cosine radiators. Parallel, perpendicular and inclined positions of two-dimensional radiator relative to rated surface are examined. Error constituents occurring at standard approach to description of light field of two-dimensional radiator with $m > 1$ are studied.

UDC 621.039

Shamanin I.V., Godovykh A.V., Seleznev P.A.
ANOMALY IN DEPENDENCE OF NEUTRON RESONANCE
ABSORPTION ON RATIO OF VOLUMES OF MODERATOR
AND FUEL IN THORIUM-BEARING MULTIPLYING SYSTEMS

The results of numerical experiments determining range of values boundaries of the ratio «moderator volume/fuel volume» have been given; there anomaly in dependence of resonance adsorption in multiplying mode on this ration is observed. Physical advantages of using Th^{232} in comparison with U^{238} as a breeder material in nuclear fuel composition were proved.

UDC 669.882

Brus I.D., Buynovskiy A.S., Turaev N.S.
INFLUENCE OF ULTRASONIC MACHINING ON THE PROCESS
OF URANIUM MELT REFINING OF NITROGEN AND CARBON

Influence of ultrasonic machining on the process of removing nitrogen and carbon from metal uranium melt at vacuum refining has been considered. It is shown that ultrasound increases the coefficient of mass transfer at an average for nitrogen in 2,58 and for carbon in 2,36 times.