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## ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.14.018.295:621.774:539.374

**Principles of controlled development of structural nanoscale elements in pipe steels at large plastic strains.** Orlov V. V. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 5–17.

The paper is aimed at the development and realization of scientific structural formation principles applied to rolled strips for main pipelines which provide the structural refinement of a highly economically alloyed steel. The principles are based on comprehensive investigations including the quantitative mechanism of the effect of structural component proportions, their morphology, anisotropy of rolled plates differing in nature, and that of large plastic strains on the dispersity of structural elements. The paper studies steels alloyed with manganese compositions. Pilot specimens of rolled plates were manufactured on the mill "5000" at Cherepovets Integrated Iron and Steel Works "Severstal" and JSC "Magnitogorsk Metallurgical Combine". They carried out structural and phase transformation analysis, test of standard mechanical properties, they determined the serviceability of new steel grades taking into consideration the requirements of standards API, ISO and DNV and modern approaches predicting the service life of main pipelines for 25–30 years.

*Keywords:* economically alloyed pipe steel, main pipelines, rolled strip, large plastic strains, dispersity of structural elements, determined the serviceability.

UDC 669.15–194.52:621.791.052:621.78

**Optimization of heating conditions for welded joints of 09Г2СА-A steel.** Olenin M. I., Gorynin V. I., Bykovsky N. G., Markova Yu. M., Skutin V. S. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 18–29.

The structural changes of 09Г2СА-A steel are researched in various areas of welding with the view to optimize heating conditions for welded joints, which allow increasing of seams metal cold resistance and welded joints heat-affected zone under the temperature of  $-50^{\circ}\text{C}$ .

*Keywords:* silicium manganese steel of ferrite-perlite class, containers for the spent fuel, welded joints, after welding heat treatment, seams metal cold resistance.

UDC 669.14'71–419:669.3

**Copper influence upon formation of laminated composite materials of steel–aluminum.** Kovtunov A. I., Miamin S. V., Chermashentseva T. V. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 30–36.

The paper shows copper influence on the phenomena occurring during liquid-phase formation of laminated composite material of steel–aluminum, and its mechanical properties, structure and phase composition. They obtained the data characterizing the influence of copper on the strength of layers adhesion of laminated composite material and on the intermetallic zone size, and established the effect of temperature conditions on the mechanical properties, structure and phase composition of laminated composite material of steel–aluminum.

*Keywords:* laminated composite material of steel–aluminum, liquid-phase formation, copper, alloying, intermetallic alloys, activating flux

UDC 621.763–97:621.777

**Curie temperature of fibrous Cu–Fe composites prepared by packet hydroextrusion.** Beloshenko V. A., Varyukhin V. N., Dmitrenko V. Yu., Nepochatykh Yu. I., Cherkasov A. N. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 37–41.

The paper investigates the dependence of the Curie temperature  $T_C$  on diameter of iron fibers in Cu–Fe composites produced by packet hydroextrusion combined with drawing. They determined  $T_C$  value by temperature dependences of low-frequency susceptibility varying fiber diameter  $d$  from 3 nm to 160  $\mu\text{m}$ .  $T_C$  value was found to decrease with  $d$  and depends on thermocycling (heating–cooling in the 20–800 $^{\circ}\text{C}$  range). The obtained results were analyzed basing on the concept of broken exchange bonds and symmetry upsetting in the local surrounding of the surface atoms in iron grains.

*Keywords:* fibrous composite, Curie temperature, packet hydroextrusion.

UDC 666.665.1:536.2

**Thermal conductivity of silicon carbide materials.** Perevislov S. N. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 42–49.

The paper presents the temperature dependence of thermal conductivity for silicon carbide materials by reactionary (SiSiC) and activated (LPSiC) sintering and shows thermal conductivity dependences on the density of the material (for SiSiC and LPSiC), porosity (for SiSiC, SiG and LPSiC) and the content of activator (for LPSiC).

*Keywords:* thermal conductivity, silicon carbide, reactionary sintering, activated sintering.

UDC 678.5:539.538

**Research of structural aggregation characteristics of filler's particles in polymeric thermoplastic composites based on the comparative analysis of the wear particles size.** Kozyrev Yu. P., Sedakova E. B., Stukach A. V. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 50–56.

The paper analyzes an engineering space-time model distributing filler's particles in the composite material volume with regard to the polyamide composite and the formation of structural units of filler's particles, substantially relieving a matrix. They calculated the share of the external compressing loading of the composite (containing 10 mas. % powder aluminum) matrix. The result was confirmed by comparative estimation of the areas of polyamide wear particles, of the filling material and the composite itself.

*Keywords:* polymeric thermoplastic composites, structural aggregation of filler's particles, areas of wear particles.

UDC 678.743.41:621.921.34

**Properties of composite diamond-containing materials on polytetrafluoroethylene (PTFE) base.** Shitz E. Yu., Chersky I. N., Okhlopkova A. A. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 57–66.

For the first time they determined physical-mechanical, thermophysical, tribotechnical and operational characteristics of composites for toolmaking on PTFE base containing technical diamond grinding powders of natural origin. Methodically it is proved that using grinding powders with specific granulometric characteristics could be reasonable in combination with polymeric matrix with low surface energy and wettability in order to develop efficient abrasive composites. As a result of the investigations the authors succeeded in solving the complicated technological problem – how to provide efficient processing of materials with different properties, from soft and plastic to hard and brittle, using tools made of diamond-containing PTFE.

*Keywords:* composite diamond-containing materials on the basis of polytetrafluoroethylene for toolmaking, grinding powders of natural origin, physical and mechanical, thermal and physical, tribotechnical and operational characteristics.

UDC 621.793.7:661.862'022

**Development of creation process of volumetric-porous coatings upon the basis of aluminum oxide method by microplasma spraying.** Yurkov M. A. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 67–76.

The developed technology of microplasma spraying of composite powders of Al/Al(OOH) system allowed the production of volume-porous coating with the  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> content higher than 70%, specific surface value 29–41 m<sup>2</sup>/g and adhesion up to 8 MPa. The paper determines that the coating has the multi-disperse porous structure with the mean pore size 12 nm. Micropores constitute 9%, mesopores – 58%, macropores – 33%. This coating up to its parameters suits optimally as the catalyst carrier for steam conversion of hydrocarbon raw material to hydrogenous fuel.

*Keywords:* microplasma spraying, aluminum oxide, composite powder, volume-porous coating, steam hydrocarbons conversion.

UDC 621.793.74:669.017.165:621.762

**Development of creation process of volumetric-porous coatings upon the basis of intermetallide of Ni–Al systems.** Yurkov M. A., Krasikov A. V., Yakovleva N. V., Sholkin S. E., Bobkova T. I. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 77–87.

The basic microplasma spraying technology of bulk-porous coatings based on Ni–Al system intermetallic compounds with specific surface up to  $15 \text{ m}^2/\text{g}$  was developed. The technology feature consists in the use of composite powders and powder mixtures, containing easily removing from the coating sacrificial material, for spraying. The paper defines that at the expense of removing the sacrificial material, Ni–Al coating the specific surface increases greatly. As the specific surface increases, the water-activated chemical water source of MA2-1/sea water/Ni–Al system current density increases (at the constant voltage). Using the volume-porous coating with specific surface  $15 \text{ m}^2/\text{g}$  they made the electrochemical element for water-activated chemical water source with specific energy content  $150 \text{ W}\cdot\text{h}/\text{kg}$ .

*Key words:* microplasma spraying, intermetallic of Ni–Al systems, composite powders, volume-porous coatings, water-activating chemical current source.

UDC 621.762.34–977:669.018.45

**Technology of nanopowders for high-resistant compositions for creation of anodic and cathodic materials for lithium-ion (polymer) batteries.** Popovich A. A., Onishchenko D. V., Van Tsin Shen. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 88–97.

The paper shows the technological parameters of high temperature mechanochemical synthesis (HMS) of refractory compounds. During HMS high temperature develops and they made a calculation of thermal effect and temperature maximum. The cited values correspond to stoichiometric carbides. Methods used for calculating the temperature maximum allow valuing the influence of thermal physical constants (heat capacity, thermal conductivity and diffusivity) inherent to basic components and gas environment upon the temperature distribution in the zone of synthesis. A wide range of alloyed powders based on titanium containing a certain number of titanium carbide of different stoichiometry could be produced with mechanochemical synthesis. They explored the possibility of obtaining tungsten nanopowders when manufacturing nanocomposites for electrodes lithium-ion (polymer) batteries.

*Keywords:* nanopowders, lithium-ion (polymer) batteries, refractory compounds, high temperature mechanochemical synthesis.

UDC 621.762.34:669.27

**Synthesis boron-containing tungsten powders in ionic melts.** Gostishchev V. V., Teslina M. A., Ri E. Kh. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 98–102.

The paper considers the synthesis of boron-containing tungsten powders at joint restoration of oxides of metal and compounds of boron by magnesium in salt melts of KF–KCl system. The synthesis of composites needs to go through a whole number of redox reactions when original compounds are reduced by magnesium to elements. They determined granulometric parameters of powders and established that the specific surface of powders makes up  $6.30 \cdot 10^5 \text{ m}^{-1}$ .

*Key words:* synthesis of powders, compounds of boron, tungsten, melts of salt, granulometric parameters.

UDC [621.791.725+621.791.754]:669.15–194.591

**Studies of seam forming at multipass hybrid welding by CO<sub>2</sub>-laser + MIG of steel ULCB700.** Zhao Fucheng. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 103–110.

The paper shows characteristics of seam forming at multipass hybrid welding by middle capacity CO<sub>2</sub>-laser combined with consumable electrode welding (MIG) using samples of steel ULCB700, 12 mm thick. They made an analysis dedicated to processing factors and its influence upon those characteristics – such, as grooving, protective gases and power factors, and determined certain ranges of technological parameters of hybrid welding.

*Keywords:* bainite steels with ultralow content of carbon, hybrid welding by CO<sub>2</sub>-laser + MIG, multipass welding, seam forming.

UDC [621.791.725+621.791.754]:669.15–194.591

**Character of transition of drops in molten metal at hybrid CO<sub>2</sub>-laser + MIG welding.** Zhao Fucheng, Baranov A. V. – Voprosy Materialovedeniya, 2011, N 2 (62), p. 111–116.

They effected hybrid welding by CO<sub>2</sub>-laser combined with consumable electrode welding (MIG) and researched the process of transition of drops in molten metal using arc current analyzer and high-speed camera. The paper studies the influence of protective gas flow upon frequency and constancy of drops transition and describes the whole range of a combination of gas flow parameters and laser capacity for maintenance of optimum frequency of drops transition in molten metal.

*Keywords:* bainite steels with ultralow content of carbon, hybrid CO<sub>2</sub>-laser+MIG welding, transition of drops, protective gas flow.

UDC 669.295:621.791

**Development of non-standard welded joint and choice of regimes of welding at manufacturing of units from titanium alloys.** Khanzhin A. V., Feodorov A. M., Sakharov I. J. – Voprosy Materialovedeniya, 2011, N 2 (62), p. 117–122.

The paper states basic results received by development of process of welding of pilot designs of units from titanium alloys, working in structure of a product and having restrictions upon the maximal heating in the certain points.

*Keywords:* titanium alloys, process of welding, restrictions upon the maximal heating.

UDC 669.715:621.791

**Weldability of aluminum alloy 1575-1 grade alloyed by small quantity of scandium and properties of welded joints.** Osokin E. P., Pavlova V. I., Zykov S. A. – Voprosy Materialovedeniya, 2011, N 2 (62), p. 123–130.

They researched weldability of thermally not strengthened aluminum alloy of 1575-1 grade of high durability, alloyed by small quantity of scandium (0,12–0,20 %), and mechanical properties of welded joints from this alloy, executed with application of welding wire with the lowered content of scandium (0,25–0,35 %). Seam forming by technological beads allowed to increase durability of welded joints up to 440–460 MPa, i.e. up to  $\geq 0,9$  actual durability of the basic metal, owing to displacement of geometrical stress concentrator (area of transition of a seam to the basic metal) to heat-affected zone softened by thermal cycle of welding in an insignificant degree.

*Keywords:* aluminum alloy alloyed by small quantity of scandium, weldability, sensitivity a thermal cycle of welding, mechanical properties.

UDC 621.039.531:539.4

**Effects of neutron irradiation upon mechanical properties of materials for internals reactor of WWER type.** Sorokin A. A., Margolin B. Z., Kursevich I. P., Minkin A. I., Neustroev V. S., Belozherov S. V. – Voprosy Materialovedeniya, 2011, N 2 (66), p. 131–152.

Mechanical properties of materials (18Cr–10Ni–Ti steel and its weld metal) for internals of WWER were investigated in initial and irradiated conditions. On the basis of original investigations and generalization of available experimental data the dependencies were obtained for the yield strength and ultimate strength as function of damage dose  $D$  up to 100 dpa, irradiation temperature  $T_{irr} = 320–450^{\circ}\text{C}$  and test temperature  $T_{test} = 20–450^{\circ}\text{C}$ . Proposed method for determination of the stress-strain curves (SSC) parameters does not require using the uniform elongation as input parameter. The strain hardening was determined for various test temperatures, irradiation temperatures and damage doses. The dependency is obtained that describes the fracture strain reduction under irradiation over temperature range  $T_{irr} 320–340^{\circ}\text{C}$  when radiation swelling is absent.

*Key words:* reactor of WWER type, internals, 18Cr–10Ni–Ti steel, neutron irradiation, mechanical properties.