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ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.15–194.53:536.485

Some aspects of cold resistance improving for pearlitic steels. Olenin M. I., Gorynin V. I., Fedoseyev M. L. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 5–12.

The paper presents a comprehensive study of the temperature-time parameters and structural changes during aging of thermo improved pearlitic steel grade 25Kh1MF. It has been shown that aging at 450°C for 5 hours exposure improves steel cold resistance more than 2.5 times.

Keywords: pearlitic steel fasteners, cold resistance, aging regime.

UDC 669.15–194.56.017.11:621.73.016

Construction of a diagram of the structural states of austenitic steel type Kh18N10T (X18H10T) after hot deformation. Filimonov G. N., Dobrynina M. V. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 13–20.

A variety of state diagrams is often used to study the effect of thermal deformation modes on the metal microstructure. The paper attempts to construct a diagram of the structural states of austenitic steel type Kh18N10T (X18H10T) applied to hot deformation by forging the large pieces of individual ingot. A schematic diagram could be the basis for further refinement and research development in the field of hot-deformed austenite structure formation. The presented chart may be used to select the optimal modes of thermo-plastic processing.

Keywords: diagram of the structural states, hot plastic deformation, recrystallization.

UDC 669.15–194.55: 669.187.52:621.785

Heat treatment and melting influence on the microstructure and properties of maraging steel type H18K9M5T. Grigorenko V. B., Zheguina I. P., Iskhodzhanova I. V., Morozova L. V. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 21–29.

A comparative assessment of high-strength constructional steels propensity has been developed (especially low-carbon maraging steels the N18K9M5T type with or without additives of rare-earth metals melted by vacuum arc electron beam under the slowed-down cooling up to the deformation temperatures).

Under heat treatment grains 7–9 points, thin structure of martensite, equally spaced carbides and carbonitrides particles have been formed. When processing, simulating a violation of the technological process, the growth of grains up to 1–2 points, martensite gross packages, decreasing plasticity, allocation of carbides and carbonitrides at the boundaries of the grains have been observed.

Mechanical tests have shown that the steel after electron beam remelting and provoking heat treatment possess higher mechanical properties than steel samples remelted by the vacuum and arc method.

Key words: high-strength structural maraging steel, electron-beam remelting, vacuum arc remelting, heat treatment, metallographic analysis, mechanical tests, microstructure, X-ray microanalysis.

UDC 669.018.4:621.785:620.170.152

The selection of heat treatment alloy 21Cr43Ni2Mn2Si2Nb according to high-temperature X-ray. Fedoseev M. L., Ptashnik A. V., Petrov S. N., Barakhtin B. K., Utkin Yu. A. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 30–36.

The high-temperature model alloy based on composition 21Cr43Ni2Mn2Si2Nb is examined by X-ray phase analysis for the further optimization of producing technology. The sample was heated to 900°C, the diffraction pattern at this temperature is continuously recorded. A pattern of changes of a phase composition during the research is obtained. Microstructure of the sample is examined before and after the test. It is founded that the G-phase starts to form at relatively early stages of the phase transformation and the original niobium carbide in this case almost dissolves. This information makes possible to correct the thermal treatment rate decreasing the time of an aggregate exposure at a given temperature.

Keywords: X-ray structure analysis, high temperature X-ray analysis, refractory alloy (heat-resistant alloy), G-phase.

UDC 666.3/7

Si₃N₄-based ceramics with nanosized component. Kuznetsova N. V., Osmakov A. S., Diatlova Ya. G., Ordanyan S. S. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 37–44.

Si₃N₄-based ceramics with nanosized component was processed by hot pressing and spark plasma sintering techniques within temperature range 1700°C to 1750°C. Effects of the nanosized component and consolidation technique on microstructure formation and mechanical and physical performance were studied. Ceramics consolidated by SPS technique with 25% of nanosized component demonstrates the best mechanical and physical performance. The obtained material could be recommended for cutting tools.

Keywords: ceramics with nanosized component, hot pressing, spark plasma sintering, mechanical and physical performance.

UDC 666.792

Reaction-sintered composite materials based on silicon nitride and silicon carbide. Perevislov S. N., Chupov V. D. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 45–52.

The paper analyzes the received materials based on silicon nitride composition, silicon carbide by reaction sintering (nitriding) with the following mechanical properties: $\rho = 2.48 \text{ g/cm}^3$, $P = 19.4 \%$; $E = 133 \text{ GPa}$; $\sigma_{12g} = 180 \text{ MPa}$. It was shown that large items could be molded and then sintered by nitriding.

Keywords: composite materials, reaction sintering, could be molded, large items.

UDC 621.763:537.3:539.538

Characteristics changes of metal graphite-containing composites' sliding contact influenced by electric current and Pb–Sn melt in the contact space. Aleutdinova M. I., Fadin V. V. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 53–58.

The paper shows that the Pb–Sn melt presence in the contact space increases electric conductivity and wear resistance of steel based composites. The start of catastrophic wear does not depend on the presence or absence of lead and tin and occurs at identical contact current density depending on composite composition. Electric conductivity and wear resistance of iron based composite at friction with Pb–Sn melt have higher numerical values than the same characteristics at friction with Pb–Sn melt.

Keywords: sliding electric contact, sintered composite, current density, Auger spectra, voltage-ampere diagram, wear rate, surface layer.

UDC 661.834:539.213:621.355

Technology research of cathode material based on Li–Fe–Si–O system. Popovich A. A., Wang Qingsheng. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 59–63.

The paper researches new technology of obtaining new cathode nanostructured materials based on Li₂FeSiO₄ for lithium-ion batteries, i. e. crystallization from amorphous state. Studying the phase composition features it was determined that the obtained structure represented a mixture of amorphous and nanocrystalline structure with size of nanocrystals varying from 4 to 30 nm.

Keywords: lithium-ion batteries, nanostructured materials.

UDC 621.762:669.27

The influence of preparation conditions on grain size of tungsten powder of ionic melts. Gostishchev V. V., Khimukhin S. N., Teslina M. A., Astapov I. A. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 64–67.

The influence of the ionic melt and the specific surface of aluminum powder on the granulometric characteristics of tungsten powders has been revealed by experiments. It is shown that the powders with the highest specific surface area ($40 \cdot 10^5 \text{ m}^{-1}$) are formed in molten potassium chloride.

As the milling of aluminum, used as a reducing WO_3 , takes place, the specific surface area of tungsten powder becomes larger. By increasing the specific surface area of aluminum 3 times the surface area of tungsten powder increases by 4–8 times.

Keywords: tungsten powders, ionic melts, granulometric characteristics.

UDC 678.742.2:621.891

Tribotechnical materials based on ultra high molecular weight polyethylene. Gogoleva O. V., Okhlopkova A. A., Nikiforov L. A. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 68–74.

The paper presents the research results of developing advanced polymeric composite materials based on ultra high molecular weight polyethylene, containing layered filler. It is found that the wear resistance in the contact area increases with the ductility, reduced friction and temperature that could improve the reliability, security and efficiency of transport operation and process equipment.

Keywords: ultra high molecular weight polyethylene, filler, structure formation, friction coefficient.

UDC 678.743.41:621.891

Structural features of tribotechnical composites on a basis of polytetrafluoroethylene with nanosize fillers. Sedakova Ye. B. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 75–82.

The analysis of the structural peculiarities of PTFE composites has been carried out. The composites with the dispersed fillers both of micron size and nano size have been considered. The peculiarities of the parameters of such structures have been determined. The calculated relations for loading parameters of the matrix related to the wear resistance have been obtained for the tribotechnical composites.

Keywords: wear, composite material, polytetrafluoroethylene, nanofiller, structure, volume concentration, surface concentration.

UDC 621.791.725:669.295

Laser welding of Ti–5Al–2.5Sn titanium alloy. Pugacheva N. B., Trushina Ye. B., Pugacheva Ye. I. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 83–92.

Features of welded seams formation at laser welding of Ti–5Al–2.5Sn titanium alloy are investigated. Methods of an optical metallography, local micro spectral analyze, micro hardness measurements, kinetic micro indenting, static stretching, fatigue and the fractures classification are used for research. It is shown that welded seam in width 1.2 and factor of a form of 2.5 mm, thermal influence zones in width no more than 1.2 mm are formed. The material of the welded seams represents unfocused packages of α -plates in primary grains. The nature of chemical elements distributions, average values of microhardness and the Young's module by all connections zones are equivalent. The welded seams material is distinguished by more elasticity and smaller plasticity, the thermal influence zones show the maximum plasticity. The tensile and fatigue strength values of the welded seams material correspond to the requirements to this alloy.

Keywords: laser, welding, microstructure, microhardness, microindenting, Young's module, tensile strength, fatigue strength, fractography.

UDC 621.791.72.011

Mathematical modeling for deforming processes and technological features for diffusion welding of precise constructions by thermal tightness pressure. Belyaev S. N. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 93–99.

The paper considers technological features for diffusion vacuum welding of precision constructions and mathematical modeling of welding process in the conditions of deformation with monoaxial compressing minimizing the welding deformations on the thin-walled flanged rotors.

Keywords: electrostatic gyroscope, diffusion welding, thin-walled flanged rotor, deforming process with monoaxial compressing, thermal tightness pressure.

UDC 621.924.93

New technology of hydroabrasive cleaning of a steel surface with use of effect of dilatancy. Tyurina S. A., Krashennikov A. I., Pupchenkov G. S. – Voprosy Materialovedeniya, 2013, N 2(74), p. 100–106.

The paper considers the new technology of metal surface cleaning that uses the solution possessing dilatancy effect. The shift speed increase for this liquid leads to significant viscosity increase. Interaction with a surface passes to other qualitative level, that is the stream of liquid interacts with a surface not as liquid, and as a firm body. It allows to reduce in times working pressure when cleaning and to keep or increase efficiency of process.

This technology has a number of indisputable advantages before traditional methods of purification of metal: higher economic efficiency in comparison with air and abrasive ways; use of simple public materials, widespread in Russia; existence of inhibiting effect; the improved working conditions of the service personnel as there is a partial binding of a dust by water; environmental friendliness of procedure.

Keywords: hydrojet cleaning, dilatancy.

UDC 669.15*786–194.546:539.431

Features of deformation and failure of the nitrogen-containing austenitic steel under low-cycle loading. Danilov G. I., Ilyin A. V., Kalinin G. Yu, Fedorova T. A. – Voprosy Materialovedeniya, 2013, N 2(74), p. 107–117.

The paper studies characteristics of nitrogen-containing steel deformation and fracture under various heat treatments and low-cycle loading. The effect of stress concentration on the cyclic loading resistance has been determined in air and corrosive environment.

Keywords: nitrogen-containing austenitic steel, low-cycle loading, cyclic loading resistance.

UDC 669.715:539.43:620.194.23

The study of residual fatigue life of aluminum alloy V95pchT1 after exposure to a variety of conditions. Grinevich A. V., Lutsenko A. N., Karimova S. A. – Voprosy Materialovedeniya, 2013, N 2(74), p. 118–122.

The paper considers the problem of reducing the fatigue life of aluminum alloy samples B95пчТ1 (V95pchT1) after exposure to a variety of corrosive conditions: in the tropical chamber, salt fog chamber, Gelendzhik and Moscow climate testing centers.

The kinetics of reduction of fatigue life is represented. The possibility of finding correlations to determine the residual fatigue long-eternity for alloys of the Al–Zn–Mg–Cu after natural and accelerated testing.

Keywords: fatigue life, corrosion damage, corrosion-IVE full-scale tests.

UDC 669.15–194.56: 621.039.531:539.421

The effect of neutron irradiation on fatigue crack growth rate in 18Cr–10Ni–Ti austenitic steel and its weld metal. Margolin B. Z., Minkin A. J., Smirnov V. I., Sorokin A. A., Kokhonov V. I. – Voprosy Materialovedeniya, 2013, N 2(74), p. 123–138.

Experimental investigations of fatigue crack growth rate (FCGR) are performed at 20, 200 and 290°C for austenitic materials (18Cr–10Ni–Ti steel and its weld) in initial condition and after neutron irradiation with doses up to 40 dpa. The model for FCGR prediction under irradiation is proposed. It is shown that the normative curve of FCGR for unirradiated austenitic materials can be used with the safety factor of 3 as conservative estimation of FCGR for irradiated austenitic materials when radiation swelling is absent.

Keywords: austenitic steel, irradiation, fatigue crack growth rate.

UDC 678.067:620.174

Research of bending deformations of carbon fiber plastic with fiber-optic sensors based on fiber Bragg gratings. Fedotov M. Yu., Goncharov V. A., Shienok A. M., Sorokin K. V. – Voprosy Materialovedeniya, 2013, N 2(74), p. 139–147.

The article describes control method of bending deformations for carbon-fiber-reinforced plastic with a system of fiber optic sensors based on fiber Bragg gratings. The paper also shows the dependence of the resonance wavelength of the Bragg grating in the carbon-fiber-reinforced plastic on the mechanical and thermal effects.

Keywords: fiber optic sensor element, carbon fiber, fiber Bragg grating, stress-strain state.

UDC 621.763:669.054.8

Production of the composite tool material from cast iron and steel cutting waste. Gurevich Yu. G., Chudinova Ye. A. – *Voprosy Materialovedeniya*, 2013, N 2(74), p. 148–152.

The technology of obtaining the composite tooling material made from cast iron and steel cutting waste by impregnation of steel with liquid cast iron and subsequent forging and hardening has been developed. The mechanical properties of the obtained material have been thoroughly studied and it has been shown that they are comparable to those of carbide cast iron and of carbide steel.

Keywords: composite tool material; iron and steel waste, thermomechanical treatment.