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ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.14.018.41:621.785

Increasing of cold resistance of low-alloy toughened steels due to coagulation of carbide phases. Gorynin V. I., Olenin M. I. – Voprosy Materialovedeniya, 2014, N 3 (79), p. 5–14.

The paper studies the influence of carbide phases coagulation at aging after toughening and thermomechanical treatment on the cold resistance of the sheets and forgings of steel 09Mn2Si grade A-A and pipe steels X80 and X90, including the heat-affected zone after welding. It is shown that the coagulation of the carbide phases suppresses the fragility of low-alloy toughened steels.

Keywords: low-alloy toughened steels, coagulation of carbide phases, cold resistance.

UDC 620.179.17

Effect of thermal cycling of Cт3кп (St3kp) steel on energy parameters of acoustic emission. Lebedev E. L., Khramkov A. A. – Voprosy Materialovedeniya, 2014, N 3 (79), p. 15–21.

The paper presents results of experimental studies undertaken to determine the dependence of the characteristics of acoustic emission signals on changes of steel properties under thermomechanical impacts.

Keywords: non-destructive testing, thermomechanical loading, degradation of the mechanical properties, acoustic emission, resource.

UDC 669.15–194:621.039.536.2

Production experience of the WWER-TOI flanged forging from the steel 15Cr2MoV grade A at the plant ENERGO MASHPETSSTAL (Ukraine). Zotova A. O., Teplukhina I. V., Tsvetkov A. S., Zaytseva O. Yu. – Voprosy Materialovedeniya, 2014, N 3 (79), p. 22–33.

The comparative analysis of 15Cr2MoV grade A and 15Cr2NiMoV cl. 1 steels hardenability is carried out. Production experience of the large size flanged forging with wall thickness of 660 mm from the 15Cr2MoV grade A steel for the vessel head is presented. The possibility of obtaining strength properties, appropriate to yield strength at 350°C more than 441 MPa and initial ductile-brittle transition temperature not higher than minus 50°C in the forging center, is shown.

Keywords: 15Cr2MoV grade A steel, hardenability, flange for vessel head of WWER-TOI, production experience.

UDC 669.14.018.44:539.377

Effect of phase composition on the deformation capacity 07Cr12NiMoVNb steel at high temperatures. Kudriavtsev A. S., Artemieva D. A., Rayner P. Ya. – Voprosy Materialovedeniya, 2014, N 3 (79), p. 34–40.

To determine the optimal temperature of hot plastic deformation the paper studies the effect of the chemical composition of 07Cr12NiMoVNb steel on its deformation capacity at high temperatures.

Keywords: heat and corrosion resistant steel, hot plastic deformation, deformation capacity.

UDC 669.28: 621.762

Metallographic study of high-temperature composite materials based on Mo–Si–B alloys. Bolshakova A. N., Efimochkin I. U., Murasheva V. V. – Voprosy Materialovedeniya, 2014, N 3 (79), p. 41–46.

The paper studies high-temperature composite materials based on Mo–Si–B alloys with high mechanical properties and resistance to oxidation at high-temperature obtained by mechanical alloying of powder. Microstructure of obtained materials has been studied. The high temperature oxidation resistance tests have been performed.

Keywords: high-temperature composite materials based on Mo–Si–B alloys, mechanical alloying, powder metallurgy industry, metallographic microstructure, high temperature oxidation resistance.

UDC 621.793.6

Metal composite protective coatings manufactured by thermal diffusion in an alternating electromagnetic field. Kubantsev V. I., Farmakovskiy B. V., Riazanov E. M., Savitskiy D. S., Trachevskiy M. L. – Voprosy Materialovedeniya, 2014, N 3 (79), p. 47–59.

The paper analyzes regularities and peculiarities of the formation of metal composite coatings by thermal diffusion method in an alternating electromagnetic field. The microstructure of the coatings has been studied by electron microscopy and X-ray diffraction. It has been shown that the tested coatings constitute a multilayer system in which each layer is a metal composite. Describes examples of implementation.

Keywords: metal composite, protective coating, thermal diffusion, electromagnetic field, intermetallic compounds, microstructure, induction unit.

UDC 621.763:537.311

Increase in the actual area of the sliding contacts of metal graphite composites under the influence of electric current and Pb–Sn melt in the contact space. Fadin V. V., Aleutdinova M. I. – Voprosy Materialovedeniya, 2014, N 3 (79), p. 60–65.

The influence of Pb–Sn melt in the contact space on the conductive area and conductivity has been studied. Semi-empirical evaluation of the electrical conductivity of the wireway containing Pb–Sn melt in the contact space has been carried out.

Keywords: metal graphite composites, electrical conductivity of the wireway, Pb–Sn melt, friction pair.

UDC 621.794.44: 621.822.175

Creating profiled functional elements on precise surfaces of gyroscopic units by ion etching. Belyaev S. N., Scherbak A. G. – Voprosy Materialovedeniya, 2014, N 3 (79), p. 66–72.

The paper considers the airfoil formation on the spherical surfaces of the gas bearing for the floated gyro by ion etching technology. The description of the parts orientation forming the profile of variable depth has been proposed and the effect of structural-phase state of the 40CrNiAl alloy (by vacuum induction smelting) (40XHЮ-ВИ) on the quality and accuracy of the generated profile has been studied. Technical solutions for coordination modes of heat treatment and ion etching technology have been proposed. Practical research results have been provided.

Keywords: ion etching, airfoil, bearing, gyro motor, two-degree-of-freedom floated gyroscope.

UDC 669.245:621.315.3

Development of tensor and thermo resistant alloys for micro wires casting. Masailo D. V., Smelov A. I., Peskov T. V., Farmakovskiy B. V. – Voprosy Materialovedeniya, 2014, N 3(79), p. 73–78.

The prospects to create highly sensitive miniature sensors using cast micro wire in glass insulation have been analyzed. Experimental tensor and thermo resistant alloys with a significantly new set of electro-physical properties have been developed taking into account the specific characteristics of the casting micro wires. Exact compositions of thermo resistant alloys based on systems Ni–Sn and Ni–Cr have been optimized.

Keywords: tensor and thermo resistant alloys, cast micro wire, glass insulation, new set of electrical properties.

UDC 621.793.7–419

Multilayer wear-resistant and corrosion-resistant nanostructured functional graded coatings obtained by magnetron sputtering. Farmakovskaya A. Ya., Bobkova T. I., Eshmemetyeva E. N. – Voprosy Materialovedeniya, 2014, N 3(79), p. 79–89.

A new technological scheme of the application of metal matrix functionally graded coatings by recurrent layers has been developed. Selection and optimization of technological process have been carried out at facilities “Bulat” and “Magna-TM5”.

Keywords: nanostructured metal matrix functionally graded coatings; magnetron sputtering, wear resistance, corrosion resistance.

UDC 621.793.7:628.16

Magnetron sputtering of functionally graded coatings Ti-Ru-O system for water purification systems. Eshmemetyeva E. N., Bystrov R. Yu., Beliakov A. N., Pharmakovskiy B. V., Vasiliev A. F., Krasikov A. V. – *Voprosy Materialovedeniya*, 2014, N 3(79), p. 90–96.

The paper treats the possibility of obtaining catalytically active coatings based on titanium oxide and ruthenium oxide with high adhesion to the titanium substrate by reactive magnetron sputtering. A comparative analysis of the characteristics of the coatings obtained by thermal decomposition of titanium, ruthenium and iridium salts and by magnetron sputtering while spraying simultaneously titanium and ruthenium in oxygen has been given.

Keywords: functionally graded coatings, reactive magnetron sputtering, water purification systems.

UDC 678.067.5:621.315.61:621.396.6

Creating high-strength water-resistant non-conductors and development of technology manufacturing for radio engineering and marine insulation. Oryshchenko A. S., Anisimov A. V., Bakhareva V. E., Sargsyan A. S., Churikova A. A. – *Voprosy Materialovedeniya*, 2014, N 3 (79), p. 97–108.

The paper studies physical, mechanical and dielectric properties of the epoxy hot pressed fiberglass STET-1 and STET-2 plastics developed by CRISM “Prometey” at different temperatures in the initial state and after exposure to water, including influence of hydrostatic pressure. The experience in radio engineering products deformations after long-term operation (up to 15 years) has been summarized.

Keywords: epoxy fiberglass, physical, mechanical and dielectric properties, radio engineering, marine electrical insulation.

UDC13УДК 678.067:544.723

Analysis of the relationship between the water resistance of samples and blocks of constructional polymeric materials (spheroplast) and the ratio of the surface area to volume. Sedletsky R. V., Nikolaev G. I. – *Voprosy Materialovedeniya*, 2014, N 3 (79), p. 109–121.

Highly structured polymer composites have been investigated by hydro testing and by physico-chemical meniscus modeling of reverse water mass transfer under pressure. The paper describes the relationship between the water resistance of samples (blocks) and the ratio of the total area of their surface to volume. Its non-Fickian sinuous nature has been established due to macromolecular defects in the three-dimensional structure of such composites, and also to extensive borders ‘polymer – filler’ and its finish coatings. Just these factors lead to a significant strengthening of the active adsorption depending on different energetic active centers with antiphase effect on the polarity of the three-phase boundary ‘water – polymer’, which regulates level of water absorption.

Keywords: spheroplast, liquid meniscus, reversing water mass transition, flotation ability, durability, impregnation, glass microspheres, hydrostatic pressure.

UDC 678.067:544.723

Analysis and experimental study of the reversible kinetics of water mass transfer in highly structured polymer composites (spheroplast, fiber, carbon composites). Sedletsky R. V. – *Voprosy Materialovedeniya*, 2014, N 3 (79), p. 122–137.

The paper describes an integrated system created for continuous hydrostatic weighing of samples during hundreds of hours with simultaneous recording of the kinetic curves of ‘water absorption – time and temperature of the working fluid – time’. It was established in order to make correct interpretation of experimental data on the process of water absorption kinetics (in particular reversibility of water mass transfer) in highly structured polymeric composites. For the same purpose they made thermodynamic calculation of thermal effects both positive (spontaneous adsorption of water molecules on the molecular defects of structure) and negative (dissociation of finishing coating at the interface of ‘polymer – impregnation agent – filler’) during the autocatalytic hydrolysis.

Comparing these calculations and experimental data obtained at the continuous registration of the absorption kinetics it was found that they exactly match the meniscus modeling of reversing water mass transfer in polymer composites.

Keywords: spheroplasts, fiberglass, carbon composites, water absorption, hydrostatic pressure, composite, molecular structure.

UDC 678.067:539.213:620.181.4

The comparative measurements of the glass transition temperature of the polymer composite materials by DSC, TMA and DMA techniques. Khaskov M. A. – *Voprosy Materialovedeniya*, 2014, N 3 (79), p. 138–144.

The glass transition temperatures T_g of the cured epoxy resin and the composites with different fillers based on it have been measured by differential scanning calorimetry (DSC), thermal mechanical analysis (TMA) and dynamic mechanical analysis (DMA). It was shown that the T_g values obtained with DSC could be influenced by the recommended cooling rate before measurements and this influence is more prominent for the less kinetically fragile samples. The T_g values calculated from the onset of the storage modulus drop or from the maximum of the loss modulus tend to be higher for the composites comparing to the neat resin. The less dependent on the fillers values of T_g are probably measured by TMA and DMA calculated with the maximum of the dissipation factor.

Keywords: differential scanning calorimetry, dynamic mechanical analysis, thermomechanical analysis, glass transition temperature, technique comparison, polymer-based composite materials.

UDC 678.742.2:539.2

UHMWPE structural changes under the influence of ceramic nanodispersions. Okhlopkova T. A., Okhlopkova A. A., Spiridonov A. M., Nikiforov L. A. – *Voprosy Materialovedeniya*, 2014, N 3 (79), p. 145–153.

The paper investigates the structure of crystalline phase in UHMWPE-based polymer matrix nanocomposites modified by nonorganic nanostructured oxides ($\text{Al}_2\text{O}_3 + 0.5\% \text{MgO}$, SiO_2) using small-angle (SAXS) and wide-angle (WAXS) X-ray scattering. The influence of nanoparticles on the UHMWPE crystallization processes has been shown. The combination of these methods with transmission and scanning electron microscopy has been used to make a more detailed description of the ordered phase in the polymer nanocomposite.

Keywords: UHMWPE, aluminum oxide, silicon oxide, alumag, tarkosil, polymer composite material, supramolecular structure.

UDC 669.715:621.791.14

Changing of the phase composition of the Al–Mg alloy AMg5 by friction stir welding. Naidionkin E. V., Ivanov K. V., Kolubaev E. A. – *Voprosy Materialovedeniya*, 2014, N 3(79), p. 154–159.

Changes of the phase composition of the Al–Mg alloy (AMr5) in the heat-affected zone at welding by friction stir have been studied by X-ray diffraction and scanning electron microscopy. The dissolution of secondary phase particles in the matrix has been detected by lattice parameter measurements. Rolling textures are destroyed in the heat-affected zone. The chemical composition of secondary phase particles has been measured by electron microprobe analysis.

Key words: friction stir welding, Al–Mg alloy, X-ray analysis, scanning electron microscopy.

UDC 669.15–194: 539.422.22

Change in geometry parameters of WWER fuel elements with increased uranium load during operation. Stozhuk A. V., Zhitelev V. A., Zvir E. A., Polenok V. S. – *Voprosy Materialovedeniya*, 2014, N 3 (79), p. 160–166.

The data on the change in the geometry parameters of the fuel elements with the increased uranium load for the WWER-1000 (TVSA-5M, TVS-2M) and WWER-440 working assembly of the second generation during operation are presented. It is shown that the contact between the fuel meat and cladding and subsequent increase in diameter for such fuel elements occurs at lower fuel burnups as compared to the basic design fuel elements. No significant differences in elongation were found.

Keywords: WWER fuel elements with increased uranium load, basic design fuel element, mechanisms of fuel element change in form, change in geometry parameters.

UDC 621.039.54

Thermal brittleness of NPP equipment steel and ways of its reducing. Olenin M. I., Gorynin V. I., Timofeev B. T., Pavlov V. N., Rogozhkin V. V. – *Voprosy Materialovedeniya*, 2014, N 3 (79), p. 167–173.

The paper studies the influence of temperature and time parameters of ferrite ageing on brittle fracture resistance of 10MnNi2MoV grade A steel, widely used in the nuclear industry, after ageing for 60,000 hours in the temperature range 270–310°C. It is shown that ferrite overageing leads to coagulation of cementite, which reduces the thermal embrittlement of steel and increases its resistance to brittle fracture.

Keywords: 10MnNi2MoV grade A steel, thermal brittleness, ageing temperature, ageing time, brittle fracture resistance.