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ABSTRACTS OF PUBLISHED ARTICLES

UDC 621.78:669.14 + 669.15–194.55

The dependence of the destruction character of the high-strength structural maraging steels' of the H18K9M5T-type on technological factors. Zheguina I. P., Morozova L. V., Grigorenko V. B., Zimina Z. N. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 5–14.

The research of features of high-strength hull structural particularly low carbon maraging steels obtained by vacuum-arc and electron-beam melting has been conducted by method of fractography.

After heat treatment, simulating a violation of technological process (in a mode of thermal embrittlement), a coarse-grained structure forms with significant reduction of plasticity, allocation of carbides and carbonitrides along the grain boundaries, causing predominantly grain boundary destruction, that explains the reduction of mechanical properties. The use of electron-beam melting leads to greater stability of the material, to violation of the recommended technologies of processing.

Key words: structural high-strength maraging steel, electro-beam remelting, vacuum arc remelting, thermal processing, microstructure, metallographic analysis, X-ray spectrum analysis.

UDC 669.14.018:621.785.6:533.9.92

Study of steel 20GL surface layer changes in plasma hardening. Shur V. Y., Korotkov V. A., Shishkina E. V. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 15–20.

The paper shows the results of the study of the microstructure and micro-hardness of the tempered steel 20GL surface layer obtained by manual plasma tempering set UDGZ-200 by means of optical and atomic force microscopy.

Key words: plasma surface hardening, steel 20GL, atomic force microscopy.

UDC 669.15'26'24'28–194:620.181

Structure and properties of high strength weld made of chromium-nickel-molybdenum steel before and after the stress relief in the heat-affected zone. Pazilova U. A., Khlusova E. I., Kireyeva T. S., Izotov V. I. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 21–32.

The paper shows the features of the high-strength chromium-nickel-molybdenum shipbuilding steel in the heat affected zone structure before and after high-temperature tempering. It is shown, that the type and morphology of the structural components as well as the redistribution of carbon, depending on the cooling rate and extent of release, determine the hardness and toughness of the heat-affected zone.

Key words: high-strength shipbuilding steels, heat-affected zone, tempering, structure, mechanical properties.

UDC 678.675:621.891

Features of the polymeric composite materials' production by vacuum infusion. Dushyn M. I., Chursova L. V., Khrulkov A. V., Kogan D. I. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 33–40.

The features of non-autoclave technology of parts manufacturing from composites have been considered. The production consists in impregnation of dry reinforcing fillers. Attention is paid to the influence of capillary pressure and the binder flow rate on the porosity value. The properties of carbon composites fabricated by infusion are checked.

Key words: vacuum-assisted resin transfer molding, infusion, pressure, rate of impregnation, porosity, time.

UDC 678.675:621.891

Perspective technological way of polymeric elastomer material manufacturing. Davydova M. L., Sokolova M. D. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 41–47.

The technological method of a polymeric elastomer material manufacturing on a basis of butadien-nitrile rubber (BNKS-18), ultra high-molecular polyethylene (UHMWPE) and ultradispersed diamond graphite (UDAG) is presented with use of a mechanical activation method. Whole complex research of

rubbers' main operational properties is carried out. The structure is investigated by the means of optical, scanning electronic and atomic-force microscopes. It is established that joint mechanical activation of UHMWPE and UDAG creates effective mixture with polymeric elastomer material as one of the components with the most intensive interaction on interphase border BNKS – 18/UHMWPE, which led to the improvement of modified materials operational properties.

Key words: joint mechanical activation, butadien-nitrile rubber, ultra high-molecular polyethylene, polymeric elastomer composition, polymer nanocomposition.

UDC 678.743.41:661.183.4

Filling of ultra high molecular weight polyethylene with modified kaolinite. Okhlopkova A. A., Nikiforov L. A., Gogoleva O. V., Borisova R. V. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 48–54.

The paper presents the results of research on the development of tribological polymer composite materials based on ultra high molecular weight polyethylene (UHMWPE), containing layered filler. The technologies of layered kaolinite modification by compounds of different chemical nature (polypropylene and surface active agents) through their joint mechanical activation in a planetary ball mill are developed. Thus materials are characterized by a higher wear resistance (4 times higher) in comparison with the initial UHMWPE while maintaining or increasing the deformation strength values.

Key words: ultra high molecular weight polyethylene, kaolinite, compatibilizer, exfoliation, structure formation, surface active agents.

UDC 678.067:621.822

Experimental definition of polyurethane wear intensity sliding on abrasive surface. Yakovlev S. N. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 55–63.

Values of wear ability and linear wear intensity in sliding mode of constructive polyurethane with different hardness are presented in the article. Damages of wearing surface of polyurethane specimens are described. Limit values of power criterion within polyurethane sliding on polished steel surface are discussed.

Key words: experimental unit, wear ability of polyurethane, normalized abrasive surface, wear intensity, cover of cement-concrete, true contact area.

UDC 678:539.37:543.5

Fractal analysis as a criterion of visco-elastic and deformational electromagnetic properties of dense cross-linked polymers. Ulitin N. V., Nasyrov I. I., Nabiev R. R., Shirokikh E. B., Tereschenko K. A. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 64–69.

This paper introduces a fractal-incremental approach to the theoretical estimate of mathematical model parameters of the bonded visco-elastic and electromagnetic properties of dense cross-linked polymers. This approach has allowed correlation of the fractal dimensionality and statistical parameters of dense cross-linked polymers topological structure with the model parameters. The approach has been proven by use of computer physical modeling of the topological structure in terms of epoxiamine dense cross-linked polymers. Adequacy of the model, in which certain parameters within the frame of fractal-incremental approach are applied, has been proved out by comparison of theoretical and empirical thermo-optic curves.

Key words: visco-elastic properties, deformational electromagnetic properties, dense cross-linked polymers.

UDC 678.743.41:621.892

Influence of the dispersed filler contents on adhesion ability of a matrix and filler in polymeric nanosize composites of tribotechnical purposes. Sedakova E. B., Kozyrev Yu. P. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 70–75.

Features of physical model application of relative wear process for composites with disperse nanosize filler are considered. Settlement ratio for definition of the unmodified polymer share in a composite are received depending on concentration and filler dispersiveness. It is shown, that while forecasting tribotechnical properties of polymeric nanocomposite materials on the basis of physical model of relative wear process it is necessary to take into account restriction about the top limit of filler

concentration. This limit is connected with transition of a matrix material in the completely adsorbed condition, since additional filler introduction results in decrease of adhesive durability on the border polymer – filler.

Key words: wear, composite material, forecasting, nanofiller, adhesive durability, volume concentration.

UDC 666.764.5:669...693

High-temperature antioxidation coatings for carbon ceramic composite materials. Grashchenkov D. V., Isaeva N. V., Solntsev S. St., Evdokimov S. A. – Voprosy Materialovedeniya, 2013, N 3(75), p. 76–80.

The problems of high antioxidant coatings creation for carbon ceramic composite materials used in the aviation, rocket and space equipment, the technology of its application, as well as their advantages over the common foreign technology.

Key words: carbon ceramic composite materials, antioxidation coating, application technology.

UDC 669.35:621.315.3

Cast microwire in glass insulation from copper-based alloys with a minimum temperature coefficient of resistance. Masaylo D. V., Farmakovskiy B. V., Kuznetsov P. A., Mazeeva A. K. – Voprosy Materialovedeniya, 2013, N 3(75), p. 81–87.

A study of binary systems Cu–Si; Cu–Cr; Cu–Mn; Cu–Fe; Cu–Ni; Cu–Ga; Cu–Ge; Cu–Pd; Cu–In; Cu–Sn; Cu–Ag in order to obtain microwire in glass insulation is conducted. The paper identifies the most promising binary composition copper – manganese and copper – nickel, which are the basis for casting alloys with temperature coefficient of less than $1 \cdot 10^{-5} \text{ K}^{-1}$.

Key words: copper-based alloys, cast microwire, glass insulation, temperature coefficient of resistance, resistivity.

UDC 666.3/.7:546.281 261

Application of pyrocarbon as chemical reagent for manufacturing ceramic composite materials cubic boron nitride – silicon carbide – silicon. Ordanyan S. S., Gordeev J. S. – Voprosy Materialovedeniya, 2013, N 3(75), p. 88–93.

Methods for manufacturing of composite materials in the system of cubic boron nitride – silicon carbide – silicon with pyrolytic carbon as a chemically active agent at the formation of silicon carbide matrix are shown. The basic properties of pyrolytic carbon, its structure, properties, methods of application are considered. The paper provides the most effective ways of pyrolytic carbon injections in the blank of cubic boron nitride.

Key words: pyrocarbon, pyrocarbon synthesis methods, siliconizing, cubic boron nitride, composites, non-shrink technology.

UDC 620.196.2:669.14.018.8

Elemental metal composition of the walls of micro-cracks formed during corrosion cracking of steel 18Cr10NiTi evaluated in chloride solutions by X-ray microanalysis. Malyshev V. N., Petrov S. N. – Voprosy Materialovedeniya, 2013, N 3(75), p. 94–99.

The paper provides the data about microanalysis of metal walls cracks formed during corrosion tests after cracking of U-shaped steel samples of 18Cr10NiTi in a saturated NH_4Cl solution at $\sim 100^\circ\text{C}$. Based on this data, calculation of the relative change in the metal main alloying elements in the surface crack layers according with the share of these oxides is provided.

Key words: steel 18Cr10NiTi, corrosion cracking, crack's walls, contents of elements, X-ray microanalysis.

UDC 621.039.6:620.19.193

Corrosive-erosive wear of pipelines in second circuit of power generating units of WWER-1000. Ozhigov L. S., Mitrofanov A. S., Ruzhytsky V. V., Tolstolutskaia G. D., Bryk V. V., Vasilenko R. L., Voyevodin V. N. – Voprosy Materialovedeniya, 2013, N 3(75), p. 100–106.

Corrosive-erosive wear of operational surfaces of flat spiral tube elements (FSTE) of feeding water heaters for generating power unit of WWER-1000 which were produced from ferritic-perlitic steel of brand "20" is investigated. The study was realized by metallography, scanning electron microscopy, by analysis of micro X-ray spectrometry and it was shown that for FSTE removed of operation due to the formation of through leakages the surface represents the continuous pitted pattern with ferritic structure in the form of mosaic of bordering one another rounded pits with element composition corresponding to the iron oxide FeO. It is revealed that formation of ferritic structure is related to the processes of selective corrosion of perlitic colonies due to the discontinuity on the oxide film. It was also revealed the decrease of desorbed hydrogen quantity during the increase of tube element wear. Results of electron microscopic study of the structure of FSTE surfaces and release of hydrogen from worn out metal show that the wear of low-phase ferritic-perlitic steel 20 is caused by accelerated selective corrosion of perlite with erosive carrying out of reaction products.

Key words: corrosive-erosive wear, feeding water heaters, ferritic-perlitic steel, metallography, scanning electron microscopy, release of hydrogen.

UDC 669.15–194.56:621.039.531:539.219.2

Improvement of a static fracture resistance prediction model of austenitic materials under neutron irradiation. Minkin A. J., Margolin B. Z., Smirnov V. I., Sorokin A. A. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 107–119.

On the basis of the previously proposed general model for prediction of fracture toughness of irradiated austenitic materials a new improved model is developed. This model is less conservative and allows to obtain dependences of the fracture toughness on test temperature and neutron dose individually for the base metal and the weld metal over the test temperatures range from 20 to 350°C. Input data for the model are the fracture toughness of unirradiated material and dependences of the yield strength and ultimate strength on test temperature and neutron dose.

Key words: austenitic materials, irradiation, fracture toughness, prediction

UDC 621.785.78:621.039.531

A new method for prediction of thermal ageing of WWER-reactor pressure vessel steels. Margolin B. Z., Yurchenko E. V., Morozov A. M., Chistyakov D. A. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 120–134.

A new method has been proposed for prediction of thermal ageing of reactor pressure vessel (RPV) steels. The method is based on the test results of materials in two conditions, namely, aged at high temperatures (relative operating temperature) and annealed after irradiation at RPV operation temperature. The prediction is based on the McLean equation and the dependencies describing thermally activated and radiation-enhanced phosphorus diffusion. Experimental studies have been carried out for estimation of thermal ageing of the 2Cr–Ni–Mo–V steel. For this steel the average phosphorus content is near 0.018% (the content range is 0.016–0.020%), and initial transition temperatures are $T_{k0} = -41^\circ\text{C}$ and $T_{k0} = -2^\circ\text{C}$. Estimation of the transition temperature shift ΔT_k due to phosphorus segregation has been performed on the basis of the experimental data treated by the proposed method for the time $t = 5 \cdot 10^5$ hr (~60 years of operation) for the base and weld metals of WWER-1000 RPV.

Key words: thermal embrittlement, segregation of phosphorus at interface and grain boundaries, equilibrium segregation, diffusion coefficient.

UDC 669.054.8:621.777:621.762.4

Investigation of the electric-sintering influence on the structure and properties of the briquette material of shaving metal scrap steel Ст 3 (St. 3). Andronov E. V., Vinogradov S. E., Pimenov A. V., Fedotov B. V. – *Voprosy Materialovedeniya*, 2013, N 3(75), p. 135–141.

The paper shows that a single pressing and sintering in electric furnaces of chip shredded metal scrap steel St 3 produce a low strength briquettes prone to shattering and breakage. Repeated pressing of briquettes followed by prolonged sintering in electric furnaces or sintering followed by a brief electric discharge increases the strength of the briquette material. Electric discharge sintering increases strength, density, conductivity of briquettes material by 90–95% relatively to the properties of the original compact material of the same composition. After a single pressing and sintering of briquettes in electric form pores

became elongated cavities with sharp edges, after re-pressing and sintering pore shape is retained, but their size is reduced, after the electric-sintering pore shape is close to spherical.

Key words: steel St 3, metal waste, electric discharge sintering, briquette pressing.