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CONTENTS

contents

To ninetieth birthday of Academician of the RAS Igor V. Gorynin 7

METALS SCIENCE. METALLURGY

Ivanova L. A., Travin V. V., Benemanskaya G. V., Makarenko I. V., Petrov V. N. Evolution of titanium alloy structure under elastoplastic loading 11

Sennikova L. F., Davydenko A. A., Burkhovetsky V. V., Zakoretskaya T. A. Deformation porosity for M0b copper bars after severe plastic deformation 22

FUNCTIONAL MATERIALS

Shabelskaya N. P., Zelenskaya E. A., Chernyshev V. M., Sulima S. I., Postnikov A. A., Vlasenko A. I., Taranushich V. A., Sulima E. V. The synthesis of nanosized zinc ferrite-chromites and its catalytic properties..... 29

Naguryanskaya Yu. N., Vlasov E. A. Research of Cu-containing alloys catalytic properties 36

Belyaev S. N., Scherbak A. G. On the influence of modified layer structural and phase changes for optical attributes of raster figures during laser marking 44

Sokolov A. G., Bobyliv E. E., Timofeev B. T. Improving operational performance of the carbide cutting tools through the diffusion metallization out of fusible liquid metal solutions..... 53

Kobernik N. V., Mikheev R. S., Vaganov V. E., Aborkin A. V. Structure and tribological properties of antifriction coatings modified by carbon nanotubes 60

Kudyakov A. I., Plevkov V. S., Belov V. V., Kudyakov K. L., Nevskii A. V. Technology and composition of carbon-fiber-reinforced concrete with high homogeneity of strength properties 66

POLYMERIC COMPOSITE MATERIALS

Goncharov V. A., Fedotov M. Yu., Shienok A. M., Ioshin D. V. Temperature and strain structure monitoring with distributed fiber sensors 73

Guniaeva A. G., Chursova L. V., Fedotov M. Yu., Cherfas L. V. Research of the CFRP with nanomodified lightning strike protective coating and system of the built-in control on the basis of fiber optic Bragg grating sensors..... 80

Sargsyan A. S., Bakhareva V. E. New heat-resistant electrical insulating fiberglass 92

WELDING AND RELATED PROCESSES. WELDING MATERIALS AND TECHNOLOGIES

Vasiliev N. V., Karzov G. P., Blizum A. A., Borkin P. I., Zueva M. I. Exploring the sensitization of welded joints heat-affected zone and high-temperature heat treatment efficiency for austenitic pipelines Du300 of NPP with reactors RBMK-1000 99

Karzov G. P., Galiatkin S. N., Mikhaleva E. I., Timofeev M. N. Effect of the weld thermal cycle on the structural and phase metal transformations of welded joints for heat-resistant Cr-Mo-V-steels 108

CORROSION AND PROTECTION OF METALS

Kurs M. G., Laptev A. B., Kutyrev A. E., Morozova L. W. Investigation of corrosion damage of wrought aluminium alloys at full-scale accelerated tests. Part 1..... 116

Voinov S. I., Zhelezina G. F., Pavlovskaya T. G., Volkov I. A. Problem of contact corrosion in fiber-metal laminates based on aluminum and carbon fiber reinforced plastics 127

STRUCTURAL-WORKING STRENGTH AND SERVICEABILITY OF MATERIALS

Margolin B. Z., Fomenko V. N., Vakulenko A. A., Piminov V. A., Chernobaeva A. A. Determination of spatial non-homogeneity margins for structural integrity assessment of WWER-1000 RPV by brittle fracture criterion. Part 1. Theoretical analysis 134

Margolin B. Z., Fomenko V. N., Minkin A. I., Vakulenko A. A., Chernobaeva A. A. Determination of spatial non-homogeneity margins for structural integrity assessment of WWER-1000 RPV by brittle fracture criterion. Part 2. Experimental study 151

Margolin B. Z., Kostylev V. I., Fomenko V. N., Akbashev I. F., Matkovsky V. V. On J-integral calculation for RPV structural integrity assessment during emergency core cooling..... 162

RADIATION MATERIALS SCIENCE

Kuleshova E. A., Erak A. D., Bubiakin S. A., Zhurko D. A., Bandura A. P. Comparative studies of brittle fracture mechanism for standard and reconstructed CT specimens made from WWER-1000 RPV materials 180

NEWS AND EVENTS

In memory of Oleg Evgenyevich Litonov, PhD..... 192

Abstracts of published articles..... 193

Index of authors..... 205

Instructions for authors of the scientific and technical journal "Voprosy Materialovedeniya". Manuscript requirements..... 207

ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.295:539.431

Evolution of titanium alloy structure under elastoplastic loading. Ivanova L. A., Travin V. V., Benemanskaya G. V., Makarenko I. V., Petrov V. N. – Voprosy Materialovedeniya, 2016, N 1(85), p. 11–21.

Titanium pseudo- α -alloy structure changes up to failure at different scale levels have been studied in a phased loading by methods of scanning electron and atomic force microscopy. It is shown that at the meso-level fragmented structure replaces dislocation structure, which is characteristic to the initial stretching. Influence of the initial structure is gradually disappearing with deformation.

Keywords: titanium pseudo- α -alloy, elastoplastic loading, microstructure evolution.

UDC 669.35:620.192.47:539.374

Deformation porosity for M0b copper bars after severe plastic deformation. Sennikova L. F., Davydenko A. A., Burkhovetsky V. V., Zakoretskaya T. A. – Voprosy Materialovedeniya, 2016, N 1(85), p. 22–28.

The porosity of the copper bars of brand M0b (M06) (99.99%) has been studied after severe plastic deformation by hydrostatic and angular hydrostatic extrusion. It is shown that angular hydrostatic extrusion in the processing of copper bars reduces defects and improves functional properties of the material.

Keywords: hydrostatic extrusion, angular hydrostatic extrusion, bars, deformation porosity, hardness, density, electrical resistance.

UDC 661.847:66.097

The synthesis of nanosized zinc ferrite-chromites and its catalytic properties. Shabelskaya N. P., Zelenskaya E. A., Chernyshev V. M., Sulima S. I., Postnikov A. A., Vlasenko A. I., Taranushich V. A., Sulima E. V. – Voprosy Materialovedeniya, 2016, N 1(85), p. 29–35.

Processes of phase formation in the system of $ZnFe_{2-x}Cr_xO_4$ ($x = 0.0, 1.4, 2.0$) composition have been investigated. The resulting materials were characterized using the methods of powder X-ray diffraction, electron microscopy, Scherrer, BET. The mechanism of formation of single-phase samples, comprising a step of forming of chelate complexes of cations of transition elements with citric acid and their subsequent thermal decomposition has been studied. Catalytic activity of synthesized materials has been shown in the process of oxidative degradation of methyl orange in the presence of hydrogen peroxide. The results could be applied for wastewater treatment of industrial enterprises from organic dyes.

Keywords: zinc ferrite, zinc chromite, Fenton catalyst, wastewater treatment, oxidative degradation.

UDC 669.35:621.793.16

Research of Cu-containing alloys catalytic properties. Naguryanskaya Yu. N., Vlasov E. A. – Voprosy Materialovedeniya, 2016, N 1(85), p. 36–43.

In this work, results of oxygenating of the Cu-containing alloys in the range of temperatures of 600–1000°C during 2–10 h are presented at a volume consumption of air 40 of h^{-1} ; the optimum conditions of receiving strong oxide layers are revealed. Influence of temperature, oxygenating time, and also machining of a surface on thickness of oxide layers of alloys and catalytic activity in reactions of oxidation of CO, H₂, and CH₄ is investigated.

Keywords: metal plates, oxygenating, oxide layers, reactions of oxidation, copper, brass.

UDC 669.26:621.793.7

On the influence of modified layer structural and phase changes for optical attributes of raster figures during laser marking. Belyaev S. N., Scherbak A. G. – Voprosy Materialovedeniya, 2016, N 1(85), p. 44–52.

The paper presents results of topochemical interactions analysis at the formation of raster figures on the surface of titanium nitride coatings by laser marking. Technological methods and means for controlling the optical and electrical properties of a raster by changing the phase composition of the markable layer have been proposed. The paper shows the efficiency of varying the composition and partial pressures of the components of the gaseous medium to empower the marking process. Practical results confirm the analytical calculations.

Keywords: laser marking, raster figure, contrast, electrostatic gyro rotor, solid-phase interaction.

UDC 669.295:621.793.6:621.961.025

Improving operational performance of the carbide cutting tools through the diffusion metallization out of fusible liquid metal solutions. Sokolov A. G., Bobyliv E. E., Timofeev B. T. – Voprosy Materialovedeniya, 2016, N 1(85), p. 53–59.

The work aims to make a comparative analysis of the impact of the diffusion titanizing out of fusible liquid metal solutions on operational properties of carbide cutting tools. Coating was applied to T5K10, T15K6, VK8, VK12 alloyed plates by immersing them in a vial with fusible solution containing titanium. Pre-cutting inserts were subjected to short-term high-temperature carburizing. The coated cutting inserts were tested for resistance when turning U10 steel after quenching and tempering (medium hardness is 43–45 HRC), the quality of the surface after the treatment was controlled. During the tests it was found that tool coating increases its resistance by 4–5 times comparing with the uncoated surface.

Keywords: diffusion titanium coating, carbide cutting tool, tool life, increased durability, improving the quality of treatment.

UDC 621.791.927.55:621.891

Structure and tribological properties of antifriction coatings modified by carbon nanotubes. Kobernik N. V., Mikheev R. S., Vaganov V. E., Aborkin A. V. – Voprosy Materialovedeniya, 2016, N 1(85), p. 60–65.

The possibility of modified carbon nanotubes, made of babbitt alloy coatings in plasma-powder surfacing has been reviewed. Methods of optical and electron microscopy have been used to study coatings structure on transverse sections and fracture surfaces. It was found that destruction of carbon nanotubes does not occur in typical plasma deposition process. An increasing porosity of the coatings has been observed when using the powder modified by carbon nanotubes. Modification of babbitt coatings by carbon nanotubes leads to a decrease of the friction coefficient by the average of 25% and increases the wear resistance by 18% in the considered range of loads.

Keywords: plasma-powder surfacing, carbon nanotubes, babbitt, structure, friction coefficient, wear.

UDC 666.98:693.542.4:539.4

Technology and composition of carbon-fiber-reinforced concrete with high homogeneity of strength properties. Kudyakov A. I., Plevkov V. S., Belov V. V., Kudyakov K. L., Nevskii A. V. – Voprosy Materialovedeniya, 2016, N 1(85), p. 66–72.

The article presents the results of research on carbon-fiber-reinforced concrete. Different processing techniques of introducing carbon fibers into the concrete mix have been considered. The influence of chemical additives on quality of separation of fibers being treated prior to their introduction into concrete mix has been investigated. The optimal percentage of dispersed carbon-fiber-reinforcement and technology of its production taking into account the increase in strength properties have been defined experimentally. The relative strength growth dependence of fiber-reinforced concrete under compression and tension has been defined on the basis of amount of carbon fiber reinforcement. As a result optimal composition and production technology of carbon-fiber-reinforced concrete with stable strength properties have been obtained.

Keywords: carbon-fiber-reinforced concrete, carbon fiber, dispersed reinforcement, modifying additives, fibers distribution, compressive and tensile strength, homogeneity.

UDC 620.171.32.05

Temperature and strain structure monitoring with distributed fiber sensors. Goncharov V. A., Fedotov M. Yu., Shienok A. M., Ioshin D. V. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 73–79.

The article presents the results of tests for samples and panels made of CFRP with distributed fiber sensors. The efficiency of such sensitive systems for the control of the stress-temperature state of the structure has been presented. Assessment of sensitivity to loading and change of temperature based on spectral characteristics has been investigated. The distributed sensors with Bragg gratings have been compared according to the results of mechanical tests.

Keywords: distributed fiber sensor, Brillouin frequency shift, fiber-optic sensor, fiber Bragg grating, optical time domain reflectometry, CFRP, large-sized composite wing panel.

UDC 678.067:629.7.067

Research of the CFRP with nanomodified lightning strike protective coating and system of the built-in control on the basis of fiber optic Bragg grating sensors. Guniaeva A. G., Chursova L. V., Fedotov M. Yu., Cherfas L. V. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 80–91.

The paper describes research results of lightning strike influence on CFRP with nanomodified protective coating and system of the built-in control based on fiber optic Bragg grating sensors. The main characteristics of CFRP with lightning strike protective coating and test results for resistance to lightning damage are shown. Schedules of temperature change and deformations in the course of tests for resistance to lightning strike have been obtained.

Keywords: polymeric composite material, fiber optic sensor, fiber Bragg grating, CFRP, lightning strike protective coating, nanoparticles.

UDC 678.067.5

New heat-resistant electrical insulating fiberglass. Sargsyan A. S., Bakhareva V. E. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 92–98.

The paper presents comparative tests results for new heat-resistant electrical insulating polymer composite materials based on glass tissue and various polymeric binders, and designed to operate at temperatures up to 280°C. Thermosetting (epoxy, organosilicon, polycyanurate) and thermoplastic binders (polyphenylene sulfide) have been researched.

Keywords: heat-resistant fiberglass, polyphenylene sulfide, electrical insulation properties, physical and mechanical properties, comparative tests.

UDC 621.791.052:621.78–978:621.039.536.4

Exploring the sensitization of welded joints heat-affected zone and high-temperature heat treatment efficiency for austenitic pipelines Du300 of NPP with reactors RBMK-1000. Vasiliev N. V., Karzov G. P., Bliumin A. A., Borkin P. I., Zueva M. I. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 99–107.

The regularities in the distribution of sensitization degree on the heat-affected zone of welded joints for pipelines Du300 for NPP (RBMK-1000, High Power Channel Type Reactor) have been studied. The efficiency of high-temperature heat treatment regime for austenitic pipelines Du300 welded joints has been confirmed.

Keywords: sensitization degree, heat-affected zone of welded joints, intergranular stress corrosion cracking, potentiodynamic reactivation, diagnostic complex “SAKhS-1”.

UDC 621.791.053:621.039.536.2

Effect of the weld thermal cycle on the structural and phase metal transformations of welded joints for heat-resistant Cr–Mo–V-steels. Karzov G. P., Galiatkin S. N., Mikhaleva E. I., Timofeev M. N. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 108–115.

The paper gives the results of dilatometric and metallographic studies, determining the microhardness of weld metal made by materials for automatic welding of WWER reactor vessels and oil hydrocracking reactors. Small difference of the alloying elements quantities (nickel, chromium, molybdenum and vanadium) affects weld metal structure prior to heat treatment.

Keywords: WWER-reactor vessel, petrochemical reactor vessels, welding materials, dilatometry, weld metal microstructure.

UDC 669.715:620.193.21

Investigation of corrosion damage of wrought aluminium alloys at full-scale accelerated tests. Part 1. Kurs M. G., Laptev A. B., Kutyrev A. E., Morozova L. W. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 116–126.

Investigation findings of corrosion damage of perspective aluminium alloys belonging to 8 systems after four years of full-scale accelerated tests with increase of surface concentration of chlorides under conditions of lukewarm climate are given.

Keywords: corrosion, aluminum alloys, full-scale accelerated tests.

UDC 678.067–419:620.193

Problem of contact corrosion in fiber-metal laminates based on aluminum and carbon fiber reinforced plastics. Voinov S. I., Zhelezina G. F., Pavlovskaya T. G., Volkov I. A. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 127–133.

The article considers the problem of contact corrosion in the metal-layered composite materials based on aluminum and carbon fibers, as well as ways to prevent its appearance.

Keywords: carbon fiber, CFRP, aluminum alloys, fiber-metal laminates.

UDC 621.039.536.2:539.422.22

Determination of spatial non-homogeneity margins for structural integrity assessment of WWER-1000 RPV by brittle fracture criterion. Part 1. Theoretical analysis. Margolin B. Z., Fomenko V. N., Vakulenko A. A., Piminov V. A., Chernobaeva A. A. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 134–150.

The basic methods for prediction of the temperature dependence of fracture toughness $K_{Jc}(T)$ have been considered. The margins set for adequate and conservative prediction of $K_{Jc}(T)$ based on the results of tests of surveillance specimens, has been analyzed.

The methodology for determination of margins taking into account spatial non-homogeneity of brittle fracture resistance of RPV material has been proposed. This methodology is based on probabilistic calculation of brittle fracture resistance of RPV in which deterministic condition of RPV structural integrity is introduced as input information.

Keywords: reactor vessel, fracture toughness, non-homogeneity of properties, prediction.

UDC 621.039.536.2:539.422.22

Determination of spatial non-homogeneity margins for structural integrity assessment of WWER-1000 RPV by brittle fracture criterion. Part 2. Experimental study. Margolin B. Z., Fomenko V. N., Minkin A. I., Vakulenko A. A., Chernobaeva A. A. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 151–161.

Standard deviations of the critical brittleness temperature T_k of the base metal (shells), and the weld metal for the WWER-1000 pressure reactor vessels have been described on the basis of experimental data. Values of margins for spatial non-homogeneity of brittle fracture resistance have been determined on the basis of T_k standard deviation, defect density and size of defects distribution (for probabilistic calculation), size of postulated defect (for deterministic calculation) and RPV loading during emergency core cooling.

Keywords: reactor vessel, fracture toughness, spatial non-homogeneity.

UDC 621.039.536.2:539.422.22

On J-integral calculation for RPV structural integrity assessment during emergency core cooling. Margolin B. Z., Kostylev V. I., Fomenko V. N., Akbashev I. F., Matkovsky V. V. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 162–179.

The procedure of J-integral calculation for life time assessment of the reactor pressure vessel has been elaborated by brittle fracture criterion under conditions of emergency core cooling. An approach to the choice of the integration contour size for an adequate assessment of the brittle fracture resistance has been formulated.

Keywords: WWER reactor pressure vessel, calculation of the J-integral, resistance to brittle fracture, emergency core cooling, size of the contour of integration.

UDC 621.039.536.2:539.422.22

Comparative studies of brittle fracture mechanism for standard and reconstructed CT specimens made from WWER-1000 RPV materials. Kuleshova E. A., Erak A. D., Bubiakin S. A., Zhurko D. A., Bandura A. P. – *Voprosy Materialovedeniya*, 2016, N 1(85), p. 180–191.

Until 2002, SE(B) specimens were included into surveillance specimens sets for operating WWER-1000 reactors. Transition from SE(B) specimens to CT specimens in the fracture toughness tests is caused by the necessity to reduce the scatter and conservativeness of data, that happen as a result of scale increase and loading scheme. To make such a transition possible SE(B) specimens were reconstructed into CT specimens.

A comparative fractographic analysis of the standard and reconstructed CT specimens after the fracture toughness tests shows that both types of the crack initiation start from the “leader”. Types of “leaders” and their relationship do not change, but test and fractographic analysis results of standard and reconstructed CT specimens are described by one analytical dependence CTOD(CID) for each material and state.

Keywords: WWER-1000 reactor vessel, brittle fracture, test results, comparative fractographic analysis, standard and reconstructed CT specimens.