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ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.15–194.55:539.4

Development of steam-turbine high-chromium steels of new generation with increased stability of characteristics of long-term strength. Matyusheva E. L., Teplukhina I. V. – Voprosy materialovedeniya, 2010, N 3(63), p. 5–15.

Are considered the main principles alloying of modern steels for components of steam turbines, and also the basic tendencies in maintenance of long-term strength steels for this class. Are developed two experimental structures for steels of martensite class with contents of chromium 9–12% and low content of carbon. Are certain an optimum regime of heat treatment for each material and level of properties after tests for long-term strength.

Keywords: high-chromium steels, steam turbines, long-term strength, alloying principles.

UDC 669.14.018.2:621.771

Modelling of microstructure and mechanical properties of steel sheet after rolling on mill 2000 of JSC “Severstal”. Vasilyev A. A., Kolbasnikov N. G., Sokolov D. F., Sokolov S. F., Nemtinov A. A. – Voprosy materialovedeniya, 2010, N 3(63), p. 16–26.

Are presented results of modification of model HSMM (Hot Strip Mill Model), effected with the purpose of increase of accuracy of definition of mechanical properties for steels after rolling on mill 2000 of JSC “Severstal”.

Keywords: steel from assortment of mill 2000, mechanical properties, structure, mathematical model HSMM, modification of models.

UDC 621.746.6:539.422.22

Technology of steel castings production and its effect on tendency to brittle failure. Chernyshov Ye. A. – Voprosy materialovedeniya, 2010, N 3(63), p. 27–32.

The paper presents the results of the forced cooling of complex-alloyed steel castings on its tendency to brittle failure. Cr–Ni–Mo–V steel in heavy body castings was researched. External effect of forced cooling was studied on thin-walled shell moulds; complex effect on thin-walled shell moulds with suspension cast, and the volumetric form left as control specimen.

Keywords: technology, quality, working capacity, casting, brittle failure, impact toughness, temperature.

UDC 669.15'786–194.56:537.621:620.172.254

Effect of tensile stress on magnetic parameters of austenitic steel with 0,4% N. Mitropolskaya S. Yu. – Voprosy materialovedeniya, 2010, N 3(63), p. 33–39

The effect of tension under room temperature on magnetic parameters (coercivity, magnetization and differential magnetic permeability) was studied on nitrogen-bearing steel 0Kh20AG12N8M, which consists of austenite+10% δ -ferrite + CrN-nitrides after precipitation hardening. A sharp increase of differential magnetic permeability was revealed in magnetic field of 1.5 kA/m under applied tensile stress in the vicinity of yield point. The described features of magnetic behavior should be considered by steel structure designers as well as metallurgists in order to ensure constantly low magnetic permeability.

Keywords: austenitic nitrogen-bearing steel, magnetic parameters, tensile stress.

UDC 669.15–194.2:621.771–413

Thermally reinforced heavy plate products from low-alloyed steels. Maksimov A. B. – Voprosy materialovedeniya, 2010, N 3(63), p. 40–44.

Are considered theoretical aspects of failure of thermally reinforced heavy plate products from low-alloyed steel. Available literary data are analysed. Are offered recommendations for practical use of effects of reflection and refraction of elastic waves in steel.

Keywords: low-alloyed steel, thermally reinforced heavy plate iron, model of failure.

UDC 669.15–194.56:548.4:539.374

Dislocation structures and textures in specimens from steel 08X18H10T after hot deformation by pressing. Barakhtin B. K., Vargasov N. R., Mikhailov-Smolnyakov M. S., Fedoseev M. L. – Voprosy materialovedeniya, 2010, N 3(63), p. 45–52.

After plastometrical tests of specimens from steel 08X18H10T at temperatures 900–1200°C with speeds of deformation in range of 10^{-3} – 10 c⁻¹ and studying of metal structure by methods of X-ray structure analysis, light and electronic transmission microscopy is found out connection between formed texture of deformation and kind of dislocation formations. For example, in conditions of intensive fragmentation dislocation structures generate formation of structures {100} <100>, {111} <110> and {111} <112> which upon its symmetry are close to symmetry of stresses field from external forces. Plastic deformation in regime of superplasticity at minimal expenses of mechanical energy promotes to formation of new condition – a germ of recrystallization grain thorough internal structure.

Keywords: steel 08X18H10T, plastometrical tests, dislocation structures and textures, hot deformation by pressing.

UDC 669.245'71'26:621.785.78:620.186.1

Disorder of alloy based on Ni₃Al by heterogeneous mechanism. Afanasyev N. I., Lepakova O. K. – Voprosy materialovedeniya, 2010, N 3(63), p. 53–57.

Research in structural and phase transformations into the chrome and carbon-doped alloy based on Ni₃Al is carried out. The dissolution of Cr₇C₃ carbide particles, which are mainly placed along the grains boundary of the γ' -phase results in the alloy disorder and the formation of two-phase (γ' + γ) near-boundary areas at the temperature of 1373 K. These areas grow according to the heterogeneous mechanism similarly to the cells of periodic disintegration, but the initial boundaries of grains remain motionless. The reaction stops after the complete dissolution of carbides. The γ' -phase grains 0.2–0.3 microns in size surrounded by the γ -phase layers 0.1 microns in width are formed in the transformed areas. The discovered phase transformation results in the formation of an ultra-fine grain structure and softening of alloy at high temperatures.

Keywords: Intermetallide, structure, disorder, creep.

UDC 621.763:66.061.35

Technology of receiving of fibres by method of extraction stationary melted drop. Khanin D. E., Koshkin K. N., Urusov K. Kh. – Voprosy materialovedeniya, 2010, N 3(63), p. 58–66.

The paper presents an analysis and modeling process for fibers production by the method of hanging melt drops extraction, with a view to select the optimal technology parameters for the fibers of the required size.

Keywords: fibres of metals, method of receiving, extraction from stationary melted drop, modelling of process.

UDC 621.9.048.4:669.268

Use of the chrome-content materials for creating electrospark coatings. Luneva V. P. – Voprosy materialovedeniya, 2010, N 3(63), p. 67–71.

Are researched properties of chromium-content coatings upon steel 45, spreaded by electrospark method. Are certain conditions providing creation of most qualitative upon condition and mechanical properties of coatings, including degree of diffusion of chromium and chromium-content alloys in a superficial layer. Are used gravimetric, electrophysical, optical and roentgen-phase methods of research. It is established, that at electrospark alloying due to high-temperature processes the phase structure of superficial layer of steel (cathode) and anode material are changed. Metal of superficial layer is strengthened, its corrosion resistance and in this connection operational properties of steel products are increased.

Keywords: protection coatings, electrospark alloying, hardening of surface, chromium coating.

UDC 669.24'71:536.468

Microstructure and catalytic properties system of Ni–Al, obtained in the mode of SHS. Kosova N. I., Kurina L. N., Lepakova O. K., Kittler V. D., Kasatsky N. G. – Voprosy materialovedeniya, 2010, N 3(63), p. 72–77.

The paper presents experimental results of investigations of alloys of Ni–Al in the composition Ni–Ni₃Al, obtained by self-propagating high-temperature synthesis. Local microprobe and X-ray analysis showed the presence of the phase Ni(Al), Ni₃Al, Ni₅Al₃, Ni. The nature of the location of the phase of the sample of Ni–7.5 wt.% Al indicates that they were formed by the reaction diffusion in the interaction of liquid aluminum and solid nickel. Formation of products of compositions Ni–Al (10 wt.% and 13.4 wt.%) in the regimes of thermal explosion and layer-burning heating, respectively, is one mechanism: by dissolving nickel in liquid aluminum, followed by crystallization from the melt phase Ni₃Al. The catalytic properties of intermetallic compounds in the carbon dioxide conversion of methane. Maximum conversion of methane and carbon dioxide reaches 96.98%, respectively, for the binary system Ni–7.5 wt.% Al.

Keywords: microstructure of nickel aluminides, SHS synthesis, processing of natural gas.

UDC 621.762.24:669.28

Metallothermic reduction of molybdenum compounds in the melt sodium chloride. Gostishchev V. V., Hosen Ree, Khimukhin S. N., Astapov I. A. – *Voprosy materialovedeniya*, 2010, N 3(63), p. 78–81.

Physico-chemical aspects reception powder molybdenum reduction his oxygen compounds aluminium, magnesium in the melt sodium chloride are studied. Thermodynamic estimation of reduction reaction is given. It is found, that in order to provide 95–97% of powder yield, it is necessary to use 15–25% excess of the reducer amount as compared to the designed, thus the amount of impurity elements in reduction products does not exceed ~3%. It is shown, that value specific surface molybdenum powder, obtained by using magnesium, makes $20.19 \cdot 10^5$, aluminium – $64.4 \cdot 10^5 \text{ m}^{-1}$.

Keywords: salt melt, molybdenum powders, aluminium, magnesium.

UDC 621.762:661.856:666.3/.7

The preparation and properties investigation of ceramics from cuprous oxide nanopowder. Bardakhanov S. P., Lysenko V. I., Nomoev A. V., Trufanov D. Yu., Fokin A. V. – *Voprosy materialovedeniya*, 2010, N 3(63), p. 82–85.

Nanopowder of cuprous oxide (Cu₂O) produced through new technology of raw material evaporation by electron beam, was used for preparation of submicrograin (of 1 μm about) dense ceramics. The obtained ceramics structure and properties were investigated with the use of SEM, TEM, XRD, luminescence spectroscopy and by spectrophotometric method.

Keywords: nanopowder, cuprous oxide, nanoceramics, ceramics properties.

UDC 678.067:541.136

Formation technology of anode nanocomposite systems from renewed vegetative raw material and nanodisperse elements for cycling sources of current. Onishchenko D. V., Boiko Yu. N., Popovich A. A. – *Voprosy materialovedeniya*, 2010, N 3(63), p. 86–94.

Are developed energy-conserving and mechano-chemical regimes for receiving of anode nanocomposite materials on the basis of renewed vegetative raw material of systems carbon-nanodisperse silicon and carbon-nanodispersive tungsten for lithium-ion (polimeric) accumulators.

Keywords: nanocomposite materials, renewed vegetative raw material, mechano-chemical regimes, mechano-synthesis, mechano-activation, nanodispersive silicon and tungsten, lithium-ion (polymeric) accumulators.

UDC 621.385.832:66.091

Synthesis of single-layered carbon nanotubes by aerosol method. Nasibulin A. G., Shandakov S. D., Zavodchikova M. Yu., Tolochko O. V., Kauppinen E. I. – *Voprosy materialovedeniya*, 2010, N 3(63), p. 95–104.

Are considered methods of synthesis for carbon nanotubes. Is shown the opportunity of segregation individual single-layered carbon nanotubes from beams in gas phase and inspection of their parameters by means of etching agents. Is discussed advantage of aerosol method of synthesis carbon nanotubes as for a variation of their properties (diameter and morphology), and for their subsequent use in hi-tech areas (electronics, optics, electrochemistry).

Keywords: carbon nanotubes, methods of synthesis.

UDC 669.15–194.56:621.039.531:620.194.8

The method of lifetime prediction of PWR internals on the criterion of initiation of intergranular stress corrosion cracking of irradiated austenitic steels. Margolin B. Z., Fedorova V. A., Filatov V. M. – Voprosy materialovedeniya, 2010, N 3(63), p. 105–118.

Available experimental data on susceptibility to intergranular stress corrosion cracking (IGSCC) of irradiated austenitic steels in the first circuit of PWR are analyzed. On the basis of performed analysis a physical-mechanical modeling of damages in austenitic steels by IGSCC mechanism is carried out. Stress damage dose curve is introduced as a locus of threshold stresses below which IGSCC does not occur for any level of damage dose. The method for lifetime prediction of reactor vessel internals is elaborated on the crack initiation criterion when a stress and a neutron damage dose depend on time.

Keywords: austenitic stainless steels, irradiation, coolant, intergranular corrosion cracking, physical-mechanical model of corrosion

UDC 621.791.019:621.78:621.039.536.2

Definition of residual structurally-plastic deformations at intermittent welding and shaped thermomechanical treatment of the thin-walled case. Svetlikov V. A. – Voprosy materialovedeniya, 2010, N 3(63), p. 119–127.

Is developed the high-efficiency method of experimental definition of the residual structurally-plastic deformations arising at intermittent welding and shaped thermomechanical treatment of thin-walled hull. Application of this method will allow to develop effectual measures on prevention and elimination weld deformations of light gage case designs, to reduce duration of manufacturing and increase quality of hulls of high-speed vehicles.

Keywords: residual structurally-plastic deformations, thin-walled hull, sheet, critical width of sheet, bend.