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ABSTRACTS OF PUBLISHED ARTICLES

UDC669.15–194.55:621.77.016.2

Simulation of behaviour of 07X16H4B steel at hot deformation. V a r g a s o v N. R., R y b i n V. V. – Problems of Materials Science, 2004, № 1 (37), p. 5–11.

A possibility of simulation of behaviour of martensitic class steel at vacuum heat treatment was studied using principles of nonequilibrium thermodynamics and criterion for optimization of deformation temperature-rate conditions was formulated.

Key words: martensitic class steel, vacuum heat treatment, mechanical energy dissipation, deformation temperature-rate conditions, calculation model.

UDC 669.14.018.29:621.77.016.2

Methods of optimization of temperature-rate conditions of structural steels hot deformation. V a r g a s o v N. R., R y b i n V. V. – Problems of Materials Science, 2004, № 1 (37), p. 12–17.

A criterion is proposed which allows for optimization of the selection of temperature-rate parameters of structural steels hot plastic deformation — a portion of power dissipated by material as a result of structural and phase transformations.

Key words: structural steels, hot deformation, temperature-rate conditions, structural and phase transformations, energy dissipation, features of method.

UDC 669.14.018.27:621.785.545

Heating of spring steel with pulse current. M a l ' t s e v I. M., O s h u r i n a L. A., S u v o r o v N. V. – Problems of Materials Science, 2004, № 1 (37), p. 18–23.

It was studied the hardness and specific electric resistance of spring steel of 65Г grade after fast electric heat treatment depending on quenching media and tempering temperature. X-ray structural and metallographic examinations were carried out.

Key words: spring steel, hardness, specific electric resistance, electric heat treatment.

UDC 669.715:539.374

Structure and mechanical properties of aluminium alloy AMg6 subjected to plastic deformation and electropulse treatment. B a r y k i n N. P., V a l e e v I. S h., T r i f o n o v V. G., V a l e e v a A. K h. – Problems of Materials Science, 2004, № 1 (37), p. 23–31.

Changes in the microstructure and mechanical properties of commercial aluminium alloy AMg6 after plastic deformation and recrystallization have been studied. This alloy was recrystallized by annealing in air at temperatures of 250–450°C for 20 min in an furnace and by passing an electrical current pulse.

It was shown that the electrical pulsed treatment allows one to produce a fine-grained structure in the AMg6 alloy with a grain size (2–3 μm) less than after annealing in a furnace (9 μm) irrespective of degree of deformation. Electrical pulsed treatment improves the operative (increase in strength by 30%) and technological (decrease in the flow stress by 40%, increase in plasticity by 60%) characteristics of the Al–6Mg–0.6Mn alloy treated by pulsed current in comparison with furnace annealing.

Key words: recrystallization, powerful electrical pulsed treatment, annealing, microstructure, microhardness, grain size, mechanical properties, flow stress, strain-rate sensitivity coefficient, superplastic properties.

UDC 621.762.2

Peculiarities of structure formation at compacting of loose copper cuttings. Z a g i r o v N. N., A n i k i n V. I., B i r o n t V. S. – Problems of Materials Science, 2004, № 1 (37), p. 31–40.

Regular trends of structure formation of a material obtained as a result of compacting of copper cuttings using vacuum cold and heat treatment in combination with heat treatment.

Key words: copper cuttings, compacting, vacuum treatment, heat treatment, material structure.

UDC 621.793.7:669.71

Working out of investigation method and optimization of a process of supersonic “cold” gas-dynamic spraying at consolidation of aluminium structures. D z h u r i n s k y D. V. – Problems of Materials Science, 2004, № 1 (37), p. 41–48.

Technical peculiarities of a method of supersonic “cold” gas-dynamic spraying were experimentally studied. Methodical guides and apparatus of control of cold gas-dynamic spraying process parameters were developed. Process diagram of assembly (joining) of aluminium model elements of heat exchanging module used in high-vacuum joints. This process diagram is used in industrial production of aluminium structures.

Key words: aluminium, supersonic “cold” gas-dynamic spraying, process parameters control, features of the method.

UDC 621.762:539.4

Production technology and service characteristics of microlayer composite materials for electric contacts of new generation. Grechanyuk N. I., Osokin V. A., Grechanyuk I. N., Mamuzich I., Borisenko V. A., Bukhanovskii V. V., Rudnitskii N. P. – Problems of Materials Science, 2004, № 1 (37), p. 49–55.

The paper presents description of the production technology of microlayer composite materials for electric contacts of the system Cu–Zr–Y–Mo obtained by the method of electron-beam evaporation and layer condensation from the vapor phase and a study of their chemical composition, structure, density, electric conductivity, hardness, and main mechanical characteristics in the temperature range from 290 to 1070 K.

Key words: microlayer composite material, electron-beam technologies, nanomaterials, electric contacts, electric conductivity, strength, hardness, plasticity, high temperatures.

UDC 669.017.16:621.763

Processing, structure and mechanical properties of bulk nanostructured composite materials for medicine and engineering. Kolobov Yu. R., Grabovetskaya G. P., Dudarev E. F., Ivanov K. V. – Problems of Materials Science, 2004, № 1 (37), p. 56–63.

The effect of dispersion hardening on structure stability, physical and mechanical properties of nanostructured metallic materials processed by severe plastic deformation has been studied.

It has been established that dispersion hardening of nanostructured copper by high-strength Al₂O₃ oxide particles (20–100 nm in size) increases its strength by 1,5 times during tension and by one order of magnitude during creep. Recrystallization temperature rises from 423 to 723 K and electrical resistant from 1.69 to 1.96 Om·cm.

Using commercial titanium example, feasibility for development of nanocomposite material by way of precipitation of high-strength carbides (Ti₂C 10–30 nm in size) in metallic matrix during thermomechanical treatments in the temperature interval where the nanostructure is stable. The strength properties of the above material reach the value characteristic for heterogeneous titanium alloys ($\sigma_{0.2} = 850$ MPa, $\sigma_b = 1100$ MPa).

Key words: nanostructure, composite, dispersion hardening, severe plastic deformation, creep, strength, ductility, copper, titanium.

UDC 621.762

The effect of batch mixture on physical and mechanical properties of the porous penetrable TiC-based materials. Kulkov S. N., Gnusov S. F., Sevostia-nova I. N., Molchunova L. M. – Problems of Materials Science, 2004, № 1 (37), p. 64–69.

A study of the phase content, the molding pressure and sintering temperature on the phase formation, density, strength and electric resistance of the porous TiC–Al₂O₃, TiC–ZrO₂ and TiC–TiO₂ systems has been carried out. It has been shown, that the value of opened porosity of TiC–Al₂O₃ and TiC–TiO₂ systems changes in the range from 75 to 85% of total pore volume, the yield strength amounts from 25 to 35 MPa, and specific electric resistance is $(1-10) \cdot 10^{-4}$ Ohm·cm.

Key words: porous penetrable materials, TiC, batch mixture, value of opened porosity, strength.

UDC 62—251:621.78.08

Calculation of the temperature fields and stresses at different cooling rates of as-tempered rotor billets. Gulenko A. G., Margolin B. Z., Tsukanov V. V. – Problems of Materials Science, 2004, № 1 (37), p. 70–74.

Calculation of the temperature fields and stresses arising in as-tempered hollow and solid rotor billets under cooling made it possible to optimize high-speed cooling cycle, to obtain a lower value of the rotor metal critical brittleness temperature.

Key words: temperature stresses, temperature fields, cooling rate.

UDC 621.791.052:539.219.2:620.17

Scientific and methodical problems of fracture toughness certification tests for the welded joint structurally heterogeneous metal. Vinogradov O. P., Ilyin A. V., Filin V. Yu. – Problems of Materials Science, 2004, № 1 (37), p. 75–89.

Procedure for determination of CTOD fracture toughness parameter for the weld joint material has been included among modern regulatory documentation requirements. Carrying out these tests, however, at test temperatures

conforming to extremely low climatic temperatures is complicated by a number of methodical problems inclusive of those being strictly theoretical in nature. A formulation of these problems is given and test results making it possible to correct ways of the solution of problems in question are presented.

Key words: weld joints, structurally heterogeneous metal, fracture toughness parameter, certification tests, scientific and methodical problems.

UDC 669.14.018.8:620.194:62—251

An influence of geothermal steam atmosphere on corrosion-mechanical damage of the TPP turbine rotor material. Mushnikova S. Yu., Harkov A. A., Tsukanov V. V. – Problems of Materials Science, 2004, № 1 (37), p. 90–94.

Comparative evaluation of corrosive resistance and capacity to resist corrosion cracking was performed for steel grades P2MA, 10X13H3M2ΦAД, 26XH3M2ΦA, which had been selected as the rotor materials for turbines of geothermal power plants. General corrosion test was run on a number of specimens of these steels in aggressive medium at a temperature of 90°C, corrosion cracking test was carried out on flat test bars under constant straining and four-point bending (true bending) conditions, step loading test was run on notched test bars with a fatigue crack under console bending conditions. Steel grade 26XH3M2ΦA is shown to have the highest corrosion damage resistance in aggressive geothermal heat-transfer media.

Key words: steel, turbine rotor, corrosion, corrosion cracking, geothermal medium.

UDC 669.14.018.8:620.193.27

A problem of the threshold temperature of transgranular corrosion cracking in steel 08X18H10T caused by the influence of marine aerosols. Malyshev V. N. – Problems of Materials Science, 2004, № 1 (37), p. 95–100.

A possibility of transgranular corrosion cracking in steel 08X18H10T at a moderate temperature ($35\pm 2^\circ\text{C}$) is considered for a case when marine aerosols may precipitate on structures of such steel. In practice this may be of interest in the cases when pieces of equipment made of such steels are used under conditions being typical of sea shores in the tropics.

Key words: high-strength steel, transgranular corrosion cracking, marine aerosols, the tropics climatic conditions.

UDC 620.179.16

Defect retrieval parameters selection by angle single-crystal probes at ultrasonic test. Kruglov B. A. – Problems of Materials Science, 2004, № 1 (37), p. 101–110.

Procedure for defect retrieval parameters selection by angle single-crystal ultrasonic probes (based on analytical treatment of defect detectability functions) is described. Ways of attaining the predetermined authenticity of test and the highest test capacity for a linear-cross scanning scheme are established. Examples of using the procedure are considered.

Key words: ultrasonic test, a linear-cross scanning scheme, defect detectability functions, procedure for defect retrieval.