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CONTENTS

METALS SCIENCE. METALLURGY

- Stchastlivtsev V. M., Tabatchikova T. I., Jakovleva I. L., Egorova L. J., Vatutin K. A., Kruglova A. A., Orlov V. V., Khlusova E. I.* Research of structure and properties of low alloyed cold-resistant steel 10ГНБ grade, made under various technological regimes 7
- Stchastlivtsev V. M., Tabatchikova T. I., Jakovleva I. L., Egorova L. J., Vatutin K. A., Golosienko S. A., Kruglova A. A., Khlusova E. I.* Influence of thermomechanical processing on structure and mechanical properties of ship-building steel 09XH2MДФ grade 20
- Golosienko S. A., Motovilina G. D., Khlusova E. I.* Influence of the structure generated at hardening on properties of high-strength cold-resistant steel after tempering 32
- Kalinin G. Yu., Yampolsky V. D.* Influence of hot rolling regimes on structure and hardening of high-nitrogen corrosion resistant low-magnetic steel 05X19AГ10H6MФБ grade 45
- Jao Fuchen, Jao Luiui.* Bainite steels with ultra low content of carbon and prospects of their applications (review) 52

RADIATING OF MATERIALS SCIENCE

- Svetuhin V. V., Kozlov D. V., Golovanov V. N.* Microstructural mechanisms and model of radiating embrittlement of steel 15X2HMΦAA grade and its welded joints after irradiation in research reactors ... 62
- Svetuhin V. V., Sidorenko O. G., Golovanov V. N., Suslov D. N.* Simulating of radiating embrittlement of materials for vessels of reactors VVER-440 69

FUNCTIONAL MATERIALS

- Aleutdinova M. I., Fadin V. V.* Surface layers morphological modification of composites with copper matrix at sliding current collection 80
- Ordanjan S. S., Ponomarenko V. A., Sinani A. B., Smirnov K. A.* Features of some mechanical properties of compositions in systems hard alloy – highly hard filling compound 89
- Sevostianova I. N., Molchunova L. M., Gнусov S. F., Anisimov V. Zh., Kulkov S. N.* The Influence of pore-formation additives on a morphological structure and properties of a porous Al₂TiO₅ 97
- Boiko V. F., Vlasova N. M.* Estimation of disperse magnesium containing mineral raw material by criteria of gridability 104

STRUCTURAL-WORKING STRENGTH AND SERVICEABILITY OF MATERIALS

- Margolin B. Z., Minkin A. I., Smirnov V. I., Fedorova V. A., Kohonov V. I., Kozlov A. V., Yevseyev M. V., Kozmanov E. A.* Research of influence of neutron irradiation on static and cyclic fracture strength of chromium-nickel austenite steel 111
- Margolin B. Z., Minkin A. I., Smirnov V. I., Fomenko V. N.* Forecasting of static fracture strength of austenite materials at conditions of a neutron irradiation 123
- Filatov V. M., Komarov A. V.* Corrosion fatigue curves for austenitic stainless steels 139

TESTS, DIAGNOSTICS AND QUALITY CONTROL OF MATERIALS

- Kozyrev Yu. P., Sedakova E. B.* The definition of the optimum frequency of a spectrum of acoustic emission signals for diagnostics of the filled polytetrafluorethylene wear 156

PHYSICS AND MECHANICS OF LARGE PLASTIC STRAINS OF STRUCTURAL MATERIALS

<i>Lotkov A. I., Grishkov V. N., Dudarev E. F., Girsova N. V., Tabachenko A. N.</i> Formation of ultrafine-grained structure, martensite transformations and inelastic properties of titanium nickelide after “abc”-pressing	161
<i>Baturin A. A., Lotkov A. I., Grishkov V. N.</i> Evolution of crystalline structure defects in titanium nickelide after severe plastic deformation	166
<i>Lysak V. I., Kusmin S. V., Rybin V. V.</i> Criteria for development of super-high plastic deformation caused by oblique collision of metal objects during explosion welding.....	172
<i>Abakumov A. I., Bolshakov A. P., Gushanov A. R., Karpenko I. I., Sinitsyn V. V.</i> Experimental study and numerical simulation of low-speed deformation of energetic materials loaded in joined Hopkinson bars.....	184
<i>Panin V. E., Grynyaev Yu. V., Panin A. V.</i> Field theory of defect subsystem in the neck of strained solid	197

NEW ITEM

Memory of Editor-in-Chief of Journal “МИТОМ” prof. B. Prusakov.....	213
---	-----

Abstracts of published articles	215
--	-----

A list of articles published in the journal of science and engineering “Problems of Materials Science” in 2007 year	231
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Journal of science and engineering “Problems of Materials Science”. Design of article. Recommendations	234
---	-----

ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.14.018.41:621.789

Research of structure and properties of low alloyed cold-resistant steel 10ГНБ grade, made under various technological regimes. Stchastlivtsev V. M., Tabatchikova T. I., Jakovleva I. L., Egorova L. J., Vatutin K. A., Kruglova A. A., Orlov V. V., Khlusova E. I. – Problems of Materials Science, 2008, N 1 (53), pp. 7–20.

Mechanical properties and structure of rolled sheet from steel 10ГНБ grade after hardening, tempering and thermomechanical processing at two technological regimes are investigated. The high level of strength and cold resistance of the steel subjected to thermomechanical processing is determined by generation in steel disperse ferrite-bainite structure with high density of dispositions. It is shown, that in structure of the steel subjected to hardening and high tempering and also to hardening from rolling heating and to the subsequent tempering the density of dispositions in α -phase is lower than in structure of the steel subjected to two-stage thermomechanical processing.

Key words: high strength cold-resistant steel, rolled sheet, thermomechanical processing, strength, cold resistance.

UDC 669.14.018.293:621.789

Influence of thermomechanical processing on structure and mechanical properties of ship-building steel 09ХН2МДФ grade. Stchastlivtsev V. M., Tabatchikova T. I., Jakovleva I. L., Egorova L. J., Vatutin K. A., Golosienko S.A., Kruglova A. A., Khlusova E. I. – Problems of Materials Science, 2008, N 1 (53), pp. 20–32.

Mechanical properties of rolled sheet by thickness up to 30 mm from low carbon low alloyed steel subjected to thermomechanical processing at various regimes in laboratory and industrial conditions were investigated. By methods of metallography and electronic microscopy were investigated structure of steel after thermomechanical processing and also after additional high tempering. The structural factors influencing on increase of mechanical properties are revealed. It is established, that thermomechanical processing promotes braking of softening at tempering. Prospectivity of using such rolled sheet is shown at manufacturing of large-sized welded structures used in shipbuilding.

Key words: low carbon low alloyed steel, thermomechanical processing.

UDC 669.14.018.41:621.785.6

Influence of the structure generated at hardening on properties of high-strength cold-resistant steel after tempering. Golosienko S. A., Motovilina G. D., Khlusova E. I. – Problems of Materials Science, 2008, N 1 (53), pp. 32–44.

Influence of the structure generated at cooling with various speeds at temperatures of austenizing, on mechanical properties of high-strength cold-resistant steel after the subsequent hardening is investigated.

Key words: high-strength cold-resistant steel, rolled sheet, austenizing, speed of cooling, structure, strength, cold resistance.

UDC 669.14.018.8:621.771

Influence of hot rolling regimes on structure and hardening of high-nitrogen corrosion resistant low-magnetic steel 05X19AГ10H6MФБ grade. Kalinin G. Yu., Yampolsky V. D. – Problems of Materials Science, 2008, N 1 (53), pp. 45–52.

It was investigated influence of fine-dispersed segregations on yield strength of high-strength corrosion-resistant steel alloyed by nitrogen generating during process of plastic deformation by rolling at temperature interval 1200–900°C. It was established that at decrease of temperature of deformation there is a linear increase of yield strength in connection with increase of amount of segregations and unsoundness of austenite. Increase of yield strength at increase in concentration of vanadium from 0,18 up to 0,32% and niobium from 0,09 up to 0,18% is caused by formation of a quantity of these nitrides.

Key words: high-strength cold-resistant steel, rolled sheet, austenizing, speed of cooling, structure, strength, cold resistance.

UDC 669.15–194.591

Bainite steels with ultra low content of carbon and prospects of their applications (review). Jao Fuchen, Jao Luiui. – Problems of Materials Science, 2008, N 1 (53), pp. 52–61.

The causation and advantages of ULCB on composition, microstructure and weldability are analyzing to compare to tradition structure steels. The recent investigation and development are refered abroad. And the application is prospected.

Key words: bainite steel with the ultralow contents of carbon, strength, weldability, prospects of application.

UDC 621.039.531

Microstructural mechanisms and model of radiating embrittlement of steel 15X2HMΦAA grade and its welded joints after irradiation in research reactors. Svetuhin V. V., Kozlov D. V., Golovanov V. N. – Problems of Materials Science, 2008, N 1 (53), pp. 62–69.

Questions connected with radiating embrittlement of steel 15X2HMΦAA grade, used for manufacturing of VVER-1000 vessels are considered. The function of impurity and alloying elements are investigated. Attempt of simulating of radiating embrittlement depending from temperature of irradiation and concentration of nickel is undertaken.

Key words: reactor VVER-1000, steel 15X2HMΦAA grade, welded joints, irradiation, impurity and alloying elements, simulating of radiating embrittlement.

UDC 621.039.531

Simulating of radiating embrittlement of materials for vessels of reactors VVER-440. Svetuhin V. V., Sidorenko O. G., Golovanov V. N., Suslov D. N. – Problems of Materials Science, 2008, N 1 (53), pp. 69–79.

A kinetic model of radiation-induced clasterization and precipitation of impurities in metals and alloys is proposed. The presented model is used for description of ductile-brittle transition temperature steels in the VVER-440 reactors. Mathematical expressions describing neutron flux effect on radiation embrittlement are drown.

Key words: steel, kinetic model, precipitation of impurities, VVER-440 reactor, radiation embrittlement.

UDC 621.763:621.891

Surface layers morphological modification of composites with copper matrix at sliding current collection. Aleutdinova M. I., Fadin V. V. – Problems of Materials Science, 2008, N 1 (53), pp. 80–88.

Volt-ampere characteristic and intensity of wear for tribotechnical model matrix metall steel based composites have been determined at sliding on counterbody of steel 45 (50 HRC) with electric current density more then 100 A/cm². It is shown the model of Gadfield steel based composite has a low wear resistance at sliding with current density more then 80 A/cm². The ball bearing steel based composite forms high plasticity friction induced structures an has intensity of wear less then 30 mm/km at current density about 220 A/cm². It is noticed the counterbody steel friction surface oxidize in conditions of current sliding.

Key words: sliding electric contact, sintered composite, intensity of wear, friction, microstructure, friction induced structures.

UDC 621.763:621.891

Features of some mechanical properties of compositions in systems hard alloy - highly hard filling compound. Ordanjan S. S., Ponomarenko V. A., Sinani A. B., Smirnov K. A. – Problems of Materials Science, 2008, N 1 (53), pp. 89–97.

The basic opportunity of creation of composite materials with adjustable hardness and wear resistance in systems of matrix BK-8 – filling compound (β -BN, SiC, diamond, Al₂O₃) in which negative effects of change of a phase condition of components are minimized at the expense of applications of «pulse» technologies is confirmed. It is shown, that at corresponding selection of parameters P , T , τ reception of group of composite ceramic materials for extreme conditions of operation is possible.

Key words: the composite ceramic materials, adjustable hardness and wear resistance, «pulse» technologies, hard alloy – highly hard filling compound.

UDC 621.762.5

The Influence of pore-formation additives on a morphological structure and properties of a porous Al_2TiO_5 . Sevostianova I. N., Molchunova L. M., Gnusov S. F., Anisimov V. Zh., Kulkov S. N. – Problems of Materials Science, 2008, N 1 (53), pp. 97–103.

It has been studied the influence of pore-formation additives on a morphological structure and mechanical properties of a porous Al_2TiO_5 after reaction sintering. It has been shown that in material is formed a bi-modal porous structure with bending strength changed by exponential law.

Key words: porous Al_2TiO_5 , pore-formation additives, reaction sintering.

UDC 549.522.1:621.762.222

Estimation of disperse magnesium containing mineral raw material by criteria of gridability. Boiko V. F., Vlasova N. M. – Problems of Materials Science, 2008, N 1 (53), pp. 104–110.

With use of means of mathematical statistics and positions of colloide chemistry is investigated kinetics of crushing of mineral raw material - nemalite before and after thermal processing up to a condition of powders.

Key words: magnesium containing mineral raw material, nemalite, thermal processing, granulometric characteristics, crushing of granules.

UDC 669.15`26`24–194.56:621.039.531:539.219.2

Research of influence of neutron irradiation on static and cyclic fracture strength of chromium-nickel austenite steel. Margolin B. Z., Minkin A. I., Smirnov V. I., Fedorova V. A., Kohonov V. I., Kozlov A. V., Yevseyev M. V., Kozmanov E. A. – Problems of Materials Science, 2008, N 1 (53), pp. 111–122.

Researches of influence of a neutron irradiation on static and cyclic of chromium-nickel austenite steel 10X18H9 grade, irradiated within more than 5,5 thousand effective days in reactor БН-600 in a range of temperatures 20–400°C are carried out. Characteristics of static fracture strength of this steel at change of a damaging doze and temperatures of tests are determined. It is shown, that neutron irradiation of a doze up to 20 dpa does not result in reduction of its cyclic fracture strength.

Key words: chromium-nickel austenite steel, irradiation, fracture strength.

UDC 669.15–194.56:621.039.531:539.219.2

Forecasting of static fracture strength of austenite materials at conditions of a neutron irradiation. Margolin B. Z., Minkin A. I., Smirnov V. I., Fomenko V. N. – Problems of Materials Science, 2008, N 1 (53), pp. 123–138.

The analysis of the literary and original data on influence for static fracture strength of austenite materials of neutron irradiation and temperature of tests is executed. Relation for forecasting of static fracture strength dependence of austenite materials from fluence of neutrons, temperature of irradiation and tests temperature is offered.

Key words: austenite materials, irradiation, forecasting, fracture strength.

UDC 669.15–194.56:621.039.531:620.194.23

Corrosion fatigue curves for austenitic stainless steels. Filatov V. M., Komarov A. V. – Problems of Materials Science, 2008, N 1 (53), pp. 139–155.

Resistance to fatigue failure of austenitic stainless steels decreases in contact with the water coolant of nuclear reactors. The experimentally determined degree of reduction in the number of cycles depends on the temperature and the strain rate in the half-cycle of tension. Neutron irradiation increases the yield strength and the ultimate strength but reduces the ductility of steels, what decreases the lifetime in the low-cycle fatigue region during cyclic loading.

Fatigue curves that agree with the results of fatigue tests at air and in reactor water have been calculated based on empirical fatigue curve equations including mechanical properties of steels with regard for irradiation impacts (for irradiated steels) and the fatigue strength corrosive reduction factors. When using specified mechanical characteristics in fatigue curve equations it is necessary to correct the coefficients of bringing of the sample fatigue test laboratory conditions to the conditions of full-scale components loading. The calculated fatigue curves determined by empirical equations agree with the new design fatigue curves proposed for the ASME code.

Key words: austenitic steels, fatigue curve equation, reactor water, neutron irradiation.

UDC 621.891:620.179.17

The definition of the optimum frequency of a spectrum of acoustic emission signals for diagnostics of the filled polytetrafluorethylene wear. Kozyrev Yu. P., Sedakova E. B. – Problems of Materials Science, 2008, N 1 (53), pp. 156–160.

Are carried out the tribotechnical tests of the filled polytetrafluorethylene at change of size of sliding speed in a wide range with registration of signals of acoustic emission. For diagnostics of wear of a material the spectral analysis of a sequence of root-mean-square deviations of acoustic emission signals with application of Discrete Fourier Transform is used, and the size of wear is determined on high-frequency amplitude making a power spectrum. Comparison of the counted value of mass wear filled polytetrafluorethylene with the experimental value is given the offered method of diagnostics of wear provides sufficient accuracy.

Key words: wear, tribotechnical tests, acoustic emission, the spectral analysis, polytetrafluorethylene.

UDC 539.2:548.4:681.3

Formation of ultrafine-grained structure, martensite transformations and inelastic properties of titanium nickelide after “abc”-pressing. Lotkov A. I., Grishkov V. N., Dudarev E. F., Girsova N. V., Tabachenko A. N. – Problems of Materials Science, 2008, N 1 (53), pp. 161–165.

Effect of large plastic deformations during “abc”-pressing at 873–573 K on microstructure and martensite transformations in titanium nickelide was investigated. A mixed ultrafine-grained structure of alloy based on submicrocrystal and nanostructured fractions is shown to form at low temperatures of deformation. The diagram of martensite transformations when deformed samples were cooled and heated was built. The influence of “abc”-pressing temperature on shape memory effect in titanium nickelide was studied.

Key words: titanium nickelide, “abc”-pressing, ultrafine-grained structure, martensite transformations, shape memory effect.

UDC 669.295'245:548.4:539.374

Evolution of crystalline structure defects in titanium nickelide after severe plastic deformation. Baturin A. A., Lotkov A. I., Grishkov V. N. – Problems of Materials Science, 2008, N 1 (53), pp. 166–171.

Regularities of influence of severe plastic deformation (SPD) during ultrasonic processing (USP) on evolution of crystalline structure defects in surface layers of titanium nickelide with monoclinic martensite structure B19' were investigated. It was found that with the increase of SPD both concentration of vacancy defects and density of dislocation defects rise sharply and intensive fragmentation of grain-subgrain structure takes place at the same time. Observed in nano-structured state are mostly vacancy-type defects on boundaries of grains whose average volume is less than the volume of equilibrium vacancies in TiNi and is comparable with the size of free volumes in amorphized alloys on the base of titanium nickelide. The role of crystalline structure defects in the mechanisms of formation of nano-structured state under SPD is discussed.

Key words: titanium nickelide, plastic deformation, dislocations, vacancies, fragmentation, positron annihilation spectroscopy.

UDC 621.791.13:539.374

Criteria for development of super-high plastic deformation caused by oblique collision of metal objects during explosion welding. Lysak V. I., Kusmin S. V., Rybin V. V. – Problems of Materials Science, 2008, N 1 (53), pp. 172–183.

The degree and pattern of plastic deformation in welded joints, caused by oblique collision of metal objects during explosion welding, as well as their relationship with welding parameters and strength properties of bimetallic specimens were investigated.

Key words: composite metallic materials, explosion welding, plastic deformation.

UDC 539.411:620.173

Experimental study and numerical simulation of low-speed deformation of energetic materials loaded in joined Hopkinson bars. Abakumov A. I., Bolshakov A. P., Gushanov A. R., Karpenko I. I., Sinitsyn V. V. – Problems of Materials Science, 2008, N 1 (53), pp. 184–196.

An attempt is made to numerically simulate deformation of samples of energetic materials under static and low-speed loading in static and dynamic compression experiments. Dynamic experiments were carried out on an installation designed following the joined Hopkinson bar technique.

Key words: energetic materials, static low-speed loading, deformation, numerical model.

UDC 539.374:548.4

Field theory of defect subsystem in the neck of strained solid. Panin V. E., Grynyaev Yu. V., Panin A. V. – Problems of Materials Science, 2008, N 1 (53), pp. 197–212.

Description of multilevel defect subsystem in the neck of strained solid, based on the field theory of defects, is suggested. The key mechanism of plastic deformation in the neck is connected with self-arrangement of two macrobands of localized shifts, oriented along conjugate directions of maximum tangential stresses. Their material rotations are compensated at mesoscale level by fragmentation of material in the neck, as accommodation mechanism of crystallographic rotations. Dislocation deformation at microscale level is described by the calibration theory of defects. The field theory of defects makes it possible to describe the known mechanisms of plastic deformation in the neck at various scale levels.

Key words: field theory of defects, plastic deformation, solid.