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ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.15:786–194.56:620.193

Corrosion-resistant high-strength nitrous steels. Gorynin I. V., Malyshevsky V. A., Kalinin G. Yu., Mushnikova S. Yu., Bannykh O. A., Blinov V. M., Kostina M. V. – Problems of Materials Science, 2009, N 3 (59), pp. 7–16.

It is researched influence of alloying elements (nitrogen, chrome, manganese, nickel, molybdenum, carbon, vanadium and niobium) and regimes of hot deformation and heat treatment upon structure, mechanical properties and resistance of steels to pitting corrosion in water solutions of chlorides. A result of researches was development of new corrosion-resistant nitrogen-containing austenite steels of the increased strength for shipbuilding.

Keywords: nitrogen-containing austenite steels, alloying elements, hot deformation, heat treatment, structure, mechanical properties, resistance to pitting corrosion.

UDC 669.018.44

Influence of change of microstructure at temperatures 800–1100°C on characteristics of high-temperature strength of alloy 45X26H33C2E2. Oryshchenko A. S., Utkin Yu. A. – Problems of Materials Science, 2009, N 3 (59), pp. 17–25.

It is investigated influence of change of metal structure condition for centrifugal-casting tube out of alloy 45X26H33C2E2 after isothermal soaking at temperatures 800–1100°C on characteristics of high-temperature strength and short-term mechanical properties.

Keywords: alloy of 45X26H33C2E2 grade, centrifugal-casting tube, structure condition, isothermal soakings, high-temperature strength.

UDC 669.15–194.2:621.78:621.771.23

Singularities of bainite structure in low-carbon welded steels after thermomechanical treatment. Schastlivtsev B. M., Tabatchikova T. I., Jakovleva I. L., Kruglova A. A., Khlusova E. I., Orlov V. V. – Problems of Materials Science, 2009, N 3 (59), pp. 26–38.

Were observed structural singularities of a bainite – a size of crystals, its mutual orientation, availability discharges of carbides cementite type – in the low-carbon low-alloy steels. Was revealed influence of size of austenitic grain and hot plastic deformation on an event bainite transformation at the subsequent cooling. Were researched structural singularities of a bainite in a rolled sheet by thickness from 24 up to 40 mm out of low-carbon low-alloy steels after thermomechanical treatment in industrial conditions. Were specified the structure factors bearing upon mechanical characteristics.

Keywords: low-carbon low-alloy steels, rolled sheet, bainite structure, mechanical properties.

UDC 669.15–194:621.039.536.2:621.73:681.3

Application of computer modeling for forecasting structurization and properties at carrying out of quenching for large-size forgings out of reactor steels. Karzov G. P., Teplukhina I. V., Golod V. M., Gjulihandanov E. L. – Problems of Materials Science, 2009, N 3 (59), pp. 39–51.

It is developed manufacturing process of large-size forgings of irregular shape with application of computer modeling for secure forecasting of structure and properties upon section of a product, optimization of shape of quenched blank, and also substantiations of correctness of sampling selection for mechanical tests at designing of technological processes (including processes of heat treatment).

Keywords: reactor steels, large-size forgings, computer modeling,

UDC 669.14.018.29

Structural heterogeneity and methods of its reduction for improvement of quality of structural steels. Malakhov N. V., Motovilina G. D., Khlusova E. I., Kazakov A. A. – Problems of Materials Science, 2009, N 3 (59), pp. 52–64.

There are researched the reasons of decrease a level of mechanical properties and characteristics of working capacity of low carbon low alloyed steels and methods of elimination of these reasons.

Keywords: low carbon low alloyed steel, characteristics of working capacity, structural heterogeneity, methods of quality improvement.

UDC 669.14.018.29:621.78

Physical modeling of processes of thermomechanical processing and control of structure of structural steel. Kodzhaspirov G. E., Khlusova E. I., Orlov V. V. – Problems of Materials Science, 2009, N 3 (59), pp. 65–84.

There are analyzed the modern methods based on use physical processes of modelling of thermomechanical processing and is validated the choice of the further directions of researches.

Keywords: structural steel, structure, thermomechanical processing, physical modeling.

UDC 669.14.018.44:621.78

Improvement of regimes of a preliminary heat treatment of forgings out of thermostable steels compositions Cr–4Ni–Mo–V and Cr–Mo–V and recommendations upon final heat treatment. Durynin V. A., Tsukanov V. V. – Problems of Materials Science, 2009, N 3 (59), pp. 85–95.

Were observed the base factors influencing upon structure formation of thermostable steels of compositions Cr–4Ni–Mo–V and Cr–Mo–V from which depend characterization required complex of properties of forging after heat treatment. Were developed recommendations in view of propensity of steels to a structural heredity.

Keywords: thermostable steels, structure formation, heat treatment, structural heredity.

UDC 669.295–412

Metallurgical aspects of manufacturing process of large-size ingots out of titanium alloys. Ushkov S. S., Kudryavtsev A. S., Karasev E. A., Bereslavskij A. L., Machishina L. A. – Problems of Materials Science, 2009, N 3 (59), pp. 96–107.

There are examined metallurgical aspects of manufacture of large-size ingots ($\varnothing 1000$ – 1200 mm) – technology of melt, feature of crystallization process, formation and morphology of crystallization front and their influence upon uniformity of structure and chemical composition of metal.

Keywords: titanium alloys, large-size ingots, metallurgical aspects of manufacture.

UDC 669.14.018.41

Cold-resistant steels for techniques of conversion of Arctic shelf. Gorynin I. V., Rybin V. V., Malyshevsky V. A., Khlusova E. I. – Problems of Materials Science, 2009, N 3 (59), pp. 108–126.

There are stated the basic achievements and scientific results received at creation of a series economic competitive steels of various strength with improved in some times characteristics of cold resistance, quality and processability at welding in comparison with domestic and foreign analogues, and also small-consumption technologies of their manufacture for sea techniques operated in extreme conditions of Arctic region – at extremely low temperatures, action of static, dynamic and cyclic loadings, corrosion medium.

Keywords: steels for sea techniques, cold resistance, processability at welding, the basic achievements, scientific results.

UDC 669.14.018.295:621.643

High-strength steels for the main pipelines. Rybin V. V., Malyshevsky V. V., Khlusova E. I., Orlov V. V., Shakhpazov E. Kh., Morozov Yu. D., Nastich S. Yu., Matrosov M. Yu. – Problems of Materials Science, 2009, N 3 (59), pp. 127–137.

Work is devoted to actual question of creation of easy-welded high-strength steels for manufacturing welded tubes with increased characteristics of strength, toughness and cold resistance.

Keywords: main pipelines, welded tubes, easy-welded high-strength steels, strength, toughness, cold resistance.

UDC 669.15–194:621.039.536.2

Creation of welded steel with the accelerated recession of the induced radio-activity for reactors bodies of increased resource and environmental safety. Rybin V. V., Karzov G. P., Kursevich I. P., Lapin A. N., Smirnov V. I., Teplukhina I. V., Scherbinina N. B. – Problems of Materials Science, 2009, N 3 (59), pp. 138–151.

On the basis of applied now steels 15X2MΦ(A) type it is developed steel of 15X2B2ΦA-A grade, providing in ~100 time lower level of the induced activity after 50-years exposure time in comparison with materials using now in nuclear power mechanical engineering.

Keywords: bodies of the reactors, welded steel with the accelerated recession of the induced radioactivity, increased resource and environmental safety.

UDC 669.295.018.44

Research of high-temperature strength of welded titanium alloys of 5B and 37 grades with reference to products of energy-machine building. Ivanova L. A., Kozlova I. R., Kudryavtsev A. S.,

Chudakov Yu. V. – Problems of Materials Science, 2009, N 3 (59), pp. 152–161.

There are researched mechanical properties and characteristics of creepage at temperatures up to 500°C of sea titanium alloys 5B and 37 grades with reference to products of energy-machine building with the limited resource of operation.

Keywords: titanium alloys, mechanical properties, creepage, thermal stability, products of energy-machine building.

UDC 669.295.018.28:621.311

High-strength welded casting titanium alloys for power equipment. Kudryavtsev A. S., Molchanova N. F., Travin V. V. – Problems of Materials Science, 2009, N 3 (59), pp. 162–171.

On the basis of the analysis of statistical data about service characteristics deformable titanium pseudo- α -alloys 5BЛ and 37Л the opportunity of application of foundry titanium alloys in the power equipment is proved.

Keywords: power equipment, deformable titanium pseudo- α -alloys, service characteristics, statistical data.

UDC 669.295:621.039.524.4

Experience of application and significance of titanium alloys for development of atomic power engineering of Russia. Ushkov S. S., Kozhevnikov O. A. – Problems of Materials Science, 2009, N 3 (59), pp. 172–187.

Was observed significance of titanium alloys for becoming and development of atomic power engineering of Russia. In connection with the increased requirements were noted weak points of structural materials of the different class used now in water-water reactors. Were revealed the basic advantages and prospects of application new class of materials for nuclear reactor industry – titanium α -alloys, capable to ensure high radiation and ecological safety of operation for new generation of water-water NPP of heightened resource, various power and assignment. Were defined the basic fields of application of titanium α -alloys in structure of perspective NPP.

Keywords: titanium alloys, nuclear reactor industry, water-water reactors, prospects of application.

UDC 669.14–41:539.2:621.771.23

Perspective methods of manufacturing sheet with submicrocrystalline and nanostructure. Rudskoj A. I., Kodzhaspirov G. E. – Problems of Materials Science, 2009, N 3 (59), pp. 188–192.

Were featured last achievements and prospects of obtained submicrocrystallines and nanostructures at manufacture of steel sheet. The special attention was given to an original method multistep pack rolling (MPR), based on application of intensive plastic deformation in regimes of thermomechanical treatment.

Keywords: steel sheet, multistep pack rolling, a submicrocrystalline structure, nanostructure.

UDC 621.77.016.2

Fragmentation of metals at intensive plastic deformation and singularities of plastic flow in conditions of equally-channel angle pressing. Rybin V. V., Kuchkin V. V., Rybin Yu. I., Parshikov R. A. – Problems of Materials Science, 2009, N 3 (59), pp. 193–203.

Were observed equally-channel angle pressing from positions of forming explicated fragmented structures with large-angle boundaries. Were offered an idealized model for description of mode of deformation at ECAP. By finite element method was analysed a real pattern of current of metal at ECAP elastoplastic blank in view of contact friction and angles of intersection of channels. Were resulted numerical values of influence of contact friction and angles of intersection of channels upon forming of inhomogeneity of deformed state.

Keywords: explicated fragmented structures with large-angle boundaries, equally-channel angle pressing, mode of deformation.

UDC 621.318.13:537.612

Researches and developments in the field of application of amorphous magnetically soft alloys for creation of magnetic screens. Kuznetsov P. A., Farmakovskij B. V., Tolochko O. V., Askinazi A. Yu., Vasilieva O. V., Peskov T. V. – Problems of Materials Science, 2009, N 3 (59), pp. 204–216.

Are presented results of researches and developments in the field of application of amorphous magnetically soft alloys for creation of magnetic screens for protection from constants and the variable magnetic fields, executed by a group of authors for last 10 years. Were revealed, that protection of magnetic screens from amorphous magnetically soft alloys on the basis of Co, took by relevant heat treatment for increasing of initial magnetic properties, can be more effective than magnetic screens from permalloys. Were developed and patented construction of the magnetic screen on the basis of straps from amorphous alloys. Were resulted instances of practical implementation of the executed explorations and developments.

Keywords: amorphous magnetically soft alloys on the basis of cobalt, magnetic screens, efficiency of protection from magnetostatic and alternate magnetic fields.

UDC 678.067:539.538

Modification of chemical composition and degree of heterogeneity for polymeric matrix and carbon reinforcing materials with the purpose of tribotechnical characteristics optimization of antifrictional carbon plastics. Bakhareva V. E., Anisimov A. V., Rybin V. V., Saviolov A. S. – Problems of Materials Science, 2009, N 3 (59), pp. 217–228.

It is made an attempt to develop ways of modification of chemical composition and a degree of heterogeneity for polymeric matrix and carbon fibres upon molecular and nanolevels.

Keywords: antifrictional carbon plastics, modifying upon nano- and microlevels, tribotechnical characteristics, carbon reinforcing materials, polymeric matrix, heterogeneity.

UDC 678.067:539.538

Nano- and micromodifiers of antifrictional carbon plastics. Rybin V. V., Bakhareva V. E., Anisimov A. V., Saviolov A. S. – Problems of Materials Science, 2009, N 3 (59), pp. 229–241.

There are examined concrete examples of modifying antifrictional carbon plastics on nano- and microlevels, is given analysis of its influence upon tribotechnical characteristics of carbon plastics.

Keywords: antifrictional carbon plastics, modifying on nano- and microlevels, tribotechnical characteristics.

UDC 669.14.018.41:621.791–112.81

Problems of certification and design conditions of requirements to welded joints of high-strength steel structures for work on a shelf of Arctic regions. Ievenko V. I., Bashaiev V. K., Ilyin A. V., Leonov V. P., Filin V. Yu., Schegoleva E. G. – Problems of Materials Science, 2009, N 3 (59), pp. 242–262.

There are discussed the problems arising at certification of high-strength cold-resistant materials for structures, working upon Arctic shelf of Russia. There are presented methodical features of carrying out of additional tests, substantiations of criteria of an estimation of quality, and also the problem moments of tests and the interpretations of their results demanding the further development.

Keywords: high-strength steel structures, welded joints, certification and design conditions of requirements, criteria of quality estimation.

UDC 621.039.524.4:539.422.22

Estimation of resistance to brittle failure of vessels of atomic reactors of WWER type: problems and modern approaches. Karzov G. P., Margolin B. Z., Shvetsova V. A., Kostylev V. I. – Problems of Materials Science, 2009, N 3 (59), pp. 263–289.

Were observed a new approaches for an estimation of integrity of the reactor vessel by criteria of resistance to brittle failure which allow to consider physical and mechanical aspects of scale factor; to ensure portability of the results obtained at test of check test piece upon a fracture toughness, upon

design defect in reactor vessel; to consider inhomogeneity of distribution of stress intensity factor along front of design defect, and also biaxiality and nonsmoothness of loading of reactor vessel.

Keywords: vessels of atomic reactors of WWER type, resistance to brittle failure, problems and modern approaches.

UDC 669.15–194:621.039.536.2:539.422.22

Development and application of the local Prometey-approach for prediction of brittle failure of vessel reactor steels. Margolin B. Z., Shvetsova V. A., Karzov G. P., Gulenko A. G., Kostylev V. I., Nesterova E. V. – Problems of Materials Science, 2009, N 3 (59), pp. 290–314.

Was presented the local Prometey-approach in its evolution from local criteria of a brittle failure to engineering applications. Was short observed use of local Prometey-approach for prediction of crack resistance of vessel reactor steels, including influence of short cracks, and also connection of physical mechanisms of radiation defects with physical mechanisms of initiation and extending of microcracks of chip.

Keywords: vessel reactor steels, local criteria of brittle failure, Prometey-approach, prediction of crack resistance.

UDC 669.15–194:621.039.526.034.6:669.4

Corrosion-mechanical strength of steels with γ - and α -lattice in contact with heat-transfer metal on the basis of lead. Karzov G. P., Kashtanov A. D., Markov V. G. – Problems of Materials Science, 2009, N 3 (59), pp. 315–328.

It is investigated behaviour of steels in contact with liquid lead which is used as the heat-transfer in reactors on fast neutrons, during short-term and long static loading and low-cycle loading is investigated.

Keywords: a reactor on fast neutrons, the heat-transfer metal on the basis of lead, steels with γ - and α -lattice, corrosion-mechanical strength.

UDC 669.295:621.791.052:620.178.3

Researches of mechanical characteristics of titanium pseudo- α -alloys and its welded joints over the range temperatures from 20 up to 500°C. Ivanova L. A., Kuznetsov C. V., Mezhonov V. I., Pas O. A., Khatuntsev A. N. – Problems of Materials Science, 2009, N 3 (59), pp. 329–343.

Were researched mechanical characteristics of titanium pseudo- α -alloys 5B and 37. Over the range temperatures from 20 up to 500°C at a short-term and long static loading welded joints are full-strength to base metal if the weld is generated or remelting of base metal, or with application of filling wire BT6CB. Initial strength of deformable semiproducts from these alloys, as well as welded joints from its, do not change after preliminary cyclic and long static loading at room and heightened temperatures, a little losing in toughness.

Keywords: pseudo- α -alloys of titanium, a short-term and long static loading, mechanical properties.

UDC 669.295:621.78

Influence of heat treatment for welded stress relief on characteristics of working capacity of base metal of titanium alloy 5B. Kudryavtsev A. S., Panotskij D. A. – Problems of Materials Science, 2009, N 3 (59), pp. 344–350.

There are presented results of research of metal of whole-rolled ring and rolled stock made by JSC "Corporation VSMPO-AVISMA", influence of heat treatment on characteristics of working capacity of material out of alloy 5B grade and ways of their increase.

Keywords: titanium alloy 5B, whole-rolled ring, rolled stock, characteristics of working capacity.

UDC 669.295:621.771.23

Influence of crystallographic texture upon anisotropy of mechanical properties of sheet semiproducts out of titanium alloys. Kudryavtsev A. S., Chudakov E. V. – Problems of Materials Science, 2009, N 3 (59), pp. 351–356.

Were examined influence of crystallographic texture upon anisotropy of mechanical properties of titanium pseudo- α -alloys of system Ti–Al–V–Mo. It was positioned, that to each type of texture meet the fixed character of distribution of mechanical properties in a plane of sheet semiproduct. Was revealed, that on the basis of test operation with definition of standard and special characteristics and as a result assaying of a view of failure of specimens it is possible to estimate authentically enough type of

crystallographic texture of a sheet semiproduct. Thus it is enough to execute tests in three directions of sheet under angles 0, 45 and 90° to rolling direction.

Keywords: titanium alloys, crystallographic texture, sheet semiproduct, mechanical properties.

UDC 621.791.75–112.81:621.771.06–413

Automatic welding of structures elements of heavy gage thickness under a layer of flux. Karzov G. P., Galjatkin S. N., Varovin A. Ya., Litvinov S. G., Mikhaleva E. I., Kostylev V. I., Voronov A. V., Stepanen-

kov N. I., Beliaev N. V. – Problems of Materials Science, 2009, N 3 (59), pp. 357–371.

There are stated technological developments and results of experiment-calculated researches for a substantiation of the accepted technology and strength of welded joints out of steel 08ГДНФЛ at manufacturing of base for rolling mill 5000 by thickness of 1330 mm with application of automatic welding under a layer of flux.

Keywords: rolling mill, base, automatic welding under a layer of flux, heavy gage thickness, strength of welded joints.

UDC 669.71'295–419.4:621.791.1

Bimetallic joint between orthorhombic titanium aluminide and titanium alloy (diffusion welding, explosion welding). Rybin V. V., Sidorov I. I., Semionov V. A., Grinberg B. A., Patselov A. M., Antonova O. V., Elkina O. A., Karkina L. E., Inosemtzev A. V., Salishev G. A., Ivanov M. A. – Problems of Materials Science, 2009, N 3 (59), pp. 372–386.

Bimetallic joints of orthorhombic titanium aluminide (Ti–30Al–16Nb–1Zr–1Mo) with a titanium alloy (Ti–7.7Al–1.8V) and technically pure titanium were made by diffusion welding and explosion welding respectively. The welded joints made by the two welding methods had a layered structure. The layer forming phases were identified. It was found that the aluminide transformed to a disordered BCC phase and the titanium alloy generally regained its initial state after diffusion welding. However, the corresponding BCC phases were formed on both sides near the contact surface. The joint made by explosion welding had a strongly deformed region, which was observed in both materials, a recrystallized zone of titanium, and a transition zone near the interface. In the case of explosion welding, the following processes were observed in the transition zone: melting and mixing (the zone of vortices); carryover of particles of one metal to another followed by formation of particle tracks (outside the zone of vortices).

Keywords: bimetallic joint, diffusion welding, explosion welding, titanium alloy, orthorhombic titanium aluminide, fragmentation, traces, wave formation, vortices.

UDC 669.295:621.791.011

Weldability of high-strength titanium pseudo- α -alloys. Ivanova L. A., Kuznetsov S. V., Mikhailov V. I., Pas O. A., Sakharov I. O., Khatuntsev A. N. – Problems of Materials Science, 2009, N 3 (59), pp. 387–396.

Weldability of high-strength titanium pseudo- α -alloys depends on a yield strength and production technology of semiproducts. Deformable semiproducts keep a good weldability at a yield strength up to 900 MPa. Casting alloys ensure weld properties at smaller significances of a yield strength and require maximum cooling rates at welding and heat treatment for keeping of high quality of weld-cast structures.

Keywords: titanium pseudo- α -alloys, weldability, welding conditions, regime of heat treatment, quality of weld-cast structures.

UDC 621.791.042.4:621.78

Interaction of components of electrode coatings with liquid glass at heating. Nikolaev A. I., Pechenjuk S. I., Semushina Yu. P., Semushin V. V., Kuzmich L. F., Rogatchov D. L., Mikhajlova N. L., Brusnitsyn Yu. D., Rybin V. V. – Problems of Materials Science, 2009, N 3 (59), pp. 397–403.

With use of methods thermal and roentgen-phase analyses are determined characteristics and phase composition of base mixes of components of coatings for welding electrodes containing marble, rutile, quartz sand, alumina, fluorite, xerogel hydroxid iron (III), and on their basis – pastes with liquid glass at interaction of components of a mix at a room temperature and after glowing at 300, 800 and 980°C. The present researches allow to trace stability of hydroxides at glowing of mix of components and formation of new phases that it is necessary to consider in practice for improvement of electrodes quality.

Keywords: electrode coatings, base mixes of components, liquid glass, thermal and roentgen-phase analyses.

UDC 621.791.04:553.3

Prospects of use of mineral and technogenic raw material of Murmansk area for manufacture of welding materials and fluxes. Kalinnikov V. T., Rybin V. V., Malyshevsky V. A., Nikolaev A. I., Brusnitsyn Yu. D., Avvakumov Yu. V. – *Problems of Materials Science*, 2009, N 3 (59), pp. 404–414.

On the basis of new approaches there are developed industrial technologies of enrichment of mineral raw materials, reception and preparation for use of complex and composite components in manufacture of welding materials.

Keywords: mineral and technogenic raw materials, welding materials and fluxes, enrichment, new approaches.