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C O N T E N T S

ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.15–194:621.787:539.56

Theoretical and experimental evaluation of hardening and embrittlement of low-alloyed ferritic-pearlitic steels. Vysotskly V.M., MotovIIlna G.D., Khlusova E.I.– Problems of Material Science, 2004, N 4(40), p. 5–14.

Analysis of partial contributions of structure elements to hardening of studied steels of EZ35 and E36Z35 grades has been carried out. It is determined that grain-boundary hardening (44–48%) and alloying of ferrite (33–34%) give the best effect on hardening.

Actually embrittlement of steels is provoked by the enhanced content of elements atomic radii of which are larger than atomic radius of ferrum as well as by the enhanced portion (content) of pearlite in a steel structure. It is shown that reduction of a ferrite grain size from 22 to 7,9 μm allows for the reduction of steel tendency to brittle fracture at test temperatures being lowered which depends on alloying and pearlitic phase contribution to hardening.

Microalloying of low-alloyed normal strength steels with niobium and vanadium restricts the growth of austenitic grain in the process of hot plastic deformation and favors additional hardening of ferrite.

It is demonstrated a possibility of creation of low-alloyed easily weldable steel characterized by a complex of high physical and chemical properties (strength and cold resistance) mainly due to the formation of fine-grain structure along with the optimization of heat-mechanical treatment.

Key words: structure, carbide containing elements, yield strength, ductile brittle transition temperature, cold resistance.

UDC 669.14.018.8:621.785

Possibilities of optimization of reactor steel heat treatment conditions. Filimonov G.N., Tsukanov V.V., Grekova I.I., TeplukhIna I.V., Dyukov V.V., Savelyeva I.G. – Problems of Material Science, 2004, N 4(40), p. 14–23.

It has been studied a possibility of obtaining a new modification of mechanical properties in large forgings (heat inertial zone) made of reactor steel which would correspond to strength category КП-45 in combination with a critical ductile brittle transition temperature T_{k0} not higher than –35°C by means of a single water quenching and subsequent high tempering.

Key words: reactor steel, large-sized forgings, mechanical properties, heat treatment, optimization of the conditions.

UDC 669.14.018.29:621.7.044

Fast-electric heat treatment with high-density current of pre-eutectoid structural steels. Mal'tsev I.M. – Problems of Material Science, 2004, N 4(40), p. 24–31.

It is determined the influence of the process (technology) parameters, carbide phase component and electrophysical properties upon hardness stability of pre-eutectoidal structural steels after fast-electric treatment.

Key words: fast electric heat treatment, high density current, hardness stability, pre-eutectoidal steels.

UDC 621.921.27:621.921

Peculiarities of damage of surfaces of abrasive grains and materials of parts being subjected to high-speed grinding. SkotnIkova M.A., Priemyshev A.V., Zubarev Yu.M.– Problems of Material Science, 2004, N 4(40), p. 31–43.

On example of two materials, one of aluminium oxide another of boron nitride, investigated have been processes taking place at grinding of material at a speed of 20–100 m/s which develops in a thin layer between abrasive grains and material of parts made of pure iron, steels P18, 10Х18Н10Т and titanium alloy ВТ3-1 using scanning electron microscopy.

Key words: aluminium oxide, boron nitride, abrasive grains, high-speed grinding, surface damage peculiarities.

UDC 539.67:538.6

The change in the internal friction level of steel after the action by a single pulse of low magnetic field. Datsko O.I., Abramov V.S., DmItrenko V.Yu., Nedybalyuk A.F. – Problems of Material Science, 2004, N 4(40), p. 44–50.

On as-hardened and as-deformed specimens made of 70, 30ХН2МФА, 40Х13 steels it has been studied the change in the level of low-frequency dislocation internal pressure after the action by low magnetic field pulses. The study was carried out by two diagrams: 1–2–150 pulses (one specimen) and 1–1–1 pulse (another specimen). Every subsequent action was made in a few day after the prior one.

It has been determined that after the first action of a single pulse of a low magnetic field (upon a specimen made of steel) the level of the internal friction and the extent of interaction between dislocation and pins (stoppers) of a point defect type are being changed as the time is passing by i. e. in 3–6 hours. Kinetics of these changes may be of different nature depending of the initial structural condition of a material. Changes in the material structure after the first single pulse action were of such a character that after repeated second and third single actions of a low magnetic field (after a long period of time) the effect of the change in the internal friction level and in the extent of interaction between dislocations and pins (stoppers) appeared again. In this case kinetics of the internal friction level behavior differs from kinetics after a prior pulse action. Material structure “remembers” about a prior pulse action and its response to a new repeated pulse action is different from the first response and has a different character. After a repeated second action of two pulses and one pulse kinetics are different from each other, i. e. kinetics nature depends on the increasing number of interactions between single pulses as a result of their duplication. In case of a repeated third action by 150 pulses kinetics will have a nature close to the kinetics after the first action by a single pulse i. e. laying-on, smoothing of the influence of the first pulses of a low magnetic field upon structure of a material.

Key words: low magnetic field pulse, internal friction, material structure, point defects, dislocations.

UDC 621.791.92:669.715’24

New heat-resistant composite materials used for cladding on pressing tools. Sokolov G. N. – Problems of Material Science, 2004, N 4(40), p. 51–60.

Welding-technological properties and structure of composite alloys made with electroslag and arc cladding (welding) using flux-cored wire have been investigated. It is shown that in conditions of cyclic heat power influence at operating temperatures up to 700–750°C a clad metal of Fe–Cr–Mo–C system is efficient and at temperatures up to 900°C alloys of Ni–Cr–Mo–Nb–C system are preferable. At higher temperatures up to 1200°C it’s better to use clad composite metal based on nickel aluminide Ni_3Al. A rational combination of components in the investigated alloying systems has been determined and new compositions of flux-cored wires for electroslag and arc cladding (welding) have been developed.

Key words: cladding, flux-cored wire, cyclic heat power influence, composite clad metal, alloying system, nickel aluminide, phase composition, intermetallides, carbides, high-temperature hardness.

UDC 621.791.052.011

Peculiarities of local residual welding stresses in welded joints of steels being subject to structural transformations in heat affected zone. Leonov V. P., Manninen T.P., Mizetskiy A. V. – Problems of Material Science, 2004, N 4(40), p. 61–81.

Studied have been peculiarities of the influence of local residual welding stresses in a zone of welds contact with base metal upon the properties of high-strength chrome-nickel-molybdenum steels being subject to structural transformations in the process of welding.

Key words: local residual welding stresses, heat affected zone, structural transformations.

UDC 621.791.052.011

Influence of annealing beads and argon-arc partial melting on the formation of local residual stresses. Leonov V.P.,Mizetskiy A.V. – Problems of Material Science, 2004, N 4(40), p. 82–92.

The influence of annealing beads and argon-arc partial melting on the formation of local residual stresses in heat affected zone at welding of high-strength chrome-nickel-molybdenum steels has been studied. It is shown that the level of local residual welding stresses is determined first of all by structural components, non-uniformity of their mechanical and heat-physical properties as well as by kinetics of plastic-elastic deformation in different zones. The technological alternatives (methods) of welded joints performance accepted in making structures out of austenitic and ferritic steels in most cases result in tensile transverse strain of a level $\approx 0{,}6\sigma_y$. The longitudinal component may change from $0{,}4\sigma_y$ to the yield point value. Compressing transverse strains may appear in case if the conditions of an annealing bead laying are not kept (broken) or if calibration welds are being made at one pass i. e. by separate beads using ferrite materials.

Key words: local residual welding stresses, heat affected zone, structural transformations, annealing beads, argon-arc partial melting.

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New method of prognostication of steel crack resistance temperature curves under neutron irradiation conditions. Margolin B.Z.,Gulenko A.G.,Nikolaev V. A., Ryadkov L. N. – Problems of Material Science, 2004, N 4(40), p. 93–106.

A method is proposed that allows the prediction of the transformation of the $K_{Jc}(T)$ curve as a function of neutron fluence for RPV steels. The method is based on the Unified Curve concept and a probabilistic local approach model proposed by authors earlier as well as on the physical analysis of the effect of impurities and the carbide size on local strength σ_d of a material. The results calculated with the proposed method are compared with available experimental data.

Key words: crack resistance, Unified Curve method, probability model, local criterion, neutron fluence, pressure vessels.