

SCIENTIFIC AND TECHNICAL JOURNAL "PROBLEMS OF MATERIALS SCIENCE"

N 3(47), 2006

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ABSTRACTS OF PUBLISHED ARTICLES

UDC 669.15–194.2:620.187:621.785.4

Study of the influence of chromium on microstructure and kinetics of bainite transformation in the low-alloy steels. Titovets Yu. F., Zolotarevskiy N. Yu., Samoilo A. N., Hribernig G., Pichler A. – Problems of Materials Science, 2006, N 3(47), pp. 5–12.

The results of systematic studies of structure and kinetics of bainite isothermal transformation in low-alloy steels Fe–Mn–Cr by methods of electron microscopy are presented. Above 520°C at the initial stages of the transformation predominantly no carbon bainite is formed, and the decomposition of austenite is completed by eutectoid type reaction. It is shown that even a small increase in the content of chromium from 0,8 to 1,1% brings to the essential braking and incompleteness of the bainite transformation in the temperature range indicated.

Key words: low-alloy steel, electron microscopy, isothermal transformation, no carbon bainite.

UDC 669.15–194.2:621.785.4

Simulation of bainite transformation in the low-alloy steels. Titovets Yu. F., Zolotarevskiy N. Yu., Samoilo A. N., Hribernig G., Pichler A. – Problems of Materials Science, 2006, N 3(47), pp. 13–22.

The kinetics of bainite $\gamma \rightarrow \alpha$ transformation in the low-carbon low-alloy steels frequently has the characteristic feature: relatively rapid initial stage is changed by slow (under specific conditions — to the total stoppage) second stage, and the decomposition of austenite is completed by eutectoid type reaction. It is experimentally shown that the presence of this kinetics and its concrete parameters strongly depend on the content of some alloying elements, in particular, chromium. In the present work on the basis of the theoretical ideas prevailing in recent years about the origin and increase in the bainite the physical model of bainite transformation is proposed for low-carbon steels, which includes, in particular, description of contaminant braking of an increase in the bainite and the simplified description of eutectoid reaction. It is shown that computer version of the model in the complex with the previously developed model of ferrite transformation adequately describes basic laws governing the decomposition of austenite in the alloys being investigated.

Key words: low-carbon low-alloy steel, bainite $\gamma \rightarrow \alpha$ transformation, eutectoid reaction, physical model, laws governing the decomposition of austenite.

UDC 669.14.018.25:621.785.545

Working of tool steels by currents of high density during their heating for heat working. Maltsev I. M., Gavrilov G. N., Klimashev Yu. A., Mazul'nikov I. V., Oshurina L. A. – Problems of Materials Science, 2006, N 3(47), pp. 22–31.

Structure and properties of steels grades 6XC, 9XΦ, ШX15, 8X6HΦT are investigated after their heating by pulse current of high density 10^8 – 10^9 A/m² (by electronic wind) for hardening and tempering. The influence of rate of cooling and low temperature tempering on the stability of the hardness of steels after treatment by electronic wind is examined.

Key words: tool steels, current of high density (electronic wind), treatment for hardening and tempering, stability of hardness.

UDC 669.15–621.785.6

Features of display of a structural heredity during high-speed laser processing of steels. Brover A. V., Brover G. I., Dyatchenko L. D. – Problems of Materials Science, 2006, N 3(47), pp. 31–40.

Theoretical and experimental researches of features of display of a structural heredity during hypernonequilibrium phase transitions are carried out. The average size of a grain of austenite after various variants of volumetric and surface heat treatment of fast-cutting metals on which it is possible to estimate a temperature interval of heating of steel under training was determined.

It is established, that in a zone of laser training from a firm structural condition on alloyed steels the size of revealed austenite grains on 15–35% is more, than in the basic metal, is volumetric-trained from optimum temperatures of heating. This effect has a talk with attraction of two possible mechanisms of phase transformations in conditions of high-speed laser processing.

Key word: alloyed steels, laser hardening, a structural heredity, hypernonequilibrium phase transactions.

UDC 621.791.92:669.24`715

Effect of the mode of the electroslag surfacing on thermal and kinetic processes of reception alloyed aluminide γ' -Ni₃Al. Sokolov G. N., Zorin I. V., Lysak V. I., Arisova V. N. – Problems of Materials Science, 2006, N 3(47), pp. 41–52.

The mode of an electroslag surfacing in a section current carrying crystallizer by a composite flux-cored wire (CFW) were investigated. Set of parameters allowing were established to run a thermal situation in the slag tank. It is shown, that thermal conditions for qualitative smelting-down of diverse components of a flux-cored wires and an alloy building of a formed melt of an aluminide are provided in high-temperature area of the slag tank. On the basis of the joint assaying of a thermal mode of a electroslag surfacing and results of modelling it is developed thermal and kinetic a model of smelting-down of the CFW, allowing to predict formation of the alloyed aluminide of nickel γ' -Ni₃Al.

Key words: electroslag surfacing, section current carrying crystallizer, composite flux-cored wire, non-consumable electrode, thermal mode of a electroslag surfacing, low-melting sample piece, thermal and kinetic a model of smelting-down, melt of an aluminide of nickel γ' -Ni₃Al, surface-tension.

UDC 621.785.048.4:669.15`27–194

Research of superficial layers tungsten-containing of layers firm-alloys after of electrospark alloying by aluminium. Verhoturov A. D., Konevtsov L. A., Gordienko P. S., Panin E. S., Metlitskaia L. P. – Problems of Materials Science, 2006, N 3(47), pp. 52–62.

Electrospark alloying till now practically did not find application for hardening executive surfaces of influence of the cutting tool of tungsten-containing of hard alloys. However the decision of a question of increase of dimensional stability of such tools probably by use for these purposes electrospark alloying, in particular, by aluminium. It is shown, that at chosen modes ECA on surface of CT the alloyed layer 12–15 microns is formed, and tests CT positive results of sized stability.

Key words: electrospark alloying, tungsten-containing of hard alloys, metallographic, alloyed layer, electrode, basis, chemical compound, masstransport, erosion product, covering, stability dimensional, cutting tool.

UDC 621.763–419:621.77

Multilayer axisymmetrical semifinished products and articles made of composite materials. Kuimov S. D., Malafeyev A. S., Bytchkov N. A., Rostovshchikov V. A – Problems of Materials Science, 2006, N 3(47), pp. 63–69.

Studies on the creation of multilayer axisymmetrical articles (shafts, axes, pipes, cylinders) made of different composite materials with use of hot gas-static extrusion and contemporary radial- forging machines for the purpose of an increase in the operational characteristics of the articles of special and general type machine-building designations are carried out.

Key words: composite materials, multilayer axisymmetrical articles, hot gas-static extrusion, radial forging.

UDC 678.067:661.66

Structural and mechanical properties of carbon-carbon composites with fabric reinforcement produced by the pyrocarbon densification. Kulik V. I., Borkovskih V. A., Borkovskih N. N., Savin V. V. – Problems of Materials Science, 2006, N 3(47), pp. 70–77.

In the present work, structural and stress-strain properties of the carbon-carbon composites (CCC) with fabric reinforcement were studied. The composites were produced by chemical vapor infiltration of carbonized plastic preforms reinforced by carbon fibers. Experimental analysis of mechanical properties (tensile strength, compression strength, flexural strength and shearing strength) and parameters of the open porosity was made using plane samples. The samples are laminated pressed plates manufactured from phenol-formaldehyde resin SF-010 reinforced by graphitized viscose fabrics (“Ural” T-22 and TGN-2MB). It was found, that all mechanical characteristics increase almost linearly with density of textile CCC. Moreover, levels of compression, flexural and shearing strengths are independent of fabric type and fabric reinforcement structure. They depend only on composite density (matrix porosity). At the same time, tensile strength depends on both fabric type and fabric reinforcement structure and density of the CCC.

In this work, chemical vapor infiltration of porous preform was analyzed by numerical simulations using 1D model of the process. The model describes multicomponent mass transport in the porous medium, kinetics of deposition of the pyrocarbon during decomposition of the methane and the evolution of the porous medium. As a result of the computations, distributions along the CCC thickness of the final density and residual porosity were obtained. It was found, that three groups of various scale pores may be distinguished in the initial porous medium of the carbonized half-finished product: 1) pores in which the process are limited by the rate of mass transport - these pores determine the level of the closed porosity of the CCC; 2) pores in which the process are limited by the rate of the heterogeneous chemical reactions - these pores determine the level of the open porosity; 3) pores in which the rates of mass transport and deposition are practically equal - these pores introduce minimal residual porosity into the CCC.

Key words: carbon-carbon composites, textile composites, carbonization, chemical vapor infiltration, mechanical properties; porosity, numerical simulations.

UDC 539.4.012:539.219.2

Engineering method of evaluating the viscous increase of crack under nonisothermic thermoloading. Margolin B. Z., Minkin A. I., Kostylev V. I., Piminov V. A. – Problems of Materials Science, 2006, N 3(47), pp. 78–90.

The approaches are examined to determination of viscous increase of crack under nonisothermic thermoloading. It is shown that in a number of cases the estimation of the viscous increase of crack while using isothermal J_R -curves can be non-conservative. The engineering method is proposed for determining the viscous increase of crack taking into account the real history of nonisothermic thermoloading. The applicability of the method is demonstrated based on the example of construction nonisothermic J_R -curves for the material of anticorrosive cladding of WWER reactor vessels. Prognostication of nonisothermic J_R -curves is executed with aid of MFE. It is shown that the nature of nonisothermic J_R -curves obtained by MFE and according to the method proposed, is identical.

Key words: nonisothermic thermoloading, viscous increase of crack, J_R -curves, engineering method.

UDC 621.791.92:621.039.536.2

Prognostication of conservative J_R -curves for the material of the anticorrosive cladding of WWER reactor vessels taking into account influence of neutron irradiation. Minkin A. I., Margolin B. Z., Kostylev V. I., Smirnov V. I. – Problems of Materials Science, 2006, N 3(47), pp. 91–100.

The approach is represented, which makes it possible to obtain forecast conservative J_R -curves for the material of anticorrosive austenitic cladding of WWER reactor vessels at the specified fluence of neutrons and a temperature of tests. With this approach the dependences are used obtained earlier: the dependence of the fracture toughness on the fluence of neutrons and the dependence of yield point from the fluence of neutrons and temperature. The forecast conservative J_R -curves are obtained for different states of material

and temperatures. The comparison of forecast J_R -curves is carried out with experimental data, obtained in the specimens of the type SE(B) from the material in the initial and the state irradiated to different fluence of neutrons.

Key words: WWER reactor vessel, anticorrosive austenitic cladding, forecast conservative J_R -curves, fracture toughness.

UDC 678.067:539.37

Version of mathematical modelling of deformation processes of polymer stuffs. Demidov A. B., Makarov A. G., Stalevich A. M. – Problems of Materials Science, 2006, N 3(47), pp. 101–110.

The version of mathematical model of a non-linear-ancestral viscoelasticity of polymer stuffs is offered, on the basis of which one the forecasting of deformation processes of different complexity — from processes of a simple relaxation and simple creep before composite straining — reduction processes and processes of a return relaxation with alternation of load and unloading implements.

Key words: polymer stuffs, forecasting of deformation processes, a non-linear-ancestral viscoelasticity, mathematical model.