

CONTENTS

METALS SCIENCE. METALLURGY

- Kalinin G. Y., Malyshevskiy V. A., Mushnikova S. Y., Yampolskiy V. D.* Effect of conditions of hot plastic deformation on mechanical properties and structure of high-strength corrosion resistant austenitic nitrogen-alloyed steel.....5
- Rybin V. V., Burochkina I. M., Galyatkin S. N., Kozlov R. A., Kursevich I. P., Lapin A. N., Nesterova E. V., Shcherbinina N. B.* Research of structural transformations, mechanical properties and radiation strength of the parent and weld metal of welded joints of slow-activated steel of quality 15X2B2ΦA of bainite class12
- Vasiljev N. V.* Complex research of damage of heat-exchange tubes of steam generators PGV-1000M of the 1st unit of the South-Ukrainian atomic power station.....21

FUNCTIONAL MATERIALS AND COATINGS

- Ionov A. V., Nikolaev G. I., Ryabov V. M., Frolov S. E., Yartsev B. A.* Damping in composite structures.....28
- Vainerman A. E., Belyaev N. V.* Argon-arc facing of steel with powders on the basis of tungsten carbide to obtain a wear-resistant coating43
- Dzhurinskiy D. V.* Research of thermophysical characteristics of the process of supersonic cold gasdynamic spraying of functional coatings47
- Vinogradov S. E., Rybin V. V., Rutberg F. G., Safronov A. A., Shekalov V. I., Shiryayev V. N., Kuznetsov V. E.* Research of mechanisms of plasma generator electrodes wear.52

WELDING. BRAZE. WELDING AND BRAZING MATERIALS

- Startsev V. N., Pronin-Valsamaki M. M.* Laser welding of three-layer honeycomb panels.....60
- Startsev V. N.* Calculation of arc parameters in laser-arc process with account of metal evaporation in the welding zone.....66
- Dzhurinskiy D. V., Farmakovskiy B. V.* Certain technological and structural characteristics of activated brazing with amorphous solders.72
- Fedko V. T., Sapozhkov S. B., Zernin E. A., Zernina E. V.* Research of the effect of filler concentration on the physical and technological properties of coatings used to protect the surfaces of welded items from molten metal splashes during welding in carbon dioxide78

CORROSION. CORROSION PROTECTION

- Stepanova I. P., Mikhailova M. A., Peshakova I. V., Korniyukhina M. V.* Prospects of use of blocked amines to harden marine epoxy paintwork materials in increased relative air humidity..83

TESTS AND QUALITY CONTROL OF MATERIALS

- Berestova G. I., Konovalova I. N., Malyshev V. S., Petrov S. N.* X-ray microanalysis and ferrographic analysis of wear particles in systems of diesel engine lubrication.88
- Kruglov B. A.* Acoustic field of inclined converter in the far region.....93

NEW ITEM

- International scientific seminar «Russia–NATO».....107
- Abstracts of published articles109

ABSTRACTS OF THE ARTICLES PUBLISHED

UDC 669.15'786—194:621.771

Effect of conditions of hot plastic deformation on mechanical properties and structure of high-strength corrosion-resistant austenitic nitrogen-alloyed steel. Kalinin G. Y., Malyshevskiy V. A., Mushnikova S. Y., Yampolskiy V. D. – Problems of Materials Science, 2002, N 2(30), p. 5–11

The article studies the effect of various conditions of hot plastic deformation (rolling) on the microstructure and mechanical properties of high-strength nitrogen-alloyed steel.

It is shown that depending on the microstructure obtained in the process of hot plastic rolling deformation of austenitic steel 05X19H5Г12AM2Б and 05X19H5Г12AM2БФ containing 0.5% and 0.56% of nitrogen respectively they have different mechanical properties. The texturized subgrained structure formed in the process of rolling in the temperature range of 1100–850°C with the deformation degree of 75% ensures high strength and relatively low ductility. The fine grain structure formed in the process of dynamic recrystallization after the high-temperature rolling ($T_{\text{beg}} = 1200, 1150^\circ\text{C}$) consisting of fine blocks and uniformly distributed inclusions has the optimal combination of strong and plastic properties.

Key words: mechanical properties, microstructure, hot rolling, high-strength steel, grain orientation, recrystallization.

UDC 669.15—194.591:621.039.531

Research of structural transformations, mechanical properties and radiation strength of the parent and weld metal of welded joints of slow-activated steel of quality 15X2B2ΦA of bainite class. Rybin V. V., Burochkina I. M., Galyatkin S. N., Kozlov R. A., Kursevich I. P., Lapin A. N., Nesterova E. V., Shcherbinina N. B. – Problems of Materials Science, 2002, N 2(30), p. 12–20

The article studies the structure, phase composition and mechanical properties in the initial state, after long heat soaking and neutron exposure of the parent and weld metal of welded joints of radiation-resistant steel of quality 15X2B2ΦA of bainite class possessing fast decay of induced activity and its low residual level.

The article presents continuous cooling transformation diagrams of structural transformations with continuous metal cooling from the temperature of 1200 and 1000°C in the rate range from 0.03 to 25°C/s, the microstructure and hardness at different cooling rates. No changes of short-term mechanical properties of steel 15X2B2ΦA have been registered after heat soaking at 450°C during 260 hours.

After the exposure to fluence of $1.5 \cdot 10^{24}$ neutr./m² ($E = 0.5$ MeV) at the temperature of $270 \pm 10^\circ\text{C}$ in the research reactor VVR-M the radiation hardening of the metal of the weld made by manual arc-welding with electrodes on the basis of slow-activated welding wire СВ-08X3ГВ2ΦТА after tempering at 670°C, 10 hours and 670°C, 10 hours + 700°C, 10 hours amounted to 130 and 115 MPa respectively while the shift of the critical brittleness temperature amounts to 28 and 50°C respectively.

Key words: slow-activated steel of bainite class, welded joints, structural transformations, mechanical properties, radiation resistance.

UDC 621.039.534.25:620.19

Complex research of damage of heat-exchange tubes of steam generators PGV-1000M of the 1st unit of the South-Ukrainian atomic power station. V a s i l j e v N. V. – Problems of Materials Science, 2002, N 2(30), p. 21–27

There was carried out complex research of the state of the heat-exchange tubes of the steam generator of the 1st power unit of the South-Ukrainian atomic power station. The research did not reveal any total corrosion damage of the heat exchange tubes 1PG-1.2. The capillary bending control of the surface of the examined heat-exchange tubes showed lack of developed surface defects on them that could affect the reliability of the steam generator. There were given recommendations concerning improvement of the methods of control of the heat-exchange tubes of the steam generator.

Key words: heat-exchange tubes, corrosion damage, complex research, control methods.

UDC 678.067–419:620.178.53

Damping in composite structures. I o n o v A. V., N i k o l a e v G. I., R y a b o v V. M., F r o l o v S. E., Y a r t s e v B. A. – Problems of Materials Science, 2002, N 2(30), p. 28–42

The results of developing the complex for full design of damping polymer composite structures are presented.

The iteration method for determination of elastic and dissipative properties of polymer composite materials based on experimental data of eigenfrequencies and loss factors of bending-twisting vibrations of anisotropic rectangular cross-section bars is described.

Mathematical models of layered anisotropic bars and plates damped vibrations take into account different coupling types. These models are based on as variational Hamilton principle, corrected Bolotin's and Reissner's theories of multilayered structures as elastic-viscoelastic correspondence principle in the linear theory of viscoelasticity.

Key words: polymer composites, stiffness characteristics, dissipative characteristics, bending vibrations, twisting vibrations, natural frequencies, loss factors.

UDC 621.791.92:621.762

Argon-arc facing of steel with powders on the basis of tungsten carbide to obtain a wear-resistant coating. V a i n e r m a n A. E., B e l y a e v N. V. — Problems of Materials Science, 2002, N 2(30), p. 43–46

The article considers a hard-facing material based on a tungsten carbide powder. Its facing of carbon steel by argon-arc method with a nonconsumable electrode provides high hardness and wear resistance of the faced surfaces.

Key words: wear-resistant coatings, argon-arc facing, powders on the basis of tungsten carbide, carbon steel, faced metal properties.

UDC 621.793.7

Research of thermophysical characteristics of the process of supersonic cold gasdynamic spraying of functional coatings. D z h u r i n s k i y D. V.— Problems of Materials Science, 2002, N 2(30), p. 47–52

The article concerns experimental research of thermophysical characteristics of supersonic cold gasdynamic spraying as applied to the brazing process. It determines technological parameters for application of chemically active compositions Al–Zn and the nonequilibrium alloy of Cu–Ni–P system.

Key words: spraying of functional coatings, thermophysical characteristics, technological parameters.

UDC 669.37:620.178.16

Research of mechanisms of plasma generator electrodes wear. V i n o g r a d o v S. E., R y b i n V. V., R u t b e r g F. G., S a f r o n o v A. A., S h e k a l o v V. I., S h i r y a e v V. N., K u z n e t s o v V. E. — Problems of Materials Science, 2002, N 2(30), p. 52–59

Complex research of electrodes made of materials based on copper with iron additions from 0.3 to 30 mass.% showed that the wear resistance of materials depends of two factors — electric and heat conduction that decreases when iron is introduced into the copper alloy and total melting and evaporation heat that increases when iron is introduced. When 0.3 mass.%Fe is introduced in the copper alloy, the electric and heat conduction of the electrodes drops sharply (1.74–2.6 times) with small increase of the total melting and evaporation heat (no more than 1.5%). As a result the wear resistance decreases 1.49–1.6 times. With iron concentration from 10 to 30 mass.% the electric and heat conduction decreases considerably less with noticeable increase of the total melting and evaporation heat. The wear resistance of the material with 30 mass.%Fe content is 1.9 times higher than that of pure copper.

Key words: electrode, heat and electric conduction, wear resistance, total melting and evaporation heat.

UDC 621.791.72:629.12.011

Laser welding of three-layer honeycomb panels. S t a r t s e v V. N., P r o n i n - V a l s a m a k i M. M. — Problems of Materials Science, 2002, N 2(30), p. 60–66

A technology of laser welding of three-layer thin-walled honeycomb panels of steel and titanium alloys has been developed. There have been determined conditions of welding of standard elements of non-gathering marine constructions providing stable joints with stable penetration without any burn-through and incomplete penetration. There has been worked out a technology to increase the welded panels size in longitudinal and transverse directions. The mechanic tests of samples of welded joints of a pilot batch of non-gathering marine constructions made of steel and titanium alloys have shown their balanced life with the parent metal.

Key words: three-layer honeycomb panels, laser welding, conditions of welding of standard elements.

UDC 621.791.89

Calculation of arc parameters in laser-arc process with account of metal evaporation in the welding zone. S t a r t s e v V. N. — Problems of Materials Science, 2002, N 2(30), p. 66—71

The article provides a numerical research of the metal evaporation effect on electric arc characteristics in laser-arc welding. It is shown that among the numerous factors affecting the laser-arc welding process metal evaporation can significantly change distribution of the power supplied to the metal surface. This is connected with the fact that the laser-arc heat source itself is formed above the surface of the processed part in the gaseous phase. Therefore, in case of any exposure the characteristics of the heat source being formed will change. Calculations have shown that due to the

decrease of the ionization potential in case of metal evaporation the arc temperature and the current density in it decrease.

Key words: laser-arc welding, metal evaporation, ionization potential, temperature, current density.

UDC 621.791.3

Certain technological and structural characteristics of activated brazing with amorphous solders. D z h u r i n s k i y D. V., F a r m a k o v s k i y B. V.— Problems of Materials Science, 2002, N 2(30), p. 72–77

The article refers to the conducted analysis of the technology of activated brazing with amorphous solders of titanium and composite thin-walled constructions. There have been studied certain characteristics of brazing with non-equilibrium alloys from the point of view of achievement of high strength characteristics of brazed joints.

The results obtained show the availability of the method of activated brazing with amorphous solders of titanium and its alloys as applied to joints of composite semifinished items, parts of gas turbine blades, working parts of pumps, vacuum constructions, domestic reinforcement units.

Key words: activated brazing, amorphous solders, thin-walled constructions, properties of brazed joints.

UDC 621.791.042.4

Research of the effect of filler concentration on the physical and technological properties of coatings used to protect the surfaces of welded items from molten metal splashes during welding in carbon dioxide. F e d k o V. T., S a p o z h n i k o v S. B., Z e r n i n E. A., Z e r n i n a E. V. — Problems of Materials Science, 2002, N 2(30), p. 78–82

The article considers the effect of volume concentration of the filler on the system of binder – filler of the coatings used to protect the surfaces of welded items from molten metal splashes during welding in carbon dioxide.

It has been shown that conventional viscosity of protective coatings increases as the volume concentration of the filler grows.

Experiments have established the dependence of the critical concentration of the fillers on the specific surface of the fillers.

The article presents dependence of the number of the splashes hard to remove on the fillers concentration and the welding current value.

Key words: welding in carbon dioxide, coatings to protect from splashes, filler concentration, properties of coatings.

UDC 667.637.233

Prospects of use of blocked amines to harden marine epoxy paintwork materials in increased relative air humidity. S t e p a n o v a I. P., M i k h a i l o v a M. A., P e s h a k o v a I. V., K o r n y u k h i n a M. V. — Problems of Materials Science, 2002, N 2(30), p. 83–87

The article gives results of comparative tests of the properties of epoxy paintwork materials hardened by a traditional amine hardener and ketimine hardeners. It shows that the properties of epoxy-ketimine coatings are not inferior to standard epoxy coatings applied in standard conditions. But as distinguished from the latter they can harden in increased humidity conditions. The article substantiates the choice of the most efficient hardener, provides technological specific features of applying epoxy-ketimine paintwork materials.

The data obtained allow to recommend the epoxy-ketimine paintwork materials hardened in increased humidity conditions to provide anticorrosive protection of marine constructions.

Key words: epoxy paintwork materials, amine hardeners, relative air humidity, comparative tests.

UDC 543.422.8:621.891

X-ray microanalysis and ferrographic analysis of wear particles in systems of diesel engine lubrication. Berestova G. I., Konovalova I. N., Malyshev V. S., Petrov S. N. — Problems of Materials Science, 2002, N 2(30), p. 88–93

The article offers a method to control the wear of movable joints of marine and car engines based on joint use of methods of ferrography and X-ray microanalysis, which makes it possible to assess the wear appearance and intensity in the most informative way and establish which engine unit is subject to the most intensive wear. The material accumulated considerably widens the possibilities to identify the wear products.

Key words: wear, diesel engine, X-ray microanalysis, ferrography.

UDC 620.179.16.05:534.23

Acoustic field of inclined converter in the far region. Kruglov B. A. — Problems of Materials Science, 2002, N 2(30), p. 93–106

The article provides integral Fourier ideas of the field of transverse waves created by an inclined piezoelectric converter in homogeneous isotropic solid half-space during ultrasonic metal echo-testing. It determines the key member of asymptotic assessment of integrals by means of a stationary phase corresponding to the description of the acoustic field in the far region in geometrooptical approach. It specifies the applicability boundaries of a number of reduced expressions for the far region used in engineering calculations of the acoustic section of ultrasonic echo-testers.

Key words: ultrasonic echo-testers, piezoelectric converter, acoustic field, far region, engineering calculations.