PRS-UMS-88-015
5 OCTOBER 1988

FOREIGN BROADCAST INFORMATION SERVICE

JPRS Report

Science & Technology

USSR: Materials Science

Science & Technology
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UDC 669.35'22:536.42

Study of Decomposition Kinetics of Solid Solution of Silver in Copper

18420262b Moscow METALLY in Russian No 3, May-Jun 88 (manuscript received 28 Jan 87) pp 122-124

[Article by M.V. Martirosyan, A.A. Presnyakov and R.Sh. Nersisyan, Yerevan]

[Abstract] A study is made of the decomposition kinetics of a solid solution of silver in copper containing 6-7 percent silver upon isothermal hardening in order to determine an effective means of heat treatment of semi-finished goods for stabilization of physical and mechanical properties. The kinetics of the conversion were studied by a metallographic method on an optical microscope following etching of sections with a solution of $HCl+HNO_3+H_2SO_4+K_2Cr_2O_7$. Studies of α-phase decomposition kinetics, microstructure and microhardness indicated that during isothermal hardening the solid solution decomposes most intensely and completely at 500-550°C, holding time 1 hour. In an alloy containing about 6 percent Ag, conversion develops more rapidly than at higher silver concentrations. The recommended heat treatment of silver bronze products is isothermal hardening at 500-550°C, holding time 1 hour. Reference 1: Russian.

6508

UDC 620.178.38:539.43

Anomalous Effects of Stress Concentration on Long-Cycling Fatigue Limit for ZhS3DK Cast Heat-Resistant Nickel Alloy

18240249e Kiev PROBLEMY PROCHNOSTI in Russian No 4, Apr 88 (manuscript received 23 Jun 86) pp 37-43

[Article by B.N. Sinayskiy, Kiev, and M.Ya. Kodner, Moscow, Mechanics Institute, UkSSR Academy of Sciences]

[Abstract] An experimental study of the ZhS3DK cast heat-resistant Ni alloy was made concerning the two known anomalous effects of stress concentration on its long-cycling fatigue limit at high temperatures. The first anomaly is a low sensitivity of this alloy with an equiaxial microstructure to stress concentration up to a 2.5 high theoretical stress concentration factor under load, this anomaly being attributable to existence of an already high concentration of internal stresses produced by defects. The second anomaly is a dependence of the fatigue limit on the degree of load cycle asymmetry, namely the ratio of the two stress amplitudes, fatigue fracture occurring as this ratio exceeds some critical value. Tests were performed on this alloy, precision cast and heat treated by annealing at 1200-1220 deg C for 2-4 h and subsequent cooling in air. Specimens were cut on the lathe and then mechanically polished, residual stresses being subsequently removed by technological annealing at 950 deg C under vacuum. Smooth specimens as well as specimens intentionally notched for stress concentration were tested under tension-compression loads asymmetrically alternating at a frequency of 35 Hz, the fatigue limit being determined on a base of 2.10^7-2.10^8 cycles, at two temperatures: 700 deg C and 850 deg C. The data have been evaluated by regression analysis and correlation analysis, which yielded the equations of stress-strain and fatigue curves, with appropriate extrapolations and using the Neuber formula to account for elastoplastic stresses. The results indicate that the first critical 1.5 stress concentration factor is followed by a second critical 3.9 stress concentration factor above which the fatigue limit drops sharply. They also indicate stepwise changes of sensitivity to stress concentration and a dependence of the higher sensitivity on the degree of load cycle asymmetry, the critical ratio of the two unequal stress amplitudes separating two ranges of preferential fracture due to fatigue and due to cyclic creep respectively. References 20: 16 Russian, 4 Western (3 in Russian translation).

2415/12232

UDC 539.374

Kinetics of Viscoplastic Contact Interaction Involving Disk and Shaft of Turbine Runner

18240249c Kiev PROBLEMY PROCHNOSTI in Russian No 4, Apr 88 (manuscript received 24 Feb 86) pp 21-24

[Article by D.A. Ishchenko and V.G. Savchenko, Mechanics Institute, UkSSR Academy of Sciences, Kiev]

[Abstract] Stresses in a turbine runner and their kinetics under combined non-isothermal heat load and variable mechanical load are evaluated theoretically, taking into account elastoplastic stresses already built up during runner assembly by stacking hot disks on a cold shaft as well as viscoplastic contact stresses built up during subsequent cooling of the disks to shaft temperature with their attendant shrinkage. Analysis of the problem is based on a system of two variational integrodifferential equations describing transient heat conduction and quasi-steady inelastic deformation respectively. These equations are solved by the methods of finite elements and time discretization. For this the problem is tentatively split into two parts, with the time read from the beginning of runner assembly and from the beginning of load application in service respectively, so that the runner history can be included in the analysis. The results of calculations, which have yielded sought radial temperature profiles and distributions of radial stresses, indicate that the assembly history lowers radial contact stresses under a subsequent load. Creep deformation, moreover, can at some point reverse the radial stresses from negative to positive ones so as to facilitate separation of some disks from the shaft. References 9: all Russian.

2415/12232

UDC 629.7.036

Numerical Calculation of Natural Vibration Modes of Turbomachine Blades by Method of Finite Elements

18240249d Kiev PROBLEMY PROCHNOSTI in Russian No 4, Apr 88 (manuscript received 21 Jan 85) pp 31-36

[Article by O.V. Repetskiy, Irkutsk Polytechnic Institute, Irkutsk]

[Abstract] The mathematical apparatus of finite elements for computer-aided design and performance calculations has been found to be applicable to natural vibration modes of turbomachine blades without restrictions on contour and profile of blades, such a blade being treated as a shell and use of plane finite elements being preferred to use of more precise curvilinear and isoperimetric ones on account of their greater simplicity reflected in better computer time economy. The algorithms of this method have been tested for convergence and stability as well as for agreement with the engineering theory of twisted beams and with experimental data. A blade in the first low-pressure compressor stage of an aircraft gas-turbine engine was considered as a test problem. Calculations on the basis of a blade model consisting of 32 STSI224 elements were found to yield more correct results with the same YeS-1061 computer memory capacity than calculations on the basis of a blade model consisting of 64 STI218 or STIF18 elements. Nevertheless natural vibration modes of wide-chord blades were calculated on the basis of a model consisting of 68 STI218 elements with 282 degrees of freedom, whereupon these calculations for runner blades were refined by taking into account elasticity of the dovetail. Free vibration modes of blades with banding and antivibration slugs were calculated on the basis of a model consisting of STI218 membrane flexure elements. Various kinds of blade mounting (cantilever, two fixed supports, two hinged supports) and appropriate boundary conditions at the contacts between structural blade components were considered. The vibration frequencies obtained by this application of the method of finite elements agree within 15 percent with those calculated according to the engineering theory and with those obtained by measurement. References 6: 3 Russian, 3 Western (2 in Russian translation).

2415/12232

UDC 621.165.539.319

Theoretical-Experimental Study of Thermal Stresses in Turbine Housing Under Variable Operating Conditions

18240249b Kiev PROBLEMY PROCHNOSTI in Russian No 4, Apr 88 (manuscript received 21 Apr 87) pp 15-21

[Article by V.I. Berlyand, N.Yu. Berlyavskaya, A.A. Glyadya, A.V. Pozhidayev, D. Avrutskiy, V.S. Senin, and V.P., Skladchikov, Kharkov branch, Central Design Bureau Soyuzenergoremont; All-Union Heat Engineering Institute; Moscow Automotive Mechanics Institute, Leningrad Metal Plant Production Association]

[Abstract] A theoretical-experimental study of thermal stresses in the turbine housing of the low-pressure stage under variable operating conditions was made on the basis of two shell models in the theoretical part, two models yielding more accurate and reliable results in calculations by both the method of finite elements and the method of boundary integral equations, while the experimental part involved field measurements with strain gauges and thermocouples. The first model of a turbine housing was a composite of several different shells of revolution with the flanges for their assembly represented as circular beams and fillets joining them to the wall. The second model, according to A.P. Krol (1972), differed from the first one by representing the flanges as segments of local wall-thickness buildup. A comparison of the results of calculations made on a YeS digital computer, and including an error analysis, with the results of measurements indicates that combining the two models makes prediction of thermal stresses above the 100 MPa reference level and up to 130 MPa accurate within 10-35 pct. References 11: all Russian.

2415/12232

UDC 539.374

Thermal Stresses in Nozzle Vane With Deflector-Type Cooling System

18240249a Kiev PROBLEMY PROCHNOSTI in Russian No 4, Apr 88 (manuscript received 5 Mar 86) pp 8-11

[Article by V.P. Trushechkin, Yu.A. Balashov, V.S. Senin and V.V. Podnesbesnov, Machine Science Institute imeni A.A. Blagonravov, USSR Academy of Sciences, and All-Union Heat Engineering Institute imeni F.E. Dzerzhinskiy, Moscow]

[Abstract] An experimental model study of thermal stresses in nozzle blades for gas turbines with deflector-type cooling was conducted in the steady-state mode and in the fault mode as well as under quasi-static conditions after application and removal of the heat load. The full-scale model made of 1Cr18Ni10Ti steel differed from a prototype blade only in material and assembly technique. Tests were performed in a static wind tunnel with back-pressure regulation and with a combustion chamber inside. Measurements were made over the 293-973 K temperature range with welded-on special strain gauges, their sensing element made of 14Cr - 6A1 - 78Fe alloy with V and Mo minicontent mounted on a metal base by means of a heat-resistant oxide adhesive. A comparison of the results with those of computer-aided calculations based on special-purpose algorithms and programs in accordance with theory indicates a close agreement and, therefore, the suitability of such strain gauges for blade cooling control in gas turbines within the given range of operating temperatures.

2415/12232

UDC 621.762

Determination of Permeability by Method of Mercury Porometry

18420246a Kiev POROSHKOVAYA METALLURGIYA in Russia No 4, Apr 88 (manuscript received 11 Mar 87) pp 48-51

[Article by N.P. Pavlenko, L.Ye. Lunin, L.I. Chernyshev and A.G. Kostornov, Institute of Materials Science Problems, UkSSR Academy of Sciences]

[Abstract] A method of determining the effective porosity and the permeability of materials on the basis of volume fractions of pore size fractions has been developed which involves use of a mercury porometer. The method was tested first on plain 5 mm thick specimens 50 mm in diameter permeable to gas under conditions of laminar flow. In another test specimens made completely impermeably by impregnation with molten paraffin at a temperature of 400 K and subsequent cooling to room temperature were mounted in a special fixture and heated to 450 K (melting point of paraffin) and held at that temperature in a stream of hot air till their permeability had been restored. Materials tested for permeability by this method included: powder alloys, namely bronze and Cr18Ni15 corrosion-resistant steel produced from 0.04-0.05 mm, 0.125-0.160 mm, 0.250-0.315 mm grain size fractions, bronze grains being spherical and steel grains being aspherical; discrete nichrome fibers 0.050 mcm, 0.090 mcm, 0.130 mcm in diameter; carbonyl Ni powder compacts made porous by heating with volatile additives; and Ni "foam." These tests have revealed that the permeability, ratio of effective porosity to bare porosity, of any material class depends neither on the effective porosity nor on the grain or fiber size fraction. This is confirmed by analysis of a simple model, a stack of plain maximum-porosity (48 percent) and minimum-porosity (27 percent) layers of spherical particles. References 4: 3 Russian, 1 Western.

2415/12232

UDC 621.762:620.197:621.79

Corrosion-Resistant Gas-Thermal Coatings

18420270d Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 24 No 2, Mar-Apr 88 (manuscript received 15 Dec 86) pp 95-96

[Article by Ye.Ya. Lyublinskiy, V.G. Zilberberg and A.M. Vyaltsev, Institute of Materials Science Problems, Ukrainian Academy of Sciences, Kiev]

[Abstract] Results are presented from studies of the corrosion resistance of gas-thermal coatings of titanium and aluminum and titanium oxide-based coatings saturated with polymers or hydrophobic compositions to isolate pores when exposed to sea water. The coatings were tested on carbon steel substrates in artificial sea water with 35 percent salinity. Saturating materials tested included polyethylene, polyurethane, "Anaterm-IV" anaerobic sealant, an enamel and type GFZh hydrophobic liquid. Corrosion resistance was studied in a jet of sea water with a velocity of 16 m/s, under galvanokinetic conditions with polarization current equal to that expected in a contact pair of aluminum and titanium at the maximum conductivity of sea water. All of the coatings studied were cathodes with respect to the substrate metal. All of the unsaturated coatings had through porosity, through which the sea water reached the substrate. Saturated aluminum oxide-titanium dioxide coatings were found to have significant advantages over the best paint and varnish materials, gas-thermal titanium saturated with type 5-5-78 enamel retaining its protective properties after 1900 hours of severe testing, as opposed to 250 hours for the enamel alone. Refernces 2: both Russian.

06508

UDC 665.632.013.05:620.197.6

Gas Processing Plant Equipment Anticorrosion Coatings

18420270c Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 24 No 2, Mar-Apr 88 (manuscript received 14 Jul 86) pp 91-95

[Article by V.N. Polyakov and L.K. Gordiyenko, All-Union Scientific Research Institute of Economics, Production Organization and Technical-Economic Studies in the Gas Industry]

[Abstract] A review is presented of several studies of the effectiveness of corrosion-protective coatings for use on equipment at gas-processing plants. No universal coatings for protection from corrosion at such plants have been found. Porous aluminum coatings can be used under anodic conditions. In media in which aluminum coatings are cathodic, the corrosion-cracking process is not retarded. Nonporous nickel-phosphorus coatings have high anodic and cathodic electrochemical process overvoltages in corrosive media and provide effective anticorrosion protection for steel. Protective properties deteriorate when simultaneously exposed to mechanical loads, fretting corrosion, wear and corrosion cracking. References 20: all Russian.

06508

UDC 621.785.539:69.71:669.14

Fracture of Calorized Layers on Carbon Steels

18420271b Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 8-10

[Article by V.I. Andryushechkin and L.K. Gushchina, Moscow Steel and Alloys Institute, All-Union Scientific Research Technological Institute for Instrument-Making]

[Abstract] A study is made of the mechanism and nature of the fracture of calorized layers on type 20, 45 and U8 carbon steels. Aluminum saturation was performed by three methods: in powder mixtures of 49 percent ferroaluminum, 49 percent Al_2O_3 and 2 percent NH_4Cl in a sealed container at 1050°C for 2 hours; in pastes of 88 percent ferroaluminum, 10 percent marshalite and 2 percent NH_4Cl with a protective coating of glass powder with heating of the specimens by direct passage of current with isothermal holding for 5-7 minutes; and in dross with holding in a vacuum at 950°C for 5 hours. The structure and composition of the calorized layers were studied metallographically, durometrically and by x-ray phase and microspectral methods. Fractographic studies were performed at enlargements of X7 to X1000 in a binocular light microscope and a scanning electron microscope. Analysis of crack propagation confirmed previously observed changes in the propagation trajectory of cracks at the interface of phases with different elasticity moduli: where G_1 is greater than G_2, the crack usually propagates along the interface; otherwise the crack continues in the same direction or propagates at an angle of 60 to 70° to the previous direction. When specimens are under torsion, both normal and shear stresses are involved in fracture. In both torsion and flexure, the fracture of the diffusion layer is different from the fracture of the core of the specimen. The nature of the fracture of calorized layers is determined by their structure and phase composition. Cracks starting on the surface propagate along the boundary of crystals, grains of solid solutions and phases. References 7: 6 Russian, 1 Western.

06508

UDC 539.216.2:537.226:546.681'19:546.86

Production of Dielectric Films on GaAs in Presence of Antimony Oxide in the Gas Phase

18420263a Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 24 No 4, Apr 88 (manuscript received 6 Jun 86) pp 538-541

[Article by I.Ya. Mittova, V.V. Vasilyeva, V.N. Semenov, V.M. Kashkarov and Zh.A. Verevkina, Voronezh State University imeni Lenin's Komsomol]

[Abstract] A study is presented of the physical and chemical specifics of the growth of oxide dielectric layers

on GaAs when Sb_2O_3 is present in the gas phase, as well as the composition and properties of the layers grown. Polished GaAs plates were used to study dielectric film growth kinetics. The kinetic growth curves were found to have one linear section, and could be described by the exponential equation $d=k^n\tau^n$, where d is layer thickness, τ is process time, and k is the rate constant of the process. Values of the exponent were determined for various temperatures by the method of least squares, and indicated that the chemical reaction and diffusion rates were comparable. IR spectroscopy, ultrasoft x-ray spectroscopy and mass spectrometry were used to study the composition of the layers. The major factor in acceleration of the oxidation process when Sb_2O_3 was present was found to be transmission of oxygen to the gallium of the substrate by the Sb_2O_3. The gallium oxide partially dissolves the antimony oxide, the controlling stage of the process being diffusion of arsenic from the substrate into the gas phase. References 12: 8 Russian, 1 East European, 3 Western (1 in Russiantranslation).

6508

UDC 666.293.513(088.8)

Vitreous Enamel Protective Coatings for Niobium and Niobium Alloys

18420263f Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 24 No 4, Apr 88 (manuscript received 5 May 86) pp 676-679

[Article by V.P. Kobyakov, G.P. Sedmale, R.A. Tsimdin, U.Ya. Sedmalis and D.L. Tsetskhladze, Riga Polytechnical Institute imeni A.Ya. Pelshe; Sukhumi Physical Technical Institute imeni I.N. Bekua]

[Abstract] A study is made of vitreous-enamel coatings for protection of niobium and its alloys from embrittlement in oxidizing media at up to 1,000°C over long periods of time. The glasses used were synthesized from Al_2O_3, SiO_2, $NH_4H_2PO_4$ and R_2CO_3, where R=Ba, Sr, Mg or Ca. Vitreous-enamel coatings were applied by pulverizing with subsequent melting in an oxygen-free medium at 950-1200°C. The initial base glasses were modified with 20-40 mol. percent barium oxide. Measurements of microhardness and IR spectroscopic studies established that the coatings formed a transition zone about 20 μm thick, preventing penetration of oxygen to the niobium. The coatings were found to provide reliable protection of niobium in air at 800°C, atmospheric pressure. References 10: 9 Russian, 1 Western.

6508

Formation of Corrosion-Resistant Coatings by Thermal Oxymolybdenation

18420036a Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 87 (manuscript received 31 Jan 86) pp 101-105

[Article by S.M. Gugel, Institute for Continuing Education of Management Workers and Specialists, Ministry of Agricultural Machinery]

[Abstract] Methods for improving the corrosion resistance of carbon and alloy steels are discussed. Good corrosion resistance can be achieved by the use of chemical-thermal treatment in active media obtained directly in the heating equipment. A new technology has been developed based on thermal oxidation of parts in the vapor of an aqueous solution of ammonium molybdenate. The process can be performed in heating furnaces as a continuous or batch process. A diagram is presented of an installation to be used for the process. The process forms a dense molybdenum, containing oxide coating up to 40 fm thick on the surfaces of parts treated. Protective properties of coatings produced under laboratory and production conditions were determined by accelerated comparative testing in a corrosive atmosphere at 40°C, 95 percent with periodic condensation. Protective properties were found to be equal to zinc coatings. The new process requires no special electrolytic equipment and is less expensive, providing a potential 20-100,000 rubles savings per plant per years. References: 6 Russian.

06508/06662

UDC 621.792

Sintering of Multilayer HfO_2-W Composites. II. Influence of Sintering Temperature and Concentration of Components on Composite Strength

18420264a Kiev POROSHKOVAYA METALLURGIYA in Russian No 5, May 88 (manuscript received 18 Oct 86) pp 25-29

[Article by S.M. Kats, T.S. Basalayeva, V.N. Bogin, S.S. Ordanyan and K.P. Akimova, Leningrad Technological Institute]

[Abstract] A previous article studied the sintering of multilayer composites consisting of alternating layers of tungsten and hafnium oxide, noting the influence of sintering temperature on the shrinkage and porosity of the composites and their components. This article analyzes the same problem from the standpoint of the influence of the temperature and concentration of composite components on strength. The study of the variation of density and strength of the composites with various volumetric fractions of tungsten showed a nonmonotonic variation. The least composite density was achieved with equal volumetric ratio of the components. The strength, after passing through a certain minimum at tungsten content 0.2-0.3, increased steadily to tungsten content 0.5-0.6 by volume. The lowest density was that of a composite in which the oxide layer consisted of large-grained type GFO-1 powder, while the tungsten layers had a between-grain porosity of about 15 percent. The studies showed that the "free" model was most suitable for composites in which the oxide layers had block structure with over 15-20 percent porosity and actually performed a "passive" function in the composite. The greatest strength was that of composites sintered at 1900°C and containing oxide layers of finely dispersed HfO_2 powders. Density and strength increased with increasing content of tungsten up to W-50 percent Mo. References 4: all Russian.

06508

High-Temperature Oxidation of Titanium Diboride Composites

18420036b Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 87 (manuscript received 11 Sep 86) pp 84-86

[Article by V.A. Lavrenko, S.S. Chuprov, A.P. Umanskiy, T.G. Protsenko, and Ye.S. Lugovskaya, Institute of Materials Science Problems, Ukrainian Academy of Sciences]

[Abstract] A study is made of high-temperature oxidation of composite material powders with 20 percent (by mass) Fe-Cr and Fe-Ni binders plus compact specimens with 2-3 percent porosity in air at up to 1770K by nonisothermal thermogravimetry and differential thermal analysis. The data indicate a multistage oxidation mechanism of these materials. This agrees with the thermodynamic calculations according to which, as titanium diboride is oxidized, reactions forming boron oxide and titanium oxide are favored. The first phase involves formation of boron trioxide producing glassy films which further prevent diffusion of oxygen from the air into the specimen. Titanium dioxide forms in the second stage. Metal additives, which improve the mechanical characteristics of titanium boride composites, also improved their corrosion resistance at high temperatures. References: 4 Russian

06508/06662

UDC 669.295.5:788:539.219

Thermal Diffusion of Hydrogen in Titanium Alloys

18420270a Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 24 No 2, Mar-Apr 88 (manuscript received 7 Apr 86) pp 59-62

[Article by O.P. Nazimov, Moscow Aviation Technological Institute imeni K.E. Tsiolkovskiy]

[Abstract] Thermal diffusion of hydrogen in titanium alloys is one cause of hydrogen segregations near welded seams. Thermodynamic analysis indicates that when a constant temperature gradient is present, a flow of matter occurs, creating a concentration difference and causing an opposite diffusion flow of matter. An equation is presented which describes the distribution of an impurity in this case. To confirm the calculation results, an experimental study of thermal diffusion was performed in iodide and technical titanium, as well as a number of titanium alloys. Near-steady distribution was recorded only at high temperatures and long times. The heat of transfer correlated satisfactorily with the heat of dissolution. Calculated and experimental results agreed satisfactorily. References 13: 12 Russian, 1 Western (in Russian translation).

06508

UDC 669.295:620.193.4

Influence of Argon Atmosphere Conditions and Purity on Oxidation of PT-7M Titanium Alloy

18420270b Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 24 No 2, Mar-Apr 88 (manuscript received 21 Nov 85) pp 77-82

[Article by V.I. Dyachkov, N.G. Lemke and V.I. Syshchikov, Leningrad State University imeni A.A. Zhdanov]

[Abstract] Using data published previously by these same authors, plus the results of additional studies, the influence of argon atmosphere conditions and the content of impurities on the kinetic characteristics and activation energy of oxygen and also on the phase composition of the products of oxidation of PT-7M α-titanium alloy (Al=2.0 percent, Zr=2.5 percent) at 350-800°C is determined. Oxidation kinetics are studied by precision gravimetric measurements using technical and high purity argon. It is found that increasing the argon flow rate above a certain limit has no influence on oxidation rate. Changing the static conditions to dynamic conditions with practically identical apparent chemical reaction activation energy, phase composition of oxide film and hydrogen content in oxidized specimens, leads to a significant increase in oxidation rate, particularly at temperatures over 550°C, activation energy of diffusion processes in the unsteady kinetic area, and relative significance of oxide film formation. In order to prevent contamination of PT-7M alloy with chemically active impurities in argon, heat treatment at temperatures over 550°C should be performed in a static argon atmosphere using additionally purified gas. References 6: all Russian.

06508

UDC 669.715'721:620.196.2

Influence of Intercrystalline Corrosion on Low-Cycle Fatigue of AMg5 Alloy

18420270e Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 24 No 2, Mar-Apr 88 (manuscript received 14 Jul 86) pp 96-97

[Article by A.N. Kuzyukov and L.V. Zaytseva, Ukrainian Scientific Research and Design Institute for Chemical Machine-Building, Severodonetsk]

[Abstract] Specimens were cut from rolled sheet products of AMg5 (4.9 percent Mg, 0.75 Mn, 0.5 Fe, 0.5 Si, 0.1 Cu, 0.2 Zn, remainder Al). Plates were welded by argon-arc welding with a 5 mm tungsten electrode and AMg5 wire. Some of the specimens were held at 145-155°C for 30 hours, then tested for intercrystalline corrosion in three percent NaCl solution at 22-28°C for 48 hours, showing slightly less corrosion for welded joints than for the base metal. Corrosion on grain boundaries was found to be a major source of stress concentrators, decreasing permissible pulsating load stress by 20 percent. Heat treatment of equipment at 280°C for 5 hours after 3 years of use is suggested to lengthen the service life of parts made of this alloy. References 2: both Russian.

06508

UDC 620.193.41:669.295

Corrosion Resistance of VT1-0 Titanium in Hydrochloric Acid Solutions

18420270f Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 24 No 2, Mar-Apr 88 (manuscript received 15 Sep 86) pp 97-99

[Article by V.Ye. Blashchuk, L.M. Onopriyenko and M.V. Chervonyy, Khlorvinil Production Association, Kaluga]

[Abstract] The purpose of this work was to determine the corrosion resistance, hydrogenation and change in strength of VT1-0 titanium in 1-7 percent solutions of hydrochloric acid at 50-133°C, and in the same solutions with 20 mass percent type BVK yeast. Corrosion rates were studied on specimens measuring 45X25X3 mm made of sheets three mm thick. Cylindrical specimens were tensile tested to determine the change in strength properties. As acid concentration increased, corrosion increased at all test temperatures. Addition of yeast reduced the corrosion rate. References 2: both Russian.

06508

Poor Planning of Metal, Plastics Production Criticized

18420036j Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 29 May 88 p 3

[Article by I. Zhagel under the rubric "Economic Survey": "An Iron Perspective"; first paragraph introduction printed in italics]

[Text] The USSR Ministry of Ferrous Metallurgy has already discussed the plan for branch developed up to 2000-2005 several times. Various details in the plan are being revised, and the breakdown of metal products to be produced at the turn of the two century is being precisely determined. Only the main guidelines outlined by USSR Gosplan have remained firm. And they presume a significant—almost 25 percent (!)—increase in rolled ferrous metal output.

Not very long ago we rated a country's power according to the growth in ferrous metallurgy output. However, we can hardly rejoice at the rates we now observe here. Even today we consume more rolled stock than anyone in the world, and we have begun to produce about as much as the United States and Japan combined. Judging from current trends, this relationship will grow in our favor every year. But it's not really in our favor if we take into account the material, raw stock, and human resources this requires.

How do the Gosplan people themselves explain their largesse? The chief of the ferrous metals subdepartment, V. Zelinskiy, states without a shadow of a doubt that their targets are based on the national economy's actual demands for structural materials, especially on the requests of machine builders, whose task is to re-equip all branches of industry by the year 2000.

Yes, this task has been assigned, and it is critical today. But how to combine our intentions to bring almost all machinebuilding goods to the world level by 1990 with a further increase in ferrous metal demand? Material input is one of the basic indicators of the technical advancement of equipment. It must be if we want to come close to even the current quality and quantity level of machine production in the United States. This means that we must consume about as much metal as they do today. But this means metal and metal products of the same high quality that our main economic rivals have. It is precisely here that we lag behind. Our efforts must be more quickly directed toward increasing the quality, not the volume of rolled stock.

True, both USSR Gosplan and the Ministry of Ferrous Metallurgy's branch institutes make the usual reference to the special conditions in our country. Huge distances and low temperatures are an objective reason, they say, for the national economy's increased metal content. Well, all right, let's say we have to consume 5-10 million tons of rolled stock more than other countries—according to figures from certain specialists. But if we develop our ferrous metallurgy according to the plan under consideration, by the year 2000 the gap between our country and the United States in the use of rolled metal will reach 30-40 million tons!

Today's exorbitant ferrous metal outputs are a unique tribute to our inefficiency and to misalignments in the policy toward the structure of metallurgy itself which have led to the lag in output of high-quality goods. We are reaping the fruits of the current economic mechanism in our economy. Instead of seeking ways to avoid such gaps, USSR Gosplan actually wants to reinforce the current situation in the future.

Are there any alternatives to this "iron" perspective? This question can be answered with a resounding "Yes." The experience of economically developed countries points to the answer. Long ago they set a course toward assimilating more efficient metal products and replacing metal with other structural materials, particularly plastics. For example, what data did R. Mkrtchanyan, general director of the NPO [Scientific-Production Association] Plastmassy and doctor of technical sciences, present at a recent all-union meeting on resource conservation?

The United States now uses more than 20 million tons of plastics, of which about two-thirds are for construction purposes. Here these indicators are 5.5 and 1.5 million tons. We are also about 20-50 times behind in the use of different types of engineering plastics, i.e. those which can replace even alloyed steels. The situation is aggravated by the fact that our country produces half as much paint and varnish, and for that reason one-third of our metal structures are not protected against corrosion. We are far behind also in the output of rolled stock with various protective coatings.

Sad statistics. However, it is even sadder that, according to prospective plans, we not only will be unable to compare ourselves with the United States in output and consumption of, let's say, structural plastics, but will not even have achieved their present level. On the whole, the gulf between us will become even wider. And here the question unwittingly arises, Is our investment policy really oriented properly, have the points of focus been correctly selected? What kind of acceleration is it if the rates of increase in the output of progressive materials, which define the face of machinebuilding and construction, are lower here than in other countries?

Of course, a powerful jump forward takes resources. There aren't even enough in other branches, which also need accelerated development. But still, is there a sensible explanation for the fact that we will first pour money into ferrous metallurgy and increase rolled stock output to a level unprecedented in world practice and only then increase its quality, only then think about what can replace this metal? Isn't it better to immediately direct our efforts to expanding the production of new structural materials?

The solution is so obvious that no evidence should be needed. However, it is obvious if only we approach it from the standpoint of normal, universal human logic. But that's the point, that the industry's economic structure and the forces of departmental gravity so distort the space, that it sometimes seems that, together with L. Carroll's heroes, we find ourselves in the looking glass, where everything is topsy-turvy. We are already building tractors for the sake of tractors, and the increase in rolled stock output looks almost like a key national economic task.

Yes, it is precisely branch isolation that prevents the coordination of efforts and timely reallocation of assets to the most important areas of work. It is no accident that we as yet have no unified, union-wide program for developing structural materials. True, USSR Gosplan's activities specifically outlines this direction, for which one of the deputy chairmen of the august organization—V. Vanchikov—is responsible. It would seem that everything related to structural materials should be concentrated in his hands. But actually he is responsible only for the development of the metallurgical complex. Because in this very Gosplan there is another deputy chairman—A. Lukashov—who take care of the chemical industry and, accordingly, plastics are in his domain.

By the way, specialists have told me that increasing the output of rolled metal to the levels outlined by Gosplan will require capital investments about equal to those allocated for the 5-year plan for the entire chemical and lumber complex. It is understandable that only a certain part of this sum will go to plastics production. But it is not being used in the best manner.

The fact is that planning agencies have long given preference to developing the production of traditional plastics, which require much lower—about 10 times lower—capital investments than do structural plastics. This permitted a rapid rise in output and the semblance of a great leap forward. These approaches remain to a certain degree even now. Naturally, they must be changed as quickly as possible.

Of course, this does not exactly mean that now we must concentrate all our efforts on engineering plastics and forget about the problems of ferrous metallurgy. Some funds intended to increase rolled stock output can successfully be used to assimilate modern, high-quality steel grades, to improve the so-called fourth process stage in metallurgy. And, thus, to greatly reduce the total demand for metal. I have had occasion to speak to many executives at the USSR Ministry of Ferrous Metallurgy, and they all insistently stressed that constantly rising outputs do not allow them to re-equip the branch and, therefore, increase production of more progressive metal products. And on the other hand, the lack of progressive types of rolled stock encourages a further rise in metal output. The result is a closed circle, and USSR Gosplan must break it: It would be worth it if, in collaboration with ministries and departments, it were to develop an essentially new concept for the development of ferrous metallurgy and the nontraditional structural materials industry and to persistently carry it out.

But for now...for now even original domestic technologies for manufacturing structural materials cannot force their way. Foreign companies have acquired or are negotiating the purchase of licenses for polycarbonate and polyformaldehyde in our country. Under these licenses, enterprises are to be created in Bulgaria, the GDR, and India. But the production of polycarbonate and polyformaldehyde still cannot go beyond the pilot plant stage here. And no real shifts are foreseen before the end of the 5-year plan. Will the old story, in which we buy goods produced abroad under our own licenses, again be repeated?

In conclusion, I would like to quote a report American economic analysts prepared for their government: "Although the United States is the leader in the production of structural materials, the government should consider and take appropriate steps to maintain this position."

How do we respond to this? Surely, not with a further increase in the output of obsolete materials?

12809/06662

UDC 669.14.018.252.3

Tungsten-Free Type 9Kh6M3F3AGST and 9Kh4M3F2AGST Steels

1842027lg Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 33-35

[Article by S.G. Uradovskikh and A.I. Lyapunov, All-Union Scientific Research Institute for Tools]

[Abstract] Results are presented from studies of the basic and technological properties of the tungsten-free steels 9Kh6M3F3AGST (EK41) and 9Kh4M3F2AGST (EK42) as replacements for R6M5 steel in the manufacture of metal-cutting tools. EK41 and EK42 have lower hardness, red hardness, inferior mechanical properties, large austenite grain and less stability of properties than R6M5. EK41 and EK42 steels are more difficult to work by cutting and grinding and have lower strength and impact toughness than R6M5. EK41 and EK42 therefore cannot be considered satisfactory replacements for R6M5 steel. References 4: 3 Russian, 1 Western (in Russian translation).

06508

UDC 669.14.08.254

Structure and Properties of 5KhNM Stamp Steel Made With Original and Normal Metallurgical Charge

18420271i Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 42-45

[Article by O.A. Bannykh, Yu.P. Liberov and A.V. Tereshchenko, Metallurgy Institute imeni A.A. Baykov]

[Abstract] A comparative study is presented of the properties and usage characteristics of 5KhNM stamp steel made from sponge iron and the ordinary metallurgical charge, analyzing the effect achieved by using direct reduction iron instead of scrap-based charge materials. The steel made from sponge iron was found to have superior mechanical characteristics, being both stronger and more ductile. The sponge-iron steel had a lower content of impurities and nonmetallic inclusions and superior wear resistance at 300-500°C. References 5: 3 Russian, 2 Western.

06508

UDC 669.14.018.252.3

The Question of Originality of Compositions of EK41 and EK42 Steels

18420271h Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 35-37

[Article by L.A. Poznyak, Institute of Materials Science Problems, Ukrainian Academy of Sciences]

[Abstract] EK41 and EK42 steels are essentially analogues of low-alloy tool steels developed in 1936-1938 in Germany. Known as EI260 and EI277 in the USSR, their compositions were published in the Soviet Union in 1941 and 1944. EK41 is found to differ from EI260 only in its slightly elevated content of manganese and silicon and the presence of the microadditives titanium, nitrogen, boron, calcium and rare-earth metals. EK42 and EI277 differ in that EK42 has about 1 percent less vanadium and 0.2 percent less carbon. The microadditives have no great influence on the physical and mechanical properties of the steels and were therefore introduced only to make the composition different from those of known steels and thus gain an author's certificate. EK41 and EK42 therefore cannot be considered new steels, or suitable to replace R6M5 steel. EK41 is of no interest for industry. EK42, with some improvement and adjustment in composition, might be interesting as a tool steel for mild usage conditions.

06508

UDC 669.14.018.252.3

Optimization of Low-Carbon High-Speed Steel Composition

18420271f Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 26-33

[Article by L.S. Kremnev and Yu.Ye. Sedov, Moscow Machine-Tools and Tools Institute]

[Abstract] Significant expansion of the area of application of low-alloy high-speed steels to replace traditional type R6M5 requires development of new steels based on more than simple tests of tools made of prospective new steels, since the cutting properties of tools depend both on the properties of the steels of which they are made and on the properties of the materials they are cutting, cutting modes, machine-tool condition, heat treatment and sharpening modes of the tools, skill of operating personnel and many other factors. Rather, a group of properties of high-speed steels must be tested, including hardness after final heat treatment, thermal stability, flexural strength and impact toughness. Only steels which pass these property tests should be used in necessary tool testing in metalworking plants. One must also consider to what extent the most important properties of high-speed steels depend on chemical composition. Based on these considerations, steels of type EK41, EK42 and EP973 cannot fully replace type R6M5 steel as their inventors have claimed. However, the hardness and thermal stability of a steel containing about 1 percent carbon, 5 percent Mo, 4 percent Cr and 1.5 percent V could be superior to those of R6M5 steel. A new steel of this composition, type 11M5F, has been produced. The new steel can be hardened from 1140-1180°C, retaining fine and uniform austenite grain structure. Addition of about 1 percent aluminum improves properties still further. References 21: 12 Russian, 9 Western (1 in Russian translation).

06508

UDC 669.14.018.298

High-Strength Carburizing Steel for Heavily Loaded Machine Parts

18420271d Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 17-19

[Article by T.Ya. Menshikova and V.I. Povar, Scientific Research Institute of Motor Vehicle and Tractor Materials]

[Abstract] Specialists at the ZIL plant and the Scientific Research Institute of Motor Vehicle and Tractor Materials have developed type 18KhGN2MFB steel, containing, in percent: 0.15-0.22 C, 0.17-0.37 Si, 0.5-0.8 Mn, 0.4-0.6 Cr, 1.6-2.0 Ni, 0.4-0.6 Mo, 0.05-0.10 Nb, 0.10-0.25 V, less than 0.25 Cu, and less than 0.016 N, in which nonmartensitic products of the decomposition of austenite do not form in the diffusion layer during hardening in oil, as occurs in other steels. The new steel has a fine-grained structure and good mechanical properties, with low deformation of parts during heat treatment, which improves durability and reduces transmission noise. The new steel is in production at the Krasnyy Oktyabr steel plant in Volgograd. Following annealing at 920°C for 3 hours, cooling with the furnace, hardening from 860°C in oil, and tempering at 200°C for 3 hours and cooling in air, the steel has a tensile strength of 1570 N/mm^2, δ=12 percent, Ψ=50 percent and $\alpha_{0.25}$=117 J/cm^2. Optimal conditions for stamping and heat treatment of parts have been selected on the basis of studies of the transformation of supercooled austenite. The steel has fatigue resistance superior to type 20Kh2N4A with several times greater durability. References 3: all Russian.

06508

UDC 669.14.018.29

Chrome-Nickel-Molybdenum Structural Steels for Large, Heavily Loaded Parts

18420271e Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 20-22

[Article by A.G. Ryzhkov and Yu.M. Kaletin, Urals Polytechnical Institute]

[Abstract] A study is made of the structure and properties of chrome-nickel-molybdenum steels with the following chemical compositions, in percent: 40Kh2N2MA: C, 0.41; Ni, 1.52; Cr, 1.37; Mn, 0.50; Si, 0.36; Mo, 0.25; S, 0.014; P, 0.025; 10Kh2N3GM: C, 0.10; Ni, 2.68; Cr, 2.23; Mn, 0.91; Si, 0.44; Mo, 0.34; S, 0.022; P, 0.012. Studies show that the properties of 40Kh2N2MA steel depend essentially on its cooling rate after austenitization. Immediately after hardening the steel has low ductility and toughness. High tempering improves ductility and impact toughness, while leaving strength and hardness at satisfactory levels. The properties of large products made of these steels, in which the probability of bainite is high, are determined by the segregation of carbides in the bainite ferrite during continuous slow cooling. Achievement of a carbide-free bainite structure yields good impact toughness and strength in the low-tempered state. Where the carbon content is 0.10-0.15 percent, cooling at 300 K/Hr yields this carbide-free bainite structure. References 6: 4 Russian, 2 Western (1 in Russian translation).

06508

UDC 669.532.72:669.715'784

Diffusion of Carbon in Aluminum and Its Alloys

18420262c Moscow METALLY in Russian No 3, May-Jun 88 (manuscript received 22 Dec 86) pp 216-218

[Article by A.V. Nasonov, Ye.A. Soldatov, L.S. Guzey and L.M. Aziyeva, Moscow]

[Abstract] The purpose of this work was to determine the diffusion coefficients of carbon in aluminum and its alloys. The influence of the rare-earth metals on diffusion of carbon in aluminum was also studied. The diffusion coefficients of carbon were determined radiometrically using the isotope ^{14}C in cylindrical specimens 8 mm high and 10 mm in diameter with polished flat surfaces to which carbon was applied by cathode atomization of ^{14}C at a voltage of 200 V, current 16 mA, in a layer about 0.01 μm thick. Diffusion annealing was performed at 633, 723 and 833 K in quartz ampules for $3.53\text{-}3.96 \cdot 10^6$ seconds at 10^{-2} Pa. The coefficient of diffusion was found to be $1.1\text{-}1.3 \cdot 10^{-18} m^2/s$ at 833 K. Y and Sc slightly decreased the coefficient of diffusion of carbon in aluminum. References 9: 8 Russian, 1 Western.

6508

UDC 621.778.1-426.029

Manufacture of Thin Titanium Wire

18420247h Moscow TSVETNYYE METALLY in Russian No 3, Mar 88 p 76

[Article by M.A. Shemetov, A.A. Klekovkin, and V.G. Yurchenko]

[Abstract] A method of manufacturing Ti wire less than 1.0 mm in diameter has been developed under laboratory conditions at the Beloretsk Metallurgical Combine. A blank wire of VT1-00 grade Ti, 1.0 mm in diameter, is annealed at 460-480 deg C for 30-40 mn in a NaOH or KOH melt and then etched with an H_2SO_4-HNO_3 acid mixture at 50-70 deg C. Wires 0.5 mm in diameter were produced from such blanks by drawing: bare wires with Ca-salt lubricant sublayer and wires with 0.0005-0.001 mm thick galvanic Cu or brass coating. Drawing to a total reduction of 50 pct and then also 75 pct was done with graphite-soap lubricant at rates gradually increased from initial 50 m/min up. Cu-coated wires were least defective and best had the surface finish brass-coated wires, the latter also having an adequate margin of plasticity for being drawn at rates up to 100 m/min, while bare wire became defective already when drawn at a rate of 50 m/min. References 1: Russian.

2415/12232

UDC 669.714.247.48

Selection of Cathode Materials for Refining Molybdenum and Tungsten in Halide Melts

18420247d Moscow TSVETNYYE METALLY in Russian No 3, Mar 88 pp 53-55

[Article by B.F. Kovalev, A.V. Volkovich and V.I. Zhuravlev]

[Abstract] Several cathode materials were comparatively evaluated for refining Mo and W in NaCl-KCl-$MoCl_5$ and KCl-KF-WCl_4 melts respectively, the refining process parameters being a cathode current density of 1.0-1.2cm^2 and a temperature of 1025-1055 K, Mo-ion content and W-ion content reaching 7 pct and 9 pct respectively after 1 h. Preliminary tests with cathodes of various shapes have revealed that Mo and W powder deposits adhere best to hexahedral ones. The cathode materials tested for extraction efficiency and for impurity content in extracted Mo or W powder size fractions were Cr, Mo, W, several grades of graphite including silicized graphite, SiC, EI69 and Cr18Ni9Ti alloy steels, and St3 plain carbon steel. References 2: both Russian.

2415/12232

UDC 669.777

Extraction of Tellurium From Intermediate Products During Reprocessing of Copper-Electrolytic Slurries

18420247a Moscow TSVETNYYE METALLY in Russian No 3, Mar 88 pp 13-15

[Article by A.G. Ryzhov and A.K. Ter-Oganesyants]

[Abstract] An experimental study was made concerning the feasibility of Te extraction from products of the reprocessing of Cu-electrolytic slurries by oxidizing heat treatment at the Norilsk Ore Dressing Plant. This technology, developed by T.N. Greyver in 1967, essentially involving extraction of Te into an 85-90 pct H_2SO_4 solution after Cu has been extracted during lixivation of the slurry and subsequent selective cementation of Te as well as of precious metals (Ag, Pd) with either Cu powder of Ni powder. Tests were performed on slurry samples containing 32.6 pct Cu and 0.66 pct Te or 5.0 pct Cu and 0.87 pct Te respectively, a solution of 250 g/dm^3 H_2SO_4 being used for lixivation with mechanical stirring of mixtures containing solid and liquid in 1:5 ratio for 2 h at 50 deg C and at 90 deg C. The results indicate that the Te concentration in the solution should not exceed 6-7 g/dm^3 for efficient extrability, refortifying of the solution after each extraction cycle with H_2SO_4 concentrate being necessary. For efficient extraction of Ag and Pd in the process, formation of their tellurides during cementation can be inhibited by their prior precipitation in the form

of chlorides. Quantitative analysis of successive reprocessing products indicates the feasibility of extracting 97.5 pct Te and 33.4 pct Cu by cementation with Ni powder, more by cementation with Cu powder. The lower efficiency of Ni powder is evidently due to its high content of inactive impurities such as NiO. References 6: all Russian.

2415/12232

UDC 621.762

Properties of Rolled Fe-Cu Composite Material Produced by Fast Sintering

18420246b Kiev POROSHKOVAYA METALLURGIYA in Russia No 4, Apr 88 (manuscript received 26 Feb 87) pp 52-57

[Article by V.M. Ocheretyanskiy, V.Ya. Berent, A.V. Aleshina and O.V. Sivak, Institute of Materials Science Problems, UkSSR Academy of Sciences]

[Abstract] An experimental study of the 15Cu - 1Ni - 84Fe pseudoalloy produced by fast solid-phase sintering (at 1050 deg C) or liquid-phase sintering (1150-1200 deg C) was made, for the purpose of determining the evolution of its porosity and mechanical strength during the process. Rolled laboratory plate specimens, 1 mm thick and with an initial porosity of 15-17 percent, were sintered both ways in a hydrogen atmosphere in a tubular furnace for 1-5 min, 7 min and 10 min. Rolled factory plate specimens, 7.8 mm thick, were sintered in a continuous furnace under laboratory conditions for 8 min, 10 min, 12 min, 15 min, 20 min. Considering that a lower Cu content is known to increase the dilation of specimens during liquid-phase sintering, control tests were performed on the 8Cu - 1Ni - 90.5Fe pseudoalloy containing 0.5 wt.pct P. All specimens were tested for density and electrical resistivity as indicators of porosity as well as for tensile strength and impact value ($1J/m^2$). The tests, together with microstructural examination under x100 and x500 magnifications, indicate that the porosity of the material dips to its minimum after 4 min sintering by either method then increases noticeably again during further liquid-phase sintering only. The factory specimens were also tested for wear in dry friction against wrought copper and against a powder metal, after they had been impregnated with molten 95Pb-5Sn alloy. Stabilization of their compactness was found to require longer liquid-phase sintering, 15-20 min or preferably even 150 min, as indicated by the increasingly uniform distribution of the impregnant over the volume of the host material. References 10: 8 Russian, 2 Western.

2415/12232

UDC 622.765.06

Testing of Effective Reagent Formulations for Flotation of Cu-Ni Ores

18420247b Moscow TSVETNYYE METALLY in Russian No 3, Mar 88 pp 16-18

[Article by M.A. Fatyanova, V.Il Perepechin, G.P. Ponomarev and V.A. Shcherbakov]

[Abstract] Several reagents for flotation of Cu-Ni ores were comparatively tested in the laboratory, the purpose being to optimize their formulation and activity level for optimum selection in view of the diversity of these ores in terms of chemical composition, habitat, inclusions (especially sulfides) as well as variances within any given deposit and differences arising in their processability. Tested were collector-reagents such as aeroflots (Na or K ethyls, butyls, isobuytls) self-sufficient or with boosters, CED (carbomethoxyester of diethyl dithiophosphoric acid), and frother-reagents (T-66 etalon, hexyl alcohols, terpene alcohols, pine oil, Methylisobutyl carbinol MIBC). References 2: both Russian.

2415/12232

UDC 621.762.4:669.018.4:661.665.3

Study of Friction Characteristics of Hot Pressed B_4O-Based Material

18420264d Kiev POROSHKOVAYA METALLURGIYA in Russian No 5, May 88 (manuscript received 10 Mar 87) pp 56-60

[Article by G.G. Karyuk, V.V. Kovalchuk, A.I. Yuga, O.N. Grigoryev and A.M. Kovalchenko, Institute of Materials Science Problems, Ukrainian Academy of Sciences]

[Abstract] A study is made of a combination of physical-mechanical characteristics of hot-pressed materials of the system B_4C plus ZrB_2. Interaction of zirconium dioxide with boron carbide during hot pressing was used to produce a heterophase B_4C-based material: $2ZrO_2$ plus B_4C plus 3C yields $2ZrB_2$ plus 4CO. X-ray phase analysis confirmed the presence of zirconium diboride in the material. Friction properties of the specimens were estimated with a steel counterbody, installed on the friction machine instead of the diamond disk and rotated at 5 m/s. The studies indicated that the microstructure of the heterophase hot-pressed materials was more homogeneous than that of pure boron carbide, yielding an improvement in mechanical properties of the material, particularly hardness and strength. The presence of the second group IV transition metal boride phase has a positive influence on the abrasion resistance of the material due to the superior mechanical properties of the two-phase material. Losses to friction of the two-phase material are lower than those of pure B_4C due to the more intensive film formation at the interface. References 8: 5 Russian, 3 Western.

06508

UDC 662.997.621

Laser Surface Hardening of Boron Carbide-Based Cermets

18420264e Kiev POROSHKOVAYA METALLURGIYA in Russian No 5, May 88 (manuscript received 25 Feb 87) pp 77-80

[Article by M.S. Kovalchenko, A.V. Paustovskiy, B.M. Boleyko and A.B. Zhidkov, Institute of Materials Science Problems, Ukrainian Academy of Sciences]

[Abstract] A study is presented of the possibility of creating hard layers on a B_4C-Al system cermet surface by laser pulses. Specimens of near-theoretical density with 30-50 percent aluminum content by volume were produced by pulsed hot pressing. Mean particle size was 30-50 μm. Specimens were exposed to laser pulses $5 \cdot 10^{-3}$ s in length with energy density of 0.5-15 J/mm^2. Metallographic analysis was performed by scanning electron-microscope; hardness was measured by the Rockwell method (60 kg load) and microhardness of phases on a PMT-3 type instrument. Flexural strength tests, x-ray phase analysis and determination of the distribution of chemical elements by depth in the zone of thermal influence were also performed. Laser treatment caused an increase in surface hardness by 20 percent with a hardened zone depth of 150-200 μm and no surface cracks in the material treated. References 6: all Russian.

06508

UDC 537

Change in Electrical Properties of Fine Crystal Graphite Upon Introduction of $FeCl_3$

18420263d Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 24 No 4, Apr 88 (manuscript received 12 Jun 86) pp 598-601

[Article by Ye.I. Kharkov, L.Yu. Matsuy and L.L. Vovchenko, Kiev State University imeni T.G. Shevchenko]

[Abstract] Results are presented from a study of the process of intercalation of $FeCl_3$ in fine crystalline anisotropic graphite, as well as data on the changes in resistivity in the plane of ρ_a layers perpendicular to the ρ_c layers, magnetic resistance and Hall coefficient resulting from introduction of $FeCl_3$ into the fine-crystalline graphite. It is shown that the resistivity, magnetic resistance and Hall coefficient are altered by addition of $FeCl_3$ as in single-crystal graphite compounds. However, in intercalated fine-crystal graphite compounds, the nature of introduction of the $FeCl_3$ and accommodation factor depend on graphite crystal size. Resistivity in the direction perpendicular to the plane of the layers decreases when $FeCl_3$ is introduced, whereas it increases in single-crystal graphite. References 16: 4 Russian, 12 Western.

6508

UDC 537.228.1+66.046

Sintering of Lithium Metaniobate Powders

18420263e Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 24 No 4, Apr 88 (manuscript received 20 May 86) pp 661-666

[Article by L.A. Reznichenko, O.N. Razumovskaya, V.A. Chernyshkov, Ye.S. Gagarina, L.A. Shilkina, A.N. Klevtsov and V.A. Aleshin, Rostov State University; Physics Scientific Research Institute]

[Abstract] A study was performed of the kinetics of sintering of lithium metaniobate powders synthesized by solid phase reaction of Li_2CO_3 with Nb_2O_5 at 970-1170 K. The data were used to determine the variation of specimen density with roasting temperature, which was found to have a maximum at 1190-1350 K, varying with synthesis temperature. The powder produced at 970 K was found to contain significant quantities of unreacted initial components, while the reaction was virtually

complete at 1020 K, though the product was not chemically and structurally homogeneous. At over 1050 K, coarse-grained chemically pure lithium metaniobate was obtained. Further increases in temperature reduced the activity of lithium metaniobate powder during sintering, making the manufacture of high-quality ceramics impossible. References 10: all Russian.

6508

Influence of Structure on Mechanical Properties of Reaction Sintered Silicon Carbide Materials

18420036e Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 87 (manuscript received 30 Jun 86) pp 61-67

[Article by G.G. Gnesin, I.V. Gridneva, Yu.P. Dyban, Yu.V. Milman, V.M. Mirolyuz, S.I. Chugunova and V.D. Bazilevich, Institute of Materials Science Problems, Ukrainian Academy of Sciences]

[Abstract] A study is made of silicon-carbide ceramic materials. Mechanical properties were determined in static tests utilizing three-point flexure. Crack resistance was determined in notched specimens. Tensile strength of ceramic materials made with grain size about 100 fm is found to be 0.18 GPa. Decreasing grain size to 3-5 fm increases tensile strength to 0.4 GPa. Crack resistance does not vary with grain size but increases with a transition to the use of two-fraction compositions, particularly one using smaller grains. Crack resistance increases with increasing strength and also correlates in some way with elements of structural heterogeneity, which increased the energy expended in the formation of a new surface. References: 3 Russian, 1 Western.

06508/06662

UDC 538.221:539.15:539.2

Influence of Sintering Temperature on Crystalline and Magnetic Structure of Nickel-Zinc Ferrites

18420264b Kiev POROSHKOVAYA METALLURGIYA in Russian No 5, May 88 (manuscript received 1 Apr 86) pp 39-42

[Article by Sh.Sh. Bashkirov, A.B. Liberman, A.M. Khasanov and L.I. Meleshko, Kazan University]

[Abstract] X-ray structural and Mossbauer studies were performed of specimens in the system $Zn_xNi_{1-x}Fe_2O_4$ (x=0, 0.1, 0.24), prepared by an oxide technology at a sintering temperature of 1250 or 1300°C and isothermal holding time of 6 hours. The oxygen parameter u, representing the deviation in the spinel structure from the ideal, was determined considering the Mossbauer spectroscopy data on cation distribution. The structural parameters can explain differences in magnetic microstructure and Curie temperature of ferrites of identical composition. Using the variation in volumetric parameters as a function of distance and bond angle, the authors calculated the contribution of their changes to the Curie point of the specimens studied, indicating good agreement of experimental and calculated quantities and indicating that changes in synthesis temperature within small limits cause structural distortions, as a result of which the magnetic microstructure and Curie point of ferrites of identical composition may differ. References 6: 5 Russian, 1 Western (in Russian translation).

06508

UDC 669.018

Thermoemission Properties of Tungsten With Rare-Earth Metal Oxides

18420264c Kiev POROSHKOVAYA METALLURGIYA in Russian No 5, May 88 (manuscript received 14 Jan 87) pp 42-44

[Article by N.I. Guralnik, V.V. Yevstifeyev, and N.G. Imangulova, Applied Physics Scientific Research Institute, Tashkent University; Chirchik Branch, All-Union Scientific Research Institute of Refractory Metals and Hard Alloys]

[Abstract] This article presents results from an experimental investigation of the thermoemission properties of tungsten cathodes containing 1.2 percent (mass) La_2O_3, Y_2O_3 and Dy_2O_3. The cathodes were produced by powder metallurgy methods, heat treated in a very high vacuum installation at $1 \cdot 10^{-6}$Pa. Measured values of emission current and temperature were used to determine the full current work function. Investigation of the thermoemission properties showed that cathodes of W plus La_2O_3 and W plus Y_2O_3 were most effective at 1700 and 1900-2100 K. The W plus Dy_2O_3 cathode had high work function at 1500-2100 K, indicating that it is not suitable for use. References 4: all Russian.

06508

UDC 548.5:669.76

Structure and Properties of Thin Films of Bismuth and Its Alloys With Antimony

18420263b Moscow NEORGANICHESKIYE MATERIALY Vol 24 No 4, Apr 88 (manuscript received 4 Jun 86) pp 542-545

[Article by V.G. Shepelevich, Belorussian State University imeni V.I. Lenin]

[Abstract] Thin foils of bismuth and alloys of Bi with 4.8 and 12 at. percent Sb were produced by throwing drops of the melted material onto the inner polished surface of a spinning copper cylinder. The thin foils were metallographically studied, x-ray structural analysis of the texture was performed and electrical and magnetic properties were determined. The thin foils were found to be polycrystalline with uniform distribution of components. The Hall coefficient and differential thermal emf of the thin foils are determined by their texture, while the resistivity and magnetic resistance are determined by the scattering of electrons and holes on the crystal boundaries. References 13: 11 Russian, 2 Western.

6508

UDC 621.762.5

Finely-Dispersed Titanium Nitride Powders With Molybdenum or Tungsten

18420207a Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA in Russian No 6, Nov-Dec 88 (manuscript received 24 Nov 86) pp 658-661

[Article by Ya.P. Grabis, Dz.M. Rashmane and A.A. Kuzyudevich, Inorganic Chemistry Institute, Latvian Academy of Sciences]

[Abstract] The properties of finely dispersed titanium nitride and either molybdenum or tungsten powders obtained in a high-temperature nitrogen stream on an experimental apparatus were studied. The products obtained were subjected to x-ray and chemical analysis. Oxygen content was determined using neutron activation analysis. Specific surface was found using argon thermal desorption. The size and shape of the particles was on EMB-100B electron microscope. The x-ray analysis showed that the finely dispersed powders contained minor admixtures of Mo_2N and W_2N. Nitrogen content as a percentage of mass decreased as the concentration of molybdenum or tungsten was increased. The correlation between nitrogen and titanium is practically independent of the concentration of molybdenum or titanium. This indicates that the nitrogen is primarily linked to the titanium, and that the presence of molybdenum or titanium does not materially affect the yield of titanium nitride. Oxygen content per unit of specific surface

remained practically unchanged until molybdenum or tungsten content as a percentage of mass exceeded 60 percent, beyond which it increased substantially. Increased molybdenum and tungsten content resulted in a gradual decrease in specific surface and a significant change in the structure of the particles. Small rod-shaped particles predominated in the Ti—Mo—N system; spherical particles in the Ti—W—N system. The complex macrostructure of the particles should lead to the synthesis of materials with a homogeneous structure, as the possibility of the formation of aglomerations of finely dispersed particles consisting primarily of the individual components of the mixture would be excluded. References 3: all Russian.

13050/12232

UDC 621.762.5

Finely Dispersed Titanium Nitride Powders With Iron or Cobalt

18420207b Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA KHIMICHESKAYA in Russian No 6, Nov-Dec 88 (manuscript received 24 Oct 86) pp 662-665

[Article by Ya.P. Grabis, Dz.M. Rashmane and I.F. Shteyns, Inorganic Chemistry Institute, Latvian Academy of Sciences]

[Abstract] The properties of finely dispersed titanium nitride powders with either iron or cobalt were studied. Mixtures of titanium of iron or cobalt powders were vaporized in a high-temperature stream of nitrogen. The experiments were done on an experimental device built around a radio-frequency generator. Particle size was regulated by feeding cold gas into the reactor. The yields were studied using x-ray and chemical analysis. Oxygen content was determined using neutron-activation analysis. Argon thermal desorption was used to determine specific surface. The morphology of the particles was studied on an EMB-100B electron microscope. The results of the experiment were consistent with thermodynamic calculations. The finely dispersed powders contained only titanium nitride and either iron or cobalt. As the proportions of iron or cobalt were increased, nitrogen as a percentage of mass in the products decreased from 22.3 percent for the titanium nitride to 1.2 percent for the cobalt and 2.4 percent for iron. The presence of iron or cobalt in the powders has practically no effect on the formation of the titanium nitride. The specific surface of the composite powders gradually decreased as the content of iron and cobalt increased. Composite powders with an iron or cobalt content of up to 50 percent of their mass consisted of sharply defined cubic particles of titanium nitride with droplets of iron or cobalt in the form of cupola-shaped islets on their surfaces. Spherical-shaped particles predominated in powders with an iron or cobalt content exceeding 50 percent of mass. These particles consisted of titanium nitride in a jacket of iron or cobalt. There were also spherical particles made up of a single metal. The specimens also contained dumbbell-shaped particles. The occurrence of these particles was attributed to the formation of titanium nitride at temperatures higher than the condensation temperature of iron and cobalt. References 4: all Russian.

13050/12232

UDC 621.315.592

Distribution of Dopant During Growth of Silicone Single Crystals in Floating Crucible

18420247e Moscow TSVETNYYE METALLY in Russian No 3, Mar 88 pp 55-57

[Article by F.I. Selitskiy, Kh.I. Makeyev, V.Ye. Zotkin, A.V. Orsa, Ye.I. Konoplev and L.A. Ryabtsev]

[Abstract] The process of doping a Si single crystal during its growth by the Czochralski method with two crucibles, a floating one inside a stationary one, is analyzed for the kinetics of dopant distribution. The inner crucible with a seed hold is immersed into the melt filling the outer crucible, whereupon it also fills with melt which rises to the same level through a hold in the bottom. A single crystal then grows in two stages, first width-wise from the seed to a fixed diameter and then height-wise without further change of diameter. the necessary dose of dopant initially added to both crucibles is calculated from the final melt and dopant concentrations on the basis of two equations of diffusion and material balance as functions of time. Numerical results are then obtained with the aid of experimental control data. For this study, specifically, single crystals of silicon grades KEF 4.5, KEF 32, and KDB 12 were grown in such a manner while being doped with boron or phosphorus. References 4: 3 Russian, 1 Western (in Russian translation).

2415/12232

UDC 621.762.4

Hot Pressing of Powder-Metal Blade for Rotary Compressor

18420246c Kiev POROSHKOVAYA METALLURGIYA in Russia No 4, Apr 88 (manuscript received 16 Feb 87) pp 97-100

[Article by Yu.G. Dorofeyev, V.A. Geydarov, S.N. Yegorov, A.T. Mamedov and G.Sh. Musealov, Novocherkassk Polytechnic Institute and Bakkonditsioner Production Association]

[Abstract] Hot pressing of powder-metal blades for rotary air-conditioner compressors was studied in an experiment concerning the buildup of defects and the distribution of material in the process. Specimens of PZh2M3 Fe-powder, prismatic blanks without the slot, were stamped in a hydraulic press under a pressure of 500 MPa with prelubricated surfaces making contact

with the plunger and then, with a porosity of 25-30 pct, were sintered in a "Koyo Lindberg" furnace at a temperature of 1423 K. The optimum slot depth was established by bilateral hot compaction and found to be 4 mm. The nonuniformity of density, established in unilateral hot compaction, was found to range from a maximum of 7500-7700 kg/m^3 at the center to a minimum of 6850-7000 kg/m^3 under the plunger face at rest. The technology can be refined on the basis of these data, and be extended to other blade materials such as ZhGr 0.8Fe-graphite powder containing 1 pct Zn stearate. Bilateral hot compaction of preslotted blanks will evidently result in nondefective blades with high and sufficiently uniform density of the material. References 2: both Russian.

2415/12232

Influence of Sintering Conditions on Structure and Mechanical Properties of Aluminum-Based Powder Alloys

18420036d Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 87 (manuscript received 4 Feb 86) pp 29-34

[Article by A.B. Altman, deceased, V.A. Brodov, A.V. Zhiltsov, and I.P. Melashenko, All-Union Electromechanics Scientific Research Institute]

[Abstract] Results are presented from a study of the influence of magnesium on volumetric changes during sintering and the physical and mechanical characteristics of the Al-Cu system. The introduction of magnesium to powdered Al-Cu alloy was found to aid in compacting specimens sintered at 595-635° for short periods of time. Longer holding at 615 and 635°C increases the porosity of the specimens. At over 595°C, Al-Cu alloys become much coarser. Addition of magnesium has little influence on structure but improves mechanical properties of the material. The extent of the improvement depends on the sintering conditions. A maximum strength of 340 MPa at k = 6 percent is obtained in specimens sintered at 595 °C for 45 minutes. References: 21: 7 Russian, 14 Western.

06508/06662

Change in Deformation Characteristics of Porous Aluminum, Copper, and Titanium Powder Blanks

18420036c Kiev POROSHKOVAYA METALLURGIYA in Russian No 9, Sep 87 (manuscript received 11 Jun 86) pp 20-24

[Article by V.W. Pavlov, M.I. Nosenko, B.V. Popov, and S.N. Yakunin, Zaporozhye Machine Building Institute]

[Abstract] Studies of sintered and unsintered blanks with 70-100 percent relative density were performed under isothermal conditions in compression. Various lubricants were used, including molybdenum disulfide and industrial oil (2:1), colloidal graphite and liquid glass. Ductility was evaluated on the basis of the maximum relative deformation corresponding to the appearance of the first crack. Lubricants were found to increase relative deformation by 6-8 percent. Increasing the degree and speed of deformation and initial density and decreasing heating temperature were found to increase deformation resistance, which can be represented as a function of a certain base deformation resistance plus thermomechanical coefficients taking into account the influence of density, temperature, speed, and degree of deformation. References: 1 Russian.

06508/06662

Thermal Magnetization of $SmCo_5$ Magnets

18420238a Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: CHERNAYA METALLURGIYA in Russian No 3, Mar 88 (manuscript received 27 May 87) pp 74-78

[Article by A.A. Zaytsev, A.S. Lileyev and V.P. Menushenkov, Moscow Steel and Alloys Institute]

[Abstract] A study is made of the influence of the sintering temperature, grain-size distribution, distribution of coercive force of microscopic volumes and irreversible induction losses on thermal magnetization when $SmCo_5$ magnets are heated. Studies were performed on cylindrical specimens 7.2mm in diameter and 7.2 mm in length, made by the standard technology. Sintering temperature was varied from 1,120 to 1,240 C. All specimens were heat treated for low coercive force by heating to 900 C, holding for 10 minutes, cooling to 750 C, holding for 2 hours and cooling with the furnace. The specimens were magnetized using pulsed fields of up to 12,000 kA/m. The increase in $\mu_o J$ upon thermal magnetization depends on the distribution of coercivity of microscopic volumes. The distribution with highest dispersion of coercive force is preferable. The change in $\mu_o J$ increases linearly with an increase in coercive force of remanence, the change being greater, the less the irreversible losses of induction upon heating. No correlation was found between sintering temperature and distribution of thermal magnetization among grains and the change in $\mu_o J$. The increase in magnetization upon heating apparently results from transition of low coercivity microscopic volumes to a μltidomain state, as well as a change in magnetic structure in these volumes as a result of magnetic interaction with neighboring domains. References 4: all Russian.

6508/12223

UDC 621.785

Nitriding Process Development Tendencies (Analysis of USSR Patent Information)

18420271c Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 15-16

[Article by S.P. Bibikov and G.A. Chaychuk]

[Abstract] The work of inventors in the area of nitriding in the Soviet Union between 1969 and 1981 is studied. Curves illustrating the number of patents issued in the USSR are presented for nitriding processes conducted in gases, liquids and powders over the time period studied. The most frequently used temperature ranges, compositions of saturating media and lengths of nitriding processes are noted. The most important trends at present are seen to be creation of optimal steel and alloy hardening technologies to improve properties, creation of new and improvement of existing media for the process, and an increase in the total number of inventions patented.

06508

UDC 621.753.3:669.14.018.25

Effective Technology for Manufacturing Large Cold Pipe Rolling Mill Passes

18420271j Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 45-46

[Article by M.V. Beloshapko, I.P. Shmyrev, V.F. Mazanik and L.M. Bondareva, All-Union Scientific Research and Design-Technological Institute for the Pipe Industry, Dnepropetrovsk; Chelyabinsk Pipe-Rolling Plant]

[Abstract] Type 9Kh2MF steel, with high hardness, wear resistance and contact fatigue resistance, has been suggested for the manufacture of cold pipe rolling mill passes. The quality of forgings for the manufacture of passes can be improved by making them from electric-slag remelted steel with subsequent antiflake heat treatment to decrease the content of nonmetallic inclusions and gas. The optimal method of heat treatment is thermal hardening using a water-air mixture, which achieves high hardness in combination with relatively low residual stresses. Hardness achieved by this method is at least HRC 52, with wear resistance an average of 20 percent higher than by traditional methods. The expected economic effect of the improved wear resistance and hardness is about 100,000 rubles per year. References 10: all Russian.

06508

UDC 621.317.3:621.778.8:669.24

Influence of Annealing Temperature on Electrical Resistance of Nickel Wire

18420271k Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 55-56

[Article by V.N. Biront, Lvov Polytechnical Institute, Lutsk Affiliate]

[Abstract] Nickel thermistors are convenient to use, highly sensitive, have satisfactory reproducibility and stable static characteristics. Nickel thermistors are not series produced in the USSR. Soviet industry now produces 99.9 percent pure nickel wire, which could be used for the manufacture of nickel thermistors. This article reports on experiments to determine the variation in resistivity of nickel wire as a function of annealing temperature. Annealing of thermistor sensing elements was performed at 300-600°C in a vacuum furnace in a special nickel container with holding at the annealing temperature for 2 hours and cooling with the furnace at 50 K/hr. It was found that the resistance decreased sharply in the 300-400°C temperature interval, changing very little at 400-500°C, then increasing with annealing temperatures over 500°C. Therefore, a temperature of 400-500°C should be used for repeated annealing of sensing elements in order to achieve minimum deviation of resistance from the nominal value. References 3: 2 Russian, 1 Western.

06508

UDC 620.178.16:620.193;669.14.018.298

Increasing Wear and Corrosion Resistance of Fuel Pump Plunger Pairs

18420271a Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6, Jun 88 pp 5-8

[Article by V.Z. Sergeyev, V.B. Fridman and T.V. Yegorshina, Central Scientific Research Institute of Information and Technical-Economic Studies, State Committee for Supply of Production Equipment for Agriculture; Scientific-Production Association, Scientific Research Institute for the Technology of Tractor and Agricultural Machine-Building]

[Abstract] A study is made of the possibility of increasing the wear and corrosion resistance of plunger pair parts in diesel engine fuel pumps by complex diffusion saturation or chromotitanation. Studies were performed on type 25Kh5MA steel following turning, grinding, nitriding, regrinding and finishing. Chromotitanation improved corrosion resistance and wear resistance of experimental specimens. The improvement resulted from the special properties of the compounds formed on the surface of

the specimens, chromium nitrides and carbides. Diffusion chromotitanation can be successfully used for hardening and also for repair of worn machine parts.

06508

UDC 537.311.33

Surface Relief Smoothing Effect in Semiconductors Processed in Etchant With Diffusion Control

18420263c Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 24 No 4, Apr 88 (manuscript received 4 Jun 86) pp 595-597

[Article by A.I. Volkov, R.F. Matveyev and I.N. Sveshnikova, Radio Engineering and Electronics Institute, USSR Academy of Sciences]

[Abstract] It has been determined that diffusion etchants are preferable to kinetic etchants due to the additional surface smoothing effect of polishing etching. This article presents a quantitative estimate of this effect. An equation is derived for calculation of the relative surface roughness by any moment in time of the etching process, based on known etching rate and hydrodynamic conditions. The process of chemical polishing follows an asymptotic curve, indicating the impossibility in principle of producing an atomically pure surface. The method can be used for at least two practically important problems, determination of the roughness of a semiconductor surface following precision polishing etching to a fixed depth, and determination of the depth to which a semiconductor specimen must be etched to achieve the desired surface form. References 4: 2 Russian, 2 Western (1 in Russian translation).

6508

UDC 669.715:621.74

Degassing of Aluminum Alloys With Titanium Getter

18420247g Moscow TSVETNNYE METALLY in Russian No 3, Mar 88 p 75

[Article by V.P. Gusev and I.P. Tsypukhin]

[Abstract] A new method of degassing aluminum alloys has been developed, namely use of a metal capable of absorbing gas, specifically hydrogen dissolved in the aluminum melt. Titanium is an effective "getter" metal, chips being preferable to sponge because of their higher absorption power with a larger specific surface and their poor solubility in aluminum alloys. The chips are first heat treated in an electrical resistance furnace at 300-450 deg c for 2-3 h till all surface moisture has been removed, whereupon they are transferred into the degassing chamber before aluminum melt is transferred into it from the mixing chamber. Spent Ti chips are extracted before aluminum melt is cast for recovery and reuse.

2415/12232

UDC [621.791.75:669.14.018.29]:620.17

Brittle Fracture of Structural Steels and Their Welded Joints in Impact Bend Testing

18420269a Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 88 (manuscript received 4 Dec 86; in final form 1 Sep 87) pp 1-4

[Article by I.K. Pokhodnya, academician, Ukrainian Academy of Sciences, V.I. Shvachko, candidate of physical-mathematical sciences, A.V. Shiyan, engineer, Electric Welding Institute imeni Ye.O. Paton, Ukrainian Academy of Sciences; Yu.Ya. Meshkov, doctor of technical sciences, S.A. Kotrechko, engineer, and G.S. Mettus, candidate of technical sciences, Metal Physics Institute, Ukrainian Academy of Sciences]

[Abstract] Based on the concept of the microscopic fracture as an elementary brittle fracture event which is independent of the macroscopic loading conditions, an interpretation is presented of the characteristics which are determined by impact-bend testing. Studies were performed on steels widely used for the manufacture of welded structures. The cold-shortness temperature is suggested as a quantitative characteristic reflecting the capability of metal to resist brittle fracture. The fracture mechanism at this temperature is occurrence of a microscopic fracture at the tip of a notch, occurring at a stress state severity of approximately 1.7. The sudden change in impact toughness upon transition from the upper cold shortness threshold to the lower threshold causes nonmonotonic variation of the toughness reserve of the deformed metal as a function of the deformation characteristic for armco-iron and low-carbon steel. References 10: 8 Russian, 2 Western (1 in Russian translation).

06508

UDC 621.791.72.03:621.373.826

Monitoring Mean Radiated Power of Industrial Laser Installations

18420269c Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 88 pp 40-44

[Article by Ye.G. Livshits, Ya.B. Pevzner and N.N. Firsova, engineers, All-Union Scientific Research, Planning-Design and Technological Institute of Electric Welding Equipment]

[Abstract] The authors' institute has developed equipment for monitoring the mean power of laser radiation in support of the program for manufacturing industrial laser equipment by Soviet industry. The new monitoring equipment is to have: 10.6 μm wavelength; continuous radiation, with maximum mean power up to 5 kW; power density up to 700 W/cm^2; aperture diameter 60 mm; operating time 0.1 s at the 0.99 level; measurement reproducibility 0.97; power consumed by measurement less than 10 percent. The equipment consists of a radiation diverter, primary and secondary measurement converters and an information processing system. The monitoring equipment is included as a part of type ULG-2.01 and ULGN-5.02 industrial laser installations. References 4: all Russian.

06508

UDC [621.791.7.011:669.15-194.56]:669.794

Introducing Yttrium to Seam Metal To Improve Hot Crack Formation Resistance During Welding of Stable Austenitic Steel

18420269d Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 88 (manuscript received 24 Jun 87; in final form 2 Sep 87) pp 49-51

[Article by K.A. Yushchenko, doctor of technical sciences, B.S. Savchenko and N.L. Kareta, candidates of technical sciences, N.I. Savoley, engineer, Yu.N. Kakhovskiy, candidate of technical sciences, Electric Welding Institute imeni Ye.O. Paton, Ukrainian Academy of Sciences]

[Abstract] A study is made of the possibility of increasing the strength of welded seams in austenitic type 12Kh23N18 steel, which has high hot crack formation tendency, by introducing yttrium to the seam metal. Tests were performed on 150X150X5 mm specimens containing, inpercent: Cr 22.8, Ni 17.8, Si 0.4, Mn 1.2, Ti 0.12, C 0.098, S 0.018, P 0.021. A layer of yttrium was applied in a vacuum in a strip 20 mm wide and 1.5-15 μm thick over the length of the seam before welding, which was performed with a tungsten electrode in an argon medium. Welded joints were heat treated before crack-resistance testing to relieve residual stresses. Yttrium content varied from 0.004 to 0.20 percent as a function of applied strip thickness. When yttrium content was 0.12 percent, the brittleness temperature interval narrowed from 125°C to 85°C. Further increases in yttrium content caused hot crack sensitivity to increase again due to segregation of an yttrium phase. Yttrium bonds the sulfur and phosphorus in refractory compounds, thus purifying the seam metal and improving its strength. References 2: both Western.

06508

UDC 621.791.927.048

Surfacing of 170Kh8SR Steel With Reduction of Chromium and Boron From Slag

18420269e Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 88 (manuscript received 28 Oct 86; in final form 4 Mar 87) pp 52-55

[Article by M.I. Zinigrad, doctor of chemical sciences, A.N. Balin, engineer, L.N. Barmin, doctor of technical sciences, Urals Polytechnical Institute imeni S.M. Kirov, and B.I. Zilbergleyt, candidate of technical sciences, Kristall Scientific-Production Association]

[Abstract] A study is made of the alloying of surface metal with boron and chromium by their reduction by carbon from oxide compounds contained in the flux

during surfacing of 170Kh8SR steel under a flux containing, in percent: 40 CaO, 10 SiO_2, 50 B_2O_3, with up to 20 percent carbon added as a reducing agent. Two-layer surfacing was performed. When type Sv-08A wire was used, even with 20 percent carbon in the flux, the boron concentration in the surface metal was 0.4 percent. When type Sv-0Kh13N9M wire was used under the same flux, the boron and carbon concentration in the metal was almost three times higher, confirming the influence of chromium on the transition of boron and carbon into the surface metal. The hardness of the surface metal was almost five times higher in this case, and also when Sv-08A wire was used under a flux containing oxides of chromium and boron and a reducing agent. Work is now being completed at Urals Polytechnical Institute on the development of a flux made from ferrous metallurgy slag containing tungsten and vanadium oxides to produce a surface metal with a composition close to that of type 40Kh4G2V2F steel. Wastes from the chemical or metallurgical industry containing oxides of nickel, cobalt and molybdenum can be used to alloy surface metal with these elements. References 14: all Russian.

06508

UDC 621.791.72.053.002.237

Formation of Seams During Electron-Beam Welding of Titanium Alloys Up to 25 mm Thick
18420269b Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 88 pp 29-30

[Article by Ya.B. Nudelman, engineer, B.A. Zaderiy, candidate of technical sciences, Electric Welding Institute imeni Ye.O. Paton, Ukrainian Academy of Sciences]

[Abstract] A study is made of the influence of electron-beam welding parameters on the geometric characteristics of seams and the stability of seam-root formation during butt welding of titanium alloy specimens 8-25 mm thick. Parameters studied included welding speed, gun current and focusing lens current. The minimum welding speed which can achieve suitable seam formation is 25 m/hr. Seam formation is stabilized when gun current is 1.75-2 times the minimum current needed for through melting. Focusing current must be maintained quite constant, particularly at relatively low welding speeds. A speed of 60-150 m/hr is recommended, with focusing current held constant to within 1-4 percent.

06508

UDC 539.3

Distribution of Hydrogen in VT6 Titanium Alloy Welded Seam
18420270g Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 24 No 2, Mar-Apr 88 (manuscript received 22 Jul 86) pp 109-111

[Article by O.K. Timonina, B.K. Zuyev, L.L. Kunin, and N.P. Novikov, Geochemistry and Analytical Chemistry Institute imeni V.I. Vernadskiy, USSR Academy of Sciences, Moscow]

[Abstract] A study is presented of the distribution of hydrogen in titanium alloys after welding and weathering. Studies were performed on specimens cut from the inner area of a welded joint in 30 mm thick plates of VT6 titanium alloy with initial hydrogen content of 0.004 mass percent, the welded joints being produced by electron-beam welding. Hydrogen distribution was studied by a laser mass-spectrometric method consisting of melting and evaporating selected microscopic areas of the specimen with subsequent recording of the quantity of hydrogen liberated by an ion-resonance mass spectrometer. The laser beam was scanned over the surface of a 5X25 mm section in a direction transverse to the seam axis. The laser evaporated a cone about 100 μm in diameter and 300-400 μm deep, with successive melted spots about 500 μm apart. It was found that at some time after welding, redistribution of hydrogen in the seam zone significantly increased the danger of hydrogen embrittlement of seams and cracking of specimens at the seams. The diffusion could be described by the simple equation $L=(Dt)^{1/2}$, where L is the length of the diffusion path, t is the diffusion time, D is the diffusion coefficient. After weathering for 1 year, the maximum of hydrogen shifted to the center of the seam, where the residual stress was at its greatest. References 5: 4 Russian, 1 Western.

06508

UDC 669.35:621.77

Advanced Technology of Welding Copper Strip for Buildup of Coils
18420247f Moscow TSVETNYYE METALLY in Russian No 3, Mar 88 pp 60-61

[Article by A.N. Bondarenko, V.M. Ilyushenko, V.A. Kuroyedov, B.V. Golovko, A.K. Nikolayev, and V.A. Anoshin]

[Abstract] Butt welding of 6-10 mm thick copper strip for subsequent hot rolling into coils without planing of the seams was studied at the Institute of Electric Welding imeni Ye.O. Paton in collaboration with Giprotsmo (possibly State Scientific Research and Planning Institute of Nonferrous-Alloys Processing), the purpose being to obtain welding seams with mechanical and thermophysical properties approaching those of the base metal. Both argon-arc welding and nitrogen-arc welding were evaluated, an argon arc with use of activator flux being most suitable for thinner strip and a nitrogen arc being more economical but not suitable for welding with a nonconsumable electrode alone. A low-alloy filler wire has been developed containing effective deoxidizing and nitride-forming additives for nitrogen-arc welding. Such a wire 2 mm in diameter was used experimentally in the Artemov Nonferrous Metals Processing Plant for nitrogen-arc welding of copper strip with a nonconsumable electrode. Use of this filler wire was found to yield better

seams than use of a brass insert with either a nitrogen arc or an argon arc. The wire is now produced at the Moscow Experimental High-Grade Alloys Plant. References 7: all Russian.

2415/12232

Causes of Crack Formation During Welding Repair of Products of ML10 Alloy

18420036i Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 87 pp 24-26

[Article by Doctor of Technical Sciences V.I. Stolbov and Candidate of Technical Sciences V.V. Yeltsov, Togliatti Polytechnical Institute]

[Abstract] Studies were performed on welded seams with craters, used to manufacture longitudinal and transverse sections through the crater and at some distance from it for microscopic x-ray spectral studies. Analysis of the spectrograms showed homogeneous qualitative composition and the presence of neodymium, zinc, zirconium and small quantities of polonium in addition to the standard alloying elements. The presence of excess neodymium in the seam metal near the welding crater was found to be one cause for the formation of cracks during welding of defects. References: 4 Russian.

06508/06662

Specifics of Macro- and Microstructure of Welded Joints of Al-Cu Aluminum Alloy

18420036h Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 87 pp 22-24

[Article by Candidate of Technical Sciences V.I. Ryazantsev, Engineer Yu.I. Tolkachev, Doctor of Technical Sciences G.A. Slavin, and Engineer T.A. Pryakhina]

[Abstract] A study is made of the influence of the specifics of the macro- and microstructure of welded joints on the mechanical properties of semifinished goods. Studies were performed on pressed 260 x 300 mm large cross section blanks, large forgings and stampings of aluminum alloy with 5-6 percent copper. Analysis of the microstructure of metal near the seams found that with all welding methods studied some melting of grain boundaries occurred, accompanied by significant thickening. In alloys containing Mn, the supersaturated solid solution of copper in aluminum breaks down under the influence of welding, accompanied by precipitation and coagulation of hardening phases. The strength and ductility of joints with fiber parallel to the height of the joint were not over half as great as in joints with transverse fiber placement. References: 10 Russian.

06508/06662

Influence of Screening on Quality of Atomized Surfaces

18420036g Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 87 pp 7-8, 9

[Article by Engineer B.P. Peregudin, Glavmosavtotrans Scientific-Production Association]

[Abstract] Atomization in a plasma is frequently used to restore complex parts such as engine crankshafts. The use of a nonmoving screen in this operation results in the screen being heated to 900-1,000°C, causing it to melt, so that large droplets of metal are transferred to the part along with the powder, thus reducing repair quality. A rotating screen improves the quality of the surface and the uniformity of the coating by maintain screen temperature lower. A coating of uniform thickness with minimum machining tolerance can be achieved by using such a screen and maintaining the design radial oscillations of the plasmotron. These screens reliably protect the crank shaft counterweights from the coating. References: 2 Russian.

06508/06662

Repair of Ship Motor Parts by Gas-Thermal Atomization

18420036f Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 9, Sep 87 pp 6-7

[Article by Engineer V.N. Titok and Engineer L.P. Zayakina, Klaypeda Ship Repair Plant No 7]

[Abstract] Gas-thermal atomization permits repair of batches of marine engine exhaust valves in any shop, even on board ship. High surface quality is achieved. The equipment required consists of a lathe, simple burners and materials for gas-thermal atomization. High quality coatings can be achieved only by applying the powder within one-half hour after preliminary lathe processing of the surface to be atomized. The powder must be dried at 120-150°C for 1.5-2 hours, then screened in a 0.1 mm screen to stabilize particle sizes and reduce the influence of the aluminum sometimes present in some batches of commercial powder produced by Tulachermet plant. Powder is applied in layers not over 1 mm thick, with a total coating thickness of not over 3 mm and melted to a characteristic shine with the flame. The economic effect of introduction of the technology is over 100,000 rubles per 1,000 parts.

06508/06662

UDC 669.294.48

Production of Technical Tantalum Pentoxide From Tantalum Concentrates

18420262a Moscow METALLY in Russian No 3, May-Jun 88 (manuscript received 5 Jun 86) pp 37-40

[Article by V.A. Petrova, V.A. Reznichenko, A.A. Palant, V.V. Stepanova and R.I. Azarovskaya, Moscow]

[Abstract] Studies were performed on the processing of artificial tantalum concentrates in order to determine possible and efficient means of producing technical Ta_2O_5 from the concentrates. The studies were based on the known process of the fusion of tantalum concentrate with caustic potash and subsequent hydrometallurgical processing, which was used previously to process natural tantalite-columbite concentrates to produce technical niobium and tantalum pentoxides. Large-scale experiments were performed on tantalum concentrates containing various quantities of tantalum. The process suggested produces good-quality tantalum products containing over 50 percent Ta_2O_5 from artificial concentrates formed by the processing of wastes. The hydrometallurgical processing used included leaching of the melt, precipitation of the sodium tantalite and acid decomposition of the sodium salt. References 7: all Russian.

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UDC 622.765

Surextraction of Metals From Tailings in Norilsk Ore Dressing Plant

18420247c Moscow TSVETNYYE METALLY in Russian No 3, Mar 88 pp 18-19

[Article by L.A. Kamagina, V.I. Perepechin, C.P. Ponomarev and B.V. Popov]

[Abstract] A surflotation technology suitable for semi-industrial and industrial operation has been developed at the laboratory of the Norilsk Ore Dressing Plant, where solid Cu-Ni sulfide ores and a mix of impregnated and cooper-bearing ores are reprocessed, the outstanding feature of this technology being preliminary dressings of tailings in a short conical hydrocyclone. The reagents for this surflotation are 100-200 g/ton butyl xanthogenate and up to 100 g/ton T-80. The hydrocyclone inlet pressure is maintained at 0.1 MPa level. The technology ensures extra extraction of up to 1.27 pct Ni, 0.20 pct Cu, and 1.1 pct precious metals from rich and impregnated ores.

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