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MATERIALS SCIENCE AND METALLURGY
No. 56

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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS
MATERIALS SCIENCE AND METALLURGY

No. 56

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USSR

UDC 669.71:620.186.12

ON THE ROLE OF DISPERSED INTERMETALLIDES IN ALUMINUM ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 7, 1978 pp 6-10

ZAKHAROV, V. V., All-Union Institute for Light Alloys

Abstract This article analyzes the influence of secondary intermetallides containing transition metals on the properties of deformable intermediate products made of Al-Zn-Mg alloys. The most commonly used additives are manganese, chromium and zirconium. This article discusses their influence on deformability in pressing, stability of the super-saturated solid solution, thermal stability of the polygonized structure, aging kinetics, sensitivity of mechanical properties to the time between hardening and artificial aging, mechanical properties themselves, and corrosion resistance. Figures 5; references 15: all Russian.

USSR

UDC 669.71'5'721:620.193.2

INFLUENCE OF VACUUM HEATING ON THE CORROSION RESISTANCE OF THE ALLOY
Al-4.5% Zn-2% Mg

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 7, 1978 pp 10-13

BRONFIN, M. B., TARASENKO, L. V. and KUZNETSOVA, Ye. A.

Abstract A study is made of a new method of increasing the stress corrosion resistance of Al-Zn-Mg alloys, consisting in changing the chemical composition of the surface layer, which plays an important role in corrosion processes. The content of zinc and magnesium in the surface layer is decreased by vacuum treatment at 10^{-5} mm Hg, 500°C , 9 hours, which has little effect on the strength properties of the sheet materials, but greatly increases corrosion resistance. Figures 3; references 3: all Russian.

USSR

UDC 669.71'721:/084.217:620.17

RELATIONSHIP BETWEEN PROPERTIES OF Al-Mg ALLOYS AND THE NONEQUILIBRIUM STATE DIAGRAM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 7, 1978 pp 13-15

LIPCHIN, T. N. and NIKULIN, L. V., Perm' Polytechnical Institute

Abstract A study is made of the relationship between the properties of alloys hardened at high cooling speeds and pressures, and the nonequilibrium state diagram. The studies were performed on alloys crystallized at cooling rates of 0.5-800°C/s under pressures of 1-4,000 atm. Diagrams show the relationship of structural characteristics of Al-Mg alloys to the non-equilibrium state diagram at 1 atmosphere, the influence of crystallization rate at 1 atmosphere on mechanical properties of these alloys, the influence of crystallization conditions on fluidity and hot shortness of the alloys, the influence of cooling rate and pressure on shrinkage of the alloys and the influence of crystallization conditions on the position of the extreme values of curves relating the properties to the composition of the alloys. Figures 5; references 3: all Russian.

USSR

UDC 669.017

TEMPERATURE-SPEED SENSITIVITY OF INDICATORS OF SUPERPLASTICITY OF THE COMMERCIAL ALUMINUM ALLOYS D20 AND O1201

Ordzhonikidze IVUZ, TSVETNAYA METALLURGIYA in Russian No 4, 1978 pp 115-188 manuscript received 3 Jan 78

BOCHVAR, O. S., PSHENICHNOV, YU. P. and GRIBOVA, N. K., Moscow Aviation Technological Institute, Department of Metals Science and the Technology of Heat Treatment

Abstract A study was made to determine the temperature-speed conditions of deformation at which commercial aluminum alloys have significant ductility at low deformation forces. Alloys in the system Al-Cu-Mn were studied. These are high alloys, containing significant quantities of the second phase. In the 425-475°C interval, at deformation rates of $6 \cdot 10^{-4}$ - $6 \cdot 10^{-3}$ s⁻¹, the alloys have significant ductility and low $\sigma_{20\%}$ (2-3 kgf/mm²). During deformation, a fine-grained, equiaxial structure is formed in the neck zone, with a mean grain diameter of 5-6 μm. The studies performed indicate the possibility of using the effect of superplasticity to manufacture stampings of the commercial aluminum alloys D20 and O1201. Figures 3; references 5: 3 Russian, 2 Western.

STRUCTURE AND PROPERTIES OF ALUMINUM-TERBIUM ALLOYS

Ordzhonikidze IZVESTIYA VYSHIKH UCHEBNYKH ZAVEDENIY, TSVETNAYA METALLURGIYA in Russian No 3, 1978 pp 157-158 manuscript received 28 Mar 77

DRITS, M. YE., KADANER, E. S., TURKINA, N. I., KUZ'MINA, V. I., Institute of Metallurgy imeni A. A. Baykov

Abstract This article presents a study of the phase equilibria and mechanical properties of aluminum-terbium alloys in the aluminum-rich area. The alloys were made of A99 aluminum and TbM-1 terbium; thermal analysis was performed on a low-frequency thermographic recorder with differential recording of thermograms. The cooling rate was 3°C/min. Addition of a small quantity of terbium (0.1%) causes significant hardening of aluminum, while further alloying to 1.5% causes an increase in the strength properties of the hot-pressed material by a factor of 1.4-1.8, of cold-drawn wire-- by a factor of 2.6-3. Ductility also increases in hot-pressed Al-Tb alloys. Figures 1; references 3: 1 Russian, 2 Western.

ELECTRON-MICROSCOPE STUDIES OF THE DISLOCATION STRUCTURE OF CAST ALUMINUM ALLOYS

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 3, May/Jun 78 pp 158-165 manuscript received 21 Jun 77

ZOLOTOREVSKIY, V. S., ORELKINA, T. A., and ISTOMIN-KASTROVSKIY, V. V., Moscow

Abstract A comparative analysis is presented of the dislocation structure of various binary alloys based on aluminum, differing essentially in the level of concentration stresses and crystallized under different conditions. The diffraction electron micrographs show the general features of the dislocation structure. It is demonstrated that the cooling rate in the process of crystallization, about 850°C/min, produces a cellular dislocation structure in most alloys, a subgrain structure in the alloy with 14at.%Mg and a mixed structure in alloys with 0.6-2.2 at.%Mg. In all of the alloys studied, the total density of dislocations of the same order is 10^9cm^{-2} , 1-2 orders higher than that indicated by the theory of concentration stresses of Tiller. Shrinkage and thermal stresses contribute little to the dislocation structure. It is assumed that most of the dislocations are formed as a result of disoriented dendritic branches. Figures 1; references 17: 10 Russian, 7 Western.

SENSITIVITY OF HIGH-STRENGTH V93 ALUMINUM ALLOY SPECIMENS TO THE NONSYMMETRICAL APPLICATION OF AN AXIAL LOAD

Kiev PROBLEMY PROCHNOSTI in Russian No 7, Jul 78 pp 79-81 manuscript received 2 Feb 77

BELETSKIY, V. M., KISHKINA, S. I. and RUBLEV, YA. A., Kiev

Abstract V93 aluminum alloy was subjected to tensile tests by applying static and cyclic nonsymmetrical axial loads (at a slant) in order to study the alloy's sensitivity to stress concentrations. Alloy blanks were heated to 450°C and quenched in water with a temperature of 80°C. The blanks were then machined to tensile specimens with a 0.1-mm-diameter notch cut under one head and the machined specimens given a two-step aging treatment: three hours at 120°C followed by four hours at 165°C. Testing was done by placing the samples in a 'Vattsau' machine where under the head of the notched samples a wedge-shape washer was spaced to provide slant angles of 2° and 4° between the support surfaces. Static tests showed that for slant angles of 2° and 4° the tensile strength of samples was reduced by 15% and 45%, respectively. These tests showed that V93 alloy is less sensitive to slanting forces than V95 alloy and similar to AK4-1 alloy. Samples subjected to cyclic loads had a notch size of 0.75 mm but the slant angle was only 0.5°. The time, or number of cycles, to failure was reduced to a fourth of their original strength when the coefficient of stress concentration K_t equals 4.0, and at $K_t = 2.2$ the number of cycles to failure was reduced to 2/5-1/3 of the original symmetrical strength. According to S. I. KISHKINA, the sensitivity to slant appears even for medium- and high-strength steels under cyclic loads and a slant angle of 1° where at $K_t = 2.2$ the number of cycles to failure decreases to 1/10 - 1/15. Comparison of the obtained results for V93 alloy with data of high-strength steels of the type 30KhGSNA shows that at $K_t = 2.2$ and a slant angle of 0.5° the lowering of durability for V93 alloy is the same as for VT22 titanium alloy and somewhat better than 30KhGSNA steel. Figures 5; references 3: all Russian.

USSR

UDC 620.179.14

COMBINED MAGNETIZATION OF ITEMS BY HALF-WAVE RECTIFIED FIELDS

Sverdlovsk DEFECTOSKOPIYA in Russian No 5, May 78 pp 51-56 manuscript received 2 Nov 77

YURENKOV, V. K., All-Union Scientific Research Institute of Aviation Materials

Abstract The use of combined magnetization of items in magnetic-powder flaw detection is considered. A technique is examined in which flaws in all directions are revealed with identical sensitivity by producing a rotating vector through a combination of two half-wave fields shifted by a given phase angle β and having durations of the half waves λ_1 and λ_2 . The combined magnetizing devices are fed through step-down transformers and regulators directly from the AC line. This system provides discrete phase shifts of 0, 60, 120, 180 and 240°. Calculations are done to determine the optimum combination of phase shift and half-wave durations to give a constant absolute value of the rotating field vector. A nomogram is presented for selecting λ_1 and λ_2 to minimize the fluctuation of the modulus of the rotating vector for $\beta = 120^\circ$. It is shown that one of the half waves should be made as short as possible to minimize fluctuations of the rotating vector. The proposed technique was experimentally verified on flat specimens with natural and artificially produced flaws. The results showed that with combined magnetization by two mutually perpendicular half-wave fields shifted in phase by 120° and having half-wave durations of 180 and 210°, flaws in a direction close to 45° to the magnetizing fields are shown up with higher sensitivity than when the same fields are used separately. Flaws with different orientations are revealed with almost identical sensitivity. Figures 5; references 8: 7 Russian, 1 Western.

USSR

UDC 620.179.16

ATTENUATION OF TRANSVERSE ULTRASONIC WAVES IN ROLLED SHEET OF ALUMINUM AND ITS ALLOYS

Sverdlovsk DEFECTOSKOPIYA in Russian No 5, May 78 pp 43-46 manuscript received 18 Apr 77

YEVSYUKOV, V. N., BEREZOVSKIY, L. B. and GERGEL', P. I., All-Union Scientific Research Institute of Chemical Machine Building, Sverdlovsk Affiliate

Abstract The coefficient of attenuation of transverse ultrasonic waves was measured in rolled sheets of aluminum and its alloys by oblique locators

for two directions of beam exposure: at an angle of beam input along and across the direction of rolling. The measurements were made by the method of variable distances and the method of comparison, and calculations were done by formulas derived from the equation of the acoustic channel of a flaw detector with oblique locator describing the reflection of ultrasonic oscillations from an infinite plane. The first method was used to measure the coefficient of attenuation on reference specimens with dimensions of 320 x 100 x 60 mm, and then specimens of different thicknesses from 12 to 40 mm were made from them for measuring the coefficient of attenuation in different aluminum alloys with the same acoustic impedance by the method of comparison. From the measurement results, the authors determined the variance of the amplitude and of the distance between the points of entry of the ultrasonic beam. It was found that the coefficient of attenuation of transverse ultrasonic waves in rolled sheet can be determined with sufficient accuracy by the method of variable distances for plates more than 60 mm thick, and when the sheets are thinner--by the method of comparison. Measurement error increases with a reduction in thickness of the stock, and therefore signals must be measured with high precision (± 0.2 dB) and at least 15-20 measurements must be made. References 5: all Russian.

USSR

UDC 669.725:539.372

INFLUENCE OF RECRYSTALLIZATION TEMPERATURE ON THE MECHANICAL PROPERTIES OF BERYLLIUM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 6, 1978 pp 74-76

KHRISTENKO, I. N., KORNIYENKO, L. A., NIKOLAYENKO, A. A., Ukrainian Physics Technical Institute, Academy of Sciences Ukrainian SSR, Khar'kov

Abstract A study is made of the mechanical properties, nature of plastic deformation and degree of hardening of polycrystalline beryllium with fixed grain size, produced after annealing in various modes. It is found that the grain size of beryllium is not a unique characteristic of the structure of the material; the mechanical properties are also determined by the substructure. The yield point produced with an increase in recrystallization temperature is related to the decrease in dislocation density. An increase in the activation volume with increasing annealing temperature is explained by a decrease in the content of impurities in the matrix. Figures 4; references 5: 4 Russian, 1 Western.

USSR

PHASE MICRODISTRIBUTION AND SUBSTRUCTURE OF A COPPER-MOLYBDENITE COMPOSITE
ELECTROLYTIC SELF-LUBRICATING COATING

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 3, May-Jun 78
pp 28-30

PRIBYSH, I. Z., BAKAKIN, G. N., BORZYAK, A. G. and SAYFULLIN, R. S., Kharkov

Abstract The effect of MoS_2 particles on the substructure of a copper matrix and their occurrence in the composition of copper-molybdenite composition electrolyte coatings, containing a solid lubricant, was investigated. X-ray spectral analysis showed that the dimensions of coherent scattering for all the investigated coatings was somewhat large, apparently due to the monodispersed state of the pure electrolytic copper grains and the copper matrix. Microstresses in the copper coatings were caused by accumulations of dislocation and spot defects. MoS_2 concentrations of 2, 5, 7, 10 and 12 mass % in the copper matrix were used to produce 30-micron electrodeposited coatings. Addition of 5-7% MoS_2 in 1-2 micron particle sizes lowers the stress state of the crystal lattice. The molybdenite is softer than the copper and plays the role of "voids". Increasing the MoS_2 content to 10-12 mass % leads to formation of particle conglomerates measuring more than 10 microns. These large formations prevent copper grain growth and cause additional microstresses. Composites containing 5-7 mass % molybdenite possess good break-in characteristics and adequate adhesive strength with the base metal and, as such, can be recommended as self-lubricating coatings for the working parts of heavily loaded machines. Figures 2; references 3: all Russian.

USSR

UDC 539.43, 669.3

FATIGUE STRENGTH OF A COPPER-CARBON FIBER COMPOSITE MATERIAL

Moscow FIZIKI I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May/June 78
pp 139-142 manuscript received 2 Nov 77

BUSALOV, YU. YE., KOP'YEV, I. M., KUZ'MIN, A. M., POMPE, V., and
VERSHTEDT, A., Moscow

Abstract A study was made of the cyclical strength of Cu-C composite materials in the low-cycle range, using a composite produced by hot pressing of a bundle of graphite fibers with a layer of copper preliminarily deposited on them by chemical precipitation. The fatigue characteristics were studied by alternating bending with constant deformation at 60 cycles per minute. Induction tensometer sensors were used to record the deformation diagram in coordinates of bending torque versus bending angle before the test and after 10, 100, 1000, etc. cycles to the point of failure. The tensile strength of the composite was about 30 kg/mm², bending strength 100 kg/mm² and modulus of elasticity 9,000-11,000 kg/mm². Ultrasonic probing of the composite was found to be an effective means of predicting the beginning of complete failure of the composite after a few hundred cycles of loading. Figures 4; references 4: 3 Russian, 1 Western.

USSR

UDC 539.42:669.71,669.781

DETERMINATION OF THE STRENGTH OF AN ALUMINUM-BORON COMPOSITE MATERIAL USING CIRCULAR SPECIMENS

Moscow FIZIKI I KHIMIYA OBRABOTSKI MATERIALOV in Russian No 3, May/June 78
pp 148-151 manuscript received 31 Aug 77

KOLESNICHENKO, V. A., and YUSUPOV, R. S., Moscow

Abstract A study is made of the possibility of determining the strength of a fiber composite material by the use of circular specimens. The circular specimens were loaded in tension by insertion of two half discs which were then pulled apart. The tests showed that the method of processing of the experimental data, based on an equation for the stress concentration factor, an equation for the elastic characteristics and an equation for strength assuming cylindrical orthotropy, describes the results of the experiment quite well and can be used in testing aluminum-boron composites in extension. However, when this method is used, comparative testing of flat specimens should also be used to refine the stress concentration factor. Figures 2; references 11: 9 Russian, 2 Western.

USSR

UDC 539.23

INFLUENCE OF A PROTECTIVE COATING OF TITANIUM NITRIDE ON THE INTERACTION OF SILICON CARBIDE FIBERS WITH A MATRIX OF A COMPLEX NICKEL ALLOY

Moscow FIZIKI I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May/June 78 pp 153-155 manuscript received 13 Sep 77

IVANOV, V. K., KUT'YENKOV, V. A., SHULEPOV, V. I., GUZEY, L. S., SOKOLOV-SKAYA, YE. M. and DOROKHOVICH, V. P., Moscow, Kiev

Abstract Methods of metallography and microscopic analysis are used to study the influence of a protective coating of titanium nitride 0.1 μ m thick on the interaction of silicon carbide fibers with a matrix of ZhS6U nickel alloy after production of composites by hot vacuum pressing and after annealing at 1100°C for 50 hrs. The fibers were coated from the gas phase; specimens were produced by hot vacuum pressing, alternating layers of fiber and granules of the alloy melt. The coatings, without changing the nature of interaction of the fibers with the matrix, significantly inhibit diffusion redistribution of the elements between them. However, with the coating thickness of 0.1 μ m, this inhibition is insufficient to preserve the fibers. Apparently, thicker coatings of a material with higher barrier properties are required. Figures 2; references 6: all Russian.

USSR

UDC 620.22.41

COMPATIBILITY OF CARBON FIBER MATERIALS WITH THE METAL MATRIX

Moscow IZVESTIYA VYSHIKH UCHEBNYKH ZAVEDENIY, CHERNAYA METALLURGIYA in Russian No 5, 1978 pp 128-131 manuscript received 27 Jun 77

VARENKOV, A. N., KOSTIKOV, V. I., MOZZHUKHIN, YE. I., and SHIMANYUK, V. T., Moscow Institute of Steel and Alloys

Abstract A study is made of the wettability of graphite fibers by an aluminum melt at temperatures of 80, 900 and 920°C. The processes of flow of the melt over the surface of the fiber are accompanied by redistribution of the components in the volume of the liquid metal, with concentration of the titanium at the surface of the fibers. The kinetics of the process of formation of the TiC transition layer are studied. The width of the transition layer is measured in microscope studies. The mechanism of the processes accompanying a change in the width of the transition zone is assumed to be diffusion. Figures 4; references 6: all Russian.

USSR

UDC 539.4.01

INFLUENCE OF BOND STRENGTH BETWEEN FIBER AND MATRIX ON THE NATURE OF RUPTURE OF A COMPOSITE MATERIAL REINFORCED WITH BRITTLE FIBERS OF BORON WITH A METAL MATRIX OF ALUMINUM ALLOYS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul/Aug 78 pp 117-123 manuscript received 2 Mar 77

SHORSHOROV, M. KH., KOLESNICHENKO, V. A., YUSUPOV, R. S. and USTINOV, L. M., Moscow

Abstract The influence of the strength of the bond between the fiber and the matrix on the nature of fracture of a composite material consisting of aluminum alloy plus boron fibers is studied. The study is performed by the method of fractographic analysis of the fracture surfaces produced in tensile and shear testing. The change in the nature of the fracture of the composite material during tensile and shear testing as a function of the hot pressing temperature at which the composite was formed of aluminum foil and boron fibers is illustrated with photomicrographs. The curve of strength as a function of pressing temperature has 3 characteristic zones, including a maximum at 500-530°C, above which the strength decreases due to physical and chemical interactions between the components. The possibility is shown of using electron microscopy to refine the technological modes of production of composite materials reinforced with brittle fibers. Figures 5; references 12: 6 Russian, 6 Western.

USSR

UDC 539.401

CALCULATION OF STRESSES AND STRAINS IN COMPOSITE FIBER MATERIALS DURING THE PROCESS OF THERMAL CYCLING

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul/Aug 78 pp 130-135 manuscript received 2 Nov 77

BELOV, V. V., YEREMENKO, V. I. and SHORSHOROV, M. Kh., Moscow

Abstract A method suggested by Garmong for analysis of elastic-plastic deformations of the components of composite materials under the influence of external stresses is further developed, in order to study the kinetics of the change in internal stresses and strains upon thermal cycling in unidirectional composite materials with continuous fibers. The results produced are used to suggest a method for determination of the optimal percentage of reinforcement, to yield stability of shape of the composite

and resistance to crack formation. The calculations consider the influence of the difference in Poisson's ratio and the modulus of elasticity upon deformation of the phases, hardening during plastic deformation and creep in the first and second stages of deformation. Calculations are to be performed on a computer by an iterative method. It is stated that the fourth or fifth approximation is usually sufficient to achieve good convergence. References 12: 7 Russian, 5 Western.

USSR

UDC 678.067.5:539.2

DIFFRACTOMETRIC STUDY OF WHISKER CRYSTAL DISTRIBUTION IN COMPOSITE ELASTOMERS

Riga MEKHANIKA POLIMEROV in Russian No 3, May/June 78 pp 550-551 manuscript received 27 May 77

GOROBETS, B. R., CHERNYAK, A. I. and SHCHETANOV, B. V., All Union Scientific Research Institute of Aviation Materials, Moscow

Abstract Samples consisting of an elastomer reinforced with 30 mass % zinc oxide whisker crystals were produced to study distribution uniformity of the reinforcing phase. Average whisker diameter was 0.05 microns and length--3-5 microns. Sample preparation varied in stirring time and velocity. X-ray diffraction of the samples was done on a DRON-2 diffractometer by collecting the {101} diffraction impulses of the zinc oxide from 18 different sections of each sample as it was rotated in a circle relative to the axis that was perpendicular to its surface. Dispersion intensity was calculated for each sample with the range of values being 3.3-7.8%. This method was deemed suitable for determining the uniformity of whisker distribution in a polymer matrix. References 1: Russian.

USSR

UDC 539.2:678.067.5

DISCRETE MATRIX MODEL FOR CARBON-CARBON COMPOSITES

Riga MEKHANIKA POLIMEROV in Russian No 3, May/June 78 pp 387-393 manuscript received 3 Nov 77

KOLESNIKOV, S.A., Moscow

Abstract Analysis of the structure of carbon-carbon composites with a high shear modulus filler showed that the characteristic feature of these

of these materials is the presence of pores and cracks in the matrix where the distance between defects is less than the effective length of the carbon filler, calculated for a given filler and matrix type. The analysis also showed that a Rosen model with a discrete matrix can be used to describe the carbon-carbon composite. The discrete matrix model can be used to explain the relatively low strength level during tension of the carbon-carbon material due to multistage increase of effective fiber length upon crushing the matrix into elements that are shorter than the calculated value of effective length for a model with a solid matrix. It was shown that thermal stresses in the process of material cooling to room temperature can lead to a breakdown and crushing of the matrix into elements smaller than the critical length. It was established that, in the case of a discrete-matrix model in which the matrix is crushed into pores with dimensions smaller than the effective length of the composite, an exponential relationship of tensile strength to increasing porosity should be observed. Figures 4; references 8: 6 Russian, 2 Western.

USSR

UDC 621.746.6

ON THE PROCESS OF FORMATION OF A FIBER COMPOSITE CASTING IN A COMBINATION MOLD

Minsk IZVESTIYA AKADEMII NAUK BSSR, SERIYA FIZIKO-TEKHNICHESKIKH NAUK in Russian No 2, 1978 p 129 manuscript received 18 Jun 77

Summary of article No 3658-77 deposited in the All-Union Institute of Scientific and Technical Information, full text 7500 words, references 10

PROKOPOV, I. P., Physicotechnical Institute, Academy of Sciences BSSR

Abstract Approximate formulas are derived for evaluating the effectiveness of technological casting parameters and determining the optimum process schedule for casting a composite fiber material in a combined mold with two layers having heat-accumulating capacity close to that of the composite material. The proposed expressions show the relation between the temperature of the casting system and the duration of the casting formation process, and also between temperature and the thermophysical properties of the reinforcing fibers, matrix and mold.

INFLUENCE OF BINDER CROSS LINKING ON THE FRICTION PROPERTIES OF COMPOSITES
BASED ON SPATIALLY RETICULAR POLYMERS

Minsk IZVESTIYA AKADEMII NAUK BSSR, SERIYA FIZIKO-TEKHNICHESKIKH NAUK in
Russian No 2, 1978 pp 114-118 manuscript received 3 Aug 77

SYSOYEV, P. V. and KORSHUNOV, A. I., Institute of Mechanics of Metal-Polymer
Systems, Academy of Sciences BSSR

Abstract The article gives the results of studies of the influence of the degree of binder cross linking on the properties of antifriction composite materials based on polymers with a three-dimensional structure. The coefficient of friction and friction-contact fatigue are compared for the pure binder and the composite materials based on it. Polymers of the phenolformaldehyde type are examined: dimethylvinylethynyl phenol, ED-6 epoxy resin, EDFA epoxyfuran resin, FA furan resin. Metallized textolites based on these binders were studied as well as TASMAN heat-resistant self-lubricating antifriction material based on modified phenol resin. It was found that with an increase in the regularity of the molecular structure of the polymer binder, there is an increase in the resistance of the composite material to friction-contact fatigue. Minimum resistance to this kind of wear is shown by materials based on epoxy resin, and maximum resistance was shown by materials based on dimethylvinylethynyl phenol oligomer. Figures 3; references 15: all Russian.

Conferences

USSR

UDC 621.791.061.3

ALL-UNION CONFERENCE ON ELECTRON-BEAM WELDING

Kiev AVTOMATICHESKAYA SVARKA in Russian No 7, Jul 78 pp 76-77

PEVZNER, R. B., Engineer, and REZNICHENKO, V. F., Candidate of Technical Sciences

/Abstract/ The sixth All-Union Conference on Electron-Beam Welding was held in Moscow 11-13 January /1978/. The reports heard at the conference discussed problems of technology, equipment and the theory of this method of welding. Subjects covered included: the relationship between vapor dynamics in the melting channel and the formation of a seam; the hydrodynamic processes occurring during welding with deep melting; high-speed cinematography of the effect of a concentrated electron beam on a transparent liquid (oil); new methods of measurement of the power and space-time characteristics of electron beams; ion focusing of electron beams; the influence of beam diameter on the formation of the seams; the parameters of an electron beam as it passes through a vapor layer; the results of studies of the weldability of steels of various types; structural heterogeneity in joints between copper and steel; welding of pistons of cast aluminum alloys; the use of electron beam welding for the manufacture of parts of small electric motors; new electron beam welding equipment; an apparatus for control of electron welding beams. The conference adopted a resolution calling for further development of scientific and technical work in the area of electron beam welding. The materials of the conference have been published. The next conference will be held in Kiev in 1980.

USSR

UDC 621.791:061.3

SEMINAR ON WELDMENTS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 78 p 78

POLISHCHUK, G. V., Engineer

/Abstract/ A seminar on production of weldments in the power machine building industry was held in Leningrad on 20-22 Dec 77 at the Hall of Scientific and Technical Propaganda. Reports were given and discussed on the modern state of research and development of welding materials and the technology of welding atomic power station and steam and gas turbine assemblies, on the creation of new welding processes suitable to power machine assemblies, and on evaluation of weld joint fitness, operational reliability of power station assemblies and selection of repair methods.

ALL-UNION CONFERENCE ON WELDMENT STRENGTH AND INSPECTION REQUIREMENTS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 78, p 77

KHOVOV, V. M., Candidate of Technical Sciences

Abstract The All-Union Conference on the theme "Strength of Weldments and Inspection Requirements" was held in Moscow on 25-26 Jan 78. Corresponding member of the Academy of Sciences USSR, G. A. NIKOLAYEV, MVTU (Moscow Order of Lenin and the Red Labor of Banner Higher Technical School imeni N. E. Bauman) opened the conference with a report on the development of weldment research. G. A. NIKOLAYEV and V. I. LOSHCHILOV reported on work at MVTU on studying the strength and expanding the possibilities of welding biological tissues. The static and fatigue strengths of weld joints and constructions were discussed by V. I. TRUFYAKOV and V. S. KOVAL'-CHUK, B. S. KASATKIN and V. V. VOLKOV (Institute of Electric Welding), I. V. KUDRYAVTSEV and others (Central Scientific Research Institute of Machine Building). A. N. SERENKO (Zhdanov Metallurgical Institute) gave the principles of calculated evaluation of the effect of stress concentrators on the fatigue of weld joints and the properties of a metal at the point of fatigue crack origin. The effect of hydrogen on weld joint strength was examined by O. S. MNUSHKINYY (Leningrad Polytechnical Institute). V. A. VINOKUROV and I. I. MAKAROV (MVTU) discussed new criteria of evaluating the properties of weld joints which can be used to calculate the strength of seams with concentrators of any sharpness and during fracture with significant plastic deformations. S. A. KURKIN and others (MVTU) examined the limiting state of fracture in welded vessels and pipelines and the problems of defect regulation. The reports of I. N. YERMOLOV and others (Central Scientific Research Institute of Machine Building), A. K. GURVICH (Scientific Research Institute of Bridges and Leningrad Order of Lenin Institute of Railway Transportation Engineers imeni V. N. OBRAZTSOV) were devoted to improved methods of inspecting weldments and using statistical analysis of the results of inspection for quality control. A. G. GRIGOR'YANTS (MVTU) and S. N. KISELEV reported on the use of computers for determining stress and strain. The reports of V. M. SAGALEVICH and others (MVTU), and I. M. ZHDANOV and V. V. BATYUK (Kiev Polytechnical Institute) were devoted to an experiment to lower residual strain and stress in weldments by using vibration and load. N. A. OL'SHANSKIY (Moscow Power Institute) reported on problems of strength in thick, electron-beam welded joints. V. I. LYSAK, et al. (Volgograd Polytechnical Institute) told about the relationship of strength of composite weld joints to the power conditions of welding. A. YA. VOLOVIK (Krasnoyarsk Polytechnical Institute) in a report, "Possibilities of a Systems Approach in Evaluating the Optimum Design-Technological Solutions of Weldments," presented the results of the first step of work in this direction. V. I. MAKHNENKO (Institute of Electric Welding) reported on prospects of using computers to calculate the strength of weldment elements, while V. N. DUBROV, et al. have a report on the structure of a steel roll as a factor of weldment reliability.

USSR

UDC 621.791.72.061.3

SIXTH ALL-UNION CONFERENCE ON ELECTRON-BEAM WELDING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 6, Jun 78 pp 55-56

PEVZNER, N. B. and REZNICHENKO, V. F.

Abstract The Sixth All-Union Conference on Electron-Beam Welding was held in Moscow 11-13 January 1978. Over 600 specialists representing 323 organizations from 74 cities attended the conference. The proceedings were published. Some of the subjects discussed at the conference were: the interrelationship between vapor dynamics in the fused channel and seam formation in welding; the thermophysical and hydrodynamic processes during electron-beam welding; the results of high-speed cinematography of the fusion channel as a concentrated beam of electrons struck a transparent liquid (oil); new methods of measurement of the energy and space-time structure of electron beams; ion focusing of electron beams; the weldability of high-strength steels; hot-crack formation tendency in heat-resistant nickel alloys; structural and chemical heterogeneity of copper-steel joints; electron-beam welding technology; welding of pistons of cast aluminum alloys; series production using EB welding equipment; and the standards for electron-beam vacuum welding equipment and processes. The conference adopted a resolution intended to further improve the technology and equipment for electron-beam welding and to introduce this promising method of welding more broadly to industry. The next conference is to be held in Kiev in 1980.

USSR

EIGHTH ALL-UNION CONFERENCE ON NONDESTRUCTIVE TESTING METHODS

Sverdlovsk DEFEKTOSKOPIYA in Russian No 5, May 78 pp 107-112

PASSI, S. KH., YERMOLOV, I. N., ROZHDESTVENSKIY, S. M., GERASIMOV, V. G. and PRANITSKIY, A. A.

Abstract The Eighth All-Union Conference on Nondestructive Testing Methods was held from 7 to 9 June 1977 in Kishinev. The conference was attended by 700 scientists and specialists from 120 enterprises as well as from 270 scientific and design organizations. There were more than 500 reports dealing with the following methods of nondestructive testing: acoustic, capillary, magnetic, optical, radiation, radio wave, thermal, electrical and electromagnetic. There were two plenary sessions and six sessions covering different types of testing as well as general problems. This conference was by far the largest of its kind ever held in the Soviet Union. This article contains a brief exposition of the work of each section of the conference.

Corrosion

USSR

UDC 669.715:669.718.5.669

ELECTROCHEMICAL PROTECTION OF D16 ALLOY FROM FATIGUE CORROSION BY MEANS OF A CLADDING LAYER

Moscow ZASHCHITA METALLOV in Russian No 4, Jul/Aug 78 pp 433-435 manuscript received 30 Jul 75

GAYNUTDINOV, R. G. and BAYSHUMUROV, Zh., Kiev Institute of Civil Aviation Engineers

Abstract In order to study the possibility of using sheet materials with a thin clad layer to replace normal sheet materials, the authors studied the electrochemical protection of the core of sheet material made of D16 alloy with normal and thin clad layers at points of damage to the coating. The protective properties of the clad layer were studied on sheet materials 1.8 mm thick with layers 52-80 μm thick and with thin layers (less than 28 μm thick). The material was scratched with a special cutter, then tested in pulsating tension. It was found that the thin clad layer was practically equal to the normal clad layer in its degree of protection of the core of the material from corrosion fatigue at points of damage to the coating. The degree of protection depended largely on the shape of the scratch, a V-shaped scratch being far more damaging than a U-shaped scratch. Figures 2; references 4: all Russian.

USSR

UDC 669.715:669.718.5.699

INFLUENCE OF THICKNESS OF CLAD LAYER ON CORROSION RESISTANCE OF SHEET MATERIALS OF D16 ALLOY

Moscow ZASHCHITA METALLOV in Russian No 4, Jul/Aug 78 pp 436-438 manuscript received 9 Jul 76

GAYNUTDINOV, R. G. and BAYSHUMUROV, Zh., Kiev Institute of Civil Aviation Engineers

Abstract A study was made of the corrosion resistance of sheet aluminum 1.8 mm thick, bare and with normal and thin clad layers produced by partially etching away the normal clad layer. The corrosion resistance of the sheets with the thin clad layer was somewhat lower than that of those with the thicker clad layer, but addition of an anodic film formed in 35 minutes in a solution of 180 g/l H_2SO_4 at 20°C, current density 1 A/dm², restored the corrosion resistance. Figures 2; references 4: all Russian.

Graphite

USSR

UDC 666.764.4:620.178.74

INVESTIGATION OF CRACK PROPAGATION KINETICS IN GRAPHITE

Kiev PROBLEMY PROCHNOSTI in Russian No 7, Jul 78 pp 52-57 manuscript received 21 Mar 77

BARABANOV, V. N., LYSHOV, L. L. and SAZHIN, A. N., Moscow

Abstract The crack propagation kinetics in MPG-6, VPP and MG-1 graphites was studied for two forms of loading: concentrated bend of a notched sample and tension of a plane sample with a notch on one side. MPG-6 graphite possessed the best tensile, compressive and bend strengths; VPP grade had the lowest strengths and the lowest rate of crack propagation. The high variation in strength and cracking rate is mainly due to the differences in graphite micro- and macrostructure, the properties of the initial raw material and production technology. Thus, crack propagation in graphites is itself a discrete process. Micro-, macrocracks and the mainline crack are propagated in jumps the magnitude of which is determined by the micro- and macrostructure of the graphite type as well as the loading conditions. The kinetic differences of the process are that rupture of fine-grain graphites of the MPG-6 and MG-1 types occurs with a smaller relative change, from section to section, of the mainline crack rate than in the coarse-grain VPP graphite which has more defects. Figures 3; reference 8: 6 Russian, 2 Western.

USSR

UDC 620.17

ON THE FEASIBILITY OF IMPROVING QUALITY IN CHECKING THE STRENGTH OF GRAPHITE

Sverdlovsk DEFECTOSKOPIYA in Russian No 5, May 78 pp 90-92 manuscript received 28 Apr 77

GAREVSKIKH, A. S.

Abstract An experimental study is done on the relation between resistivity, bending strength and coefficient of anisotropy (ratio of resistivities perpendicular and parallel to the pressing axis) of graphite. The results show that the error in quality control of graphite strength can be reduced if the coefficient of anisotropy is measured in combination with ultrasonic flaw detection or resistivity measurements. Figures 4; references 3: all Russian.

Heat Treatment

USSR

UDC 621.78

MODERN TECHNOLOGY OF HEAT TREATMENT

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 7, 1978 pp 2-5

SHUBIN, R. P.

Abstract Modern heat-treatment technology used at machinebuilding plants involves the extensive use of new technological processes, as well as the introduction of automated equipment. Some 75% of the products produced in the motor vehicle industry are manufactured using progressive, automated equipment. Such processes are isothermal annealing of forged products, induction heating, combined chemical and heat treatment, combined methods of hardening including heat treatment and mechanical working as well as chemical treatment and other new processes have been widely introduced, particularly in the motor vehicle industry. In the next 10 to 15 years, the main processes of heat treatment will be normalization, annealing, improvement, hardening, carburizing, nitrocarburizing and nitriding using controlled atmospheres. Furnaces have been sealed, and all new furnaces currently being manufactured include systems for automatic testing and regulation of the temperature parameters of the processes of heating and cooling.

USSR

UDC 621.785(045)

HEAT TREATMENT OF ALUMINUM ALLOYS UNDER THE INFLUENCE OF AN ELECTRIC FIELD

Ordzhonikidze IVUZ, TSVETNAYA METALLURGIYA in Russian No 4, 1978 pp 104-108
manuscript received 6 Jun 77

KLYPIN, A. A. and SOLOV'YEV, YE. S., Moscow Aviation Institute

Abstract The purpose of this work is to test the assumption of the possibility of changing the structure and properties of aluminum alloys with changing solubility with temperature by applying an electric field during the process of heat treatment. Aluminum alloys D16, V65 and V96 were studied. Determination of hardness after hardening and observation of the structure indicate that hardness is increased as a result of imposition of an electric field during isothermal holding, due to more active dissolution of excess phases, forming a highly supersaturated solution after cooling and increasing the hardness after hardening and aging. No consistent change in ductility was observed following application of the electric field. Figures 4; references 3: 2 Russian, 1 Western.

USSR

UDC 669.017

INFLUENCE OF HEAT TREATMENT ON THE SENSITIVITY OF THE MECHANICAL PROPERTIES OF VT6 ALLOY TO THE DEFORMATION SPEED

Ordzhonikidze IVUZ, TSVETNAYA METALLURGIYA in Russian No 4, 1978 pp 109-114
manuscript received 15 Nov 77

PIMENOVA, A. Z., KOLACHEV, B. A., KARAKOZOV, E. S. and AVTONOMOV, YE. P.,
Moscow Aviation Technological Institute, Department of Metals Science and
Hot Working of Metals

Abstract A study was made of the mechanical properties of VT6 alloy after various modes of annealing and testing at various deformation rates. The studies were performed on hot rolled bars 12 mm in diameter. It was found that the contribution of twinning to the total deformation of the metal increases with increasing deformation rates, that annealing does not provide sufficient stability of the β phase (it decomposes at low deformation rates), and that deformation in the neck zone occurs at different temperatures for different deformation rates, since there is less dissipation of the heat of deformation into the surrounding environment at higher deformation rates. The structure of the fracture surface of the specimens produced at various deformation rates is described. Figures 4; references 9: 4 Russian, 5 Western.

USSR

UDC 669.01

ON THE INFLUENCE OF THE COOLING RATE ON THE MECHANICAL PROPERTIES OF LOW-ALLOY MARTENSITIC STEELS

Moscow IZVESTIYA VYSHIKH UCHEBNYKH ZAVEDENIY, CHERNAYA METALLURGIYA in
Russian No 5, 1978 pp 125-127 manuscript received 23 Feb 77

BIRMAN, S. R., Moscow Evening Metallurgical Institute

Abstract A study was made of the influence of the temperature of heating before hardening and the cooling rate during quenching on the mechanical properties of low-alloy dispersion-hardened martensitic steel with the following chemical composition:

Steel type	C,%	Si,%	Mn,%	Cr,%	Ni,%	Mo,%	Al,%
EP888(10H4G4X2MYU)	0.12	0.16	4.21	1.91	4.27	1.72	0.80
2oN4G4KhZMYu	0.21	0.10	3.90	2.10	4.10	1.70	0.81

The variation of ductility and toughness of low-carbon martensitic steels as a function of cooling rate is determined by the degree of fragmentation

and the substructure of the martensite. With a high degree of fragmentation, this variation is weakly expressed. A decrease in cooling rate between the martensitic points leads to stress relaxation during transformation and significantly increases ductility and toughness of large crystal martensite. Aging increases the negative influence of a high cooling rate on ductility and toughness of this metal. Figures 2; references 3: all Russian.

USSR

UDC 621.762.4.043:669.295

DYNAMIC DIFFERENTIAL PRESSURE SWAGING OF TITANIUM POWDER PARTS

Kiev POROSHKOVAYA METALLURGIA in Russian No 7, Jul 78 pp 98-101 manuscript received 16 Nov 77

SYPKO, A. V., DOLGIY, N. I. and GAVRILOV-KRYAMICHEV, N. L., Zaporozh'ye Machine Building Institute imeni V. Ya. Chubar'

Abstract The possibility of producing complex structural parts from titanium powder by the method of impact swaging was investigated using a die designed for extrusion with a hydraulic head. Results of swaging tests showed that this method produces parts with good mechanical properties. A description of the machine used is given and the procedure of being able to produce powder parts by this dynamic differential pressure method without an intermediate sintering process speeds up the whole production process and produces a better product than conventional forging and extrusion. Figures 3; references 5: all Russian.

USSR

UDC 621.762

INTERACTION OF TUNGSTEN FIBERS WITH COBALT-BASE MATRICES

Kiev POROSHKOVAYA METALLURGIYA in Russian No 7, Jul 78 pp 57-64 manuscript received 22 Dec 77

MIROTVORSKIY, V. S. and OL'SHEVSKIY, A. A., Moscow

Abstract The interaction of VT7 tungsten alloy fibers (0.05 mm in diameter) and multicomponent cobalt-base powder mixtures was studied to determine structural changes in the composites caused by diffusion processes. The fibers were mixed with powdered cobalt and alloying elements, pressed at 80-90 kg/mm² and vacuum sintered for one hour at 1300-1400°C for the binary mixtures and at 1300°C for the multi-component samples. Alloying with 5% Cu did not lead to recrystallization of the W wire and did not suppress the formation of intermetallic compounds at the matrix-fiber interface. Al and Ti prevent the formation of intermetallic compounds at 1300°C, but at a content of 25% the Al completely recrystallizes the fiber both at 1300 and 1400°C. A Cr content of 5-25% recrystallizes the fibers and forms intermetallic compounds. Mo and W sometimes cause fiber recrystallization and do not prevent intermetallic compound formation. Fe and Ni do not protect the fiber from formation of intermetallic compounds and upon increasing the Ni content to 25% there is complete fiber recrystallization both at

1300 and 1400°C. When the alloying elements are present in sufficient quantity they diffuse into the tungsten fiber, where the tungsten diffuses through the layer of formed intermetallic compounds into the matrix with the compound consisting of something similar to W_6Co_7 . Of the 22 composites studied more than half fully or partially recrystallized the fiber and in some cases the fiber was partially dissolved. Figures 1; references 13: 10 Russian, 3 Western.

USSR

UDC 539.53:661.882

ON THE NATURE OF THE CHANGE IN MICROHARDNESS IN THE FIELD OF HOMOGENEITY OF TITANIUM CARBONITRIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 78 pp 70-74 manuscript received 31 Oct 77

VIL'K, YU. N., All-Union Scientific Research Institute for Abrasives and Grinding, Leningrad

Abstract A review is presented of the literature on the variations in microhardness of titanium carbonitride. The data of earlier works are presented in a table, which includes both the empirical formula and the concentration of valent electrons and microhardness. Equations are presented for the variation and microhardness with composition in the fields of homogeneity of TiC_x and TiN_y . The data presented in the table unambiguously show the extremal nature of the variation in microhardness within the limits of each equidefect cross section in the field of homogeneity. It is also demonstrated that nonmetallic atoms with valence other than that of carbon have a significant hardening effect. The changes in microhardness of TiC-TiN solid solutions seem to be related not so much to changes in stress and hardening due to distortions in the sublattice of the nonmetal as to changes in the electron structure of the solid solutions, as well as the energy characteristics of the Me-C, Me-N and Me-Me zones. The data presented allow a number of predictions to be made concerning the maximum values of microhardness for each equidefect cross section selected, as well as the form of the microhardness surface in the homogeneity field. Figures 2; reference 17: 14 Russian, 3 Western.

USSR

UDC 621-762

X-RAY SPECTRAL MICROSCOPIC ANALYSIS OF THE INTERPHASE INTERACTION IN THE SYSTEM TiCrB_2 -(Ni-Mo)

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 78 pp 65-69 manuscript received 22 Aug 77

PANASYUK, A. D., DZYKOVICH, I. YA., D'YAKONOVA, L. V. , GORDAN', G. N. and PRIKHNO, I. G., Institute of Problems of Material Science, Academy of Sciences, Ukrainian SSR

Abstract A study is made of the interaction of liquid nickel, as well as nickel-molybdenum alloys, with titanium-chromium boride, the distribution of the components of the liquid metal and solid boride phases in the contact zone, and the phase composition of the products produced. The studies were performed by metallographic, microdurometric and microscopic x-ray spectral analysis using the MS-46 microanalyzer. A complex picture of interaction was revealed. It included formation of new phases: a solid solution based on nickel, and a complex intermetallide based on Ni-Mo. It is concluded that the addition of molybdenum partially prevents the dissolution of boron in the liquid alloy and, at the same time, as it dissolves in the boride phase, should improve the mechanical properties of the alloy. Figures 3; references 2: both Russian.

USSR

UDC 669.018.96/661.862.22+546.77

INVESTIGATION OF THE INFLUENCE OF TECHNOLOGICAL FACTORS ON THE PROPERTIES OF ALUMINUM OXIDE-MOLYBDENUM CERMETS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 5(185), Mar 78 pp 93-96 manuscript received 21 Dec 76

SKIDAN, B. S., FOMINA, G. A. and SHEPILOV, I. A., Moscow Institute of Chemical Technology imeni D. I. Mendeleev

Abstract Design of simulation experiments is used to investigate the way that technological factors influence the properties of composite materials in the aluminum oxide-molybdenum system. The initial powders were mixed, pressed and vacuum sintered. Properties investigated included density, porosity, impact toughness, bending strength, coefficient of thermal expansion, temperature of deformation under a load of 2 kgf/cm^2 , residual bending strength at room temperature after a thermal shock from 850°C in water, and oxidizability. The influencing factors were metal content in the powder mixture, pressing pressure, rate of temperature rise during sintering, sintering temperature, holding time at maximum temperature and

cooling rate. The highest strength indices were obtained with sintering at 1825°C. The results of the study show that design of simulation experiments is an effective technique that considerably reduces the number of experiments needed to work out the technology for producing materials with predetermined properties. In the case of Al₂O₃-Mo cermets with metal content up to 30 vol.%, this method showed that the most important technological factors are the heat treatment conditions and the pressing pressure. References 7: all Russian.

USSR

UDC 621.762:669.018.24

INVESTIGATION OF THE STRUCTURE AND PROPERTIES OF SELF-LUBRICATED MATERIAL BASED ON TUNGSTEN DISELENIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 5(185), Mar 78 pp 88-92
manuscript received 25 May 77

KIPARISOV, S. S., SHVETSOVA, G. A., LOBOVA, T. A., SERGEYEVA, L. M.,
PIMENOVA, A. Z. and VOLODINA, G. A., Moscow Institute of Steel and Alloys

Abstract The paper gives the results of studies of the microstructure, antifriction properties and heat resistance of a self-lubricating sintered material based on tungsten diselenide doped with a eutectic alloy of gallium and indium. The initial powder with grain size of 10-40 μm was ultrasonically mixed with the liquid alloy (sol:liq = 1:2) in alcohol, dried, pressed and sintered. X-ray structural analysis and metallography showed that the WSe₂ interacts chemically with the gallium-indium alloy. Among the several chemical compounds detected in the phase composition, one corresponds to GaSe. The antifriction properties were studied in air at velocities of 1-4.5 m/sec and under loads of 5-50 kg/cm². The results of the WSe₂-Ga/In self-lubricating material are compared with data for pure tungsten diselenide. It is found that the coefficient of friction and wear decrease with increasing velocity, and that the wear for the composite material is two orders of magnitude lower than for pure WSe₂ ($I=h/L=6\cdot 10^{-9}$ and $2\cdot 10^{-11}$ respectively, where h is the depth of the abraded layer in μm, and L is the length of the friction path in km). Figures 5; references 6: 3 Russian, 3 Western.

INVESTIGATION OF THE INTERACTION OF CERTAIN REFRACTORY COMPOUNDS WITH VT3-1 TITANIUM ALLOY

Kiev POROSHKOVAYA METALLURGIYA in Russian No 7, Jul 78 pp 39-41 manuscript received 10 Feb 77

BEZYKORNOV, A. I., YEVTUSHENKO, O. V., DEYMONTOVICH, V. B. and ROGOZINSKAYA, A. A., Institute of Problems of Material Science, Ukrainian SSR Academy of Sciences

Abstract The interaction of VT3-1 titanium alloy with Ti, Zr, Ta, Cr (Cr_7C_3 , Cr_3C_2) and W carbides, Ti, Zr, Cr and W (W_2B_5) borides as well as with MoS_2 and Al_2O_3 was studied by securing the ends of titanium alloy and pressed powder refractory compound together and by inserting the refractory samples into holes drilled in a titanium alloy plate. These samples were vacuum heated to 1200°C and soaked for 45 minutes. Adhesion of the contacting pairs prepared by the first method was noted for the Ti, Ta, Cr and Si carbides, Ti, Zr and Cr borides as well as MoO_2 and Al_2O_3 with strong bonding to the titanium alloy. Separation of the pairs after diffusion annealing leads to tearing of the refractory compound. The tungsten boride-VT3-1 pair showed no adhesion. The maximum diffusion zone and greatest change in contact region can be noted in the interaction of VT3-1 and Cr_7C_3 . Total thickness of the altered layer was almost 270 microns, which corresponds to the dimension of the diffusion zone in a VT2 aluminum alloy - Al_2O_3 contact. Minimum diffusion zone can be found in the VT3-1--ZrC pair, while there is no diffusion zone in the W_2B_5 -VT3-1 pair. In the second method of testing the interaction of Al_2O_3 and chromium and silicon carbides with the titanium alloy is greater than for tungsten and zirconium carbides. No interaction was detected in the tungsten boride-aluminum alloy pair. Figures 1; references 9: 8 Russian, 1 Western.

Steels

USSR

UDC 621.752.31

CORROSION-FATIGUE STRENGTH OF 1Kh16K4N2MVFB A STEEL

L'vov FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian No 3, May/June 78
pp 55-57 manuscript received 27 Jan 77

KALICHAK, T. N., TOVTIN, M. D., ALEKSEYENKO, M. F., FEDOTOVA, L. S. and
MUKHINA, Z. N., Physico-Mechanical Institute, Academy of Sciences Ukrainian
SSR, L'vov; All-Union Institute of Aviation Materials, Moscow

Abstract Results are presented from corrosion-fatigue-testing of a new
stainless steel--1Kh16K4N2MVFB A, produced by electroslag remelting, with
the results compared with those of the basic steel 1Kh12N2MVFB A. Chemical
compositions of the two steels are listed. Both steels are of the
martensite class with the new steel containing 10-15% austenite until it
has been heated and quenched from 1120°C, cold treated at -70°C for two hours
and then tempered at 690°C, which produces a 100% martensite content.
Mechanical properties of the two steels are:

	1Kh16K4N2MVFB A	1Kh12N2MVFB A
Tensile strength, kg/mm ²	125	106
Yield strength, kg/mm ²	95	92
Elongation, %	16	19
Reduction in area, %	56	59
Impact strength, kg-m/cm ²	10	7
Brinell hardness	341	302
Fatigue limit (10 ⁷ cycles)	52	50
Nominal corrosion fatigue limit in 3% NaCl (5x10 ⁷ cycles)	23	20
Nominal corrosion fatigue limit in moist air (5x10 ⁷ cycles)	20	--

The new steel possesses a complex of positive strength properties
in corrosive media, making it suitable for use in a tropical climate
and under maritime conditions. Figures 1; references 4: all Russian.

USSR

UDC 621.78:621.787.044.2

STRENGTHENING OF HARDENED LOW-CARBON STEEL DURING EXPLOSIVE DEFORMATION

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 6,
1978 pp 57-60

KRISHTAL, M. A., LYUCHKOV, A. D., VERKHOVSKIY, S. N., VAKHRUSHEVA, V. S.,
YUSHKEVICH, P. M. Tol'yatti Polytechnical Institute; All-Union Institute
of Heat Engineering, Stavropol' Agricultural Institute

Abstract Type 0.8kt steel containing 0.045% C was repeatedly heated in a
salt bath to 1000°C, held for 2 minutes and quenched in water at room

temperature to produce a martensite structure. Explosive deformation was then performed by throwing the flat specimens (120 x 60 x 3mm) against an obstacle, with a pressure in the shock wave of 25 kbar, below the phase transition pressure. Cellular structure did not develop in the specimens, and the number of twins in the deformed specimens did not increase, apparently a result of the more intensive development of the process of twinning in the martensite as a result of the repeated hardening. Figures 4; references 12: 11 Russian, 1 Western.

USSR

UDC 669.923.4:669.14

INCREASING THE FATIGUE STRENGTH OF HARDENED ShKh15 AND 12KhN3A STEELS WITH THE AID OF DIAMOND MACHINING

Kiev SINTETICHESKIYE ALMAZY in Russian No 6, 1977 pp 58-60

SMAGLENKO, F. P., Institute of Superhard Materials, Academy of Sciences Ukrainian SSR and GRYAZNOV, B. A., Institute of Problems of Strength, Academy of Sciences Ukrainian SSSR

Abstract The fatigue strengths of ShKh15 and 12KhN3A steels were compared after being subjected to various forms of finishing including diamond belt and wheel polishing and burnishing. Steel ShKh15 with diamond-wheel polishing had the highest fatigue strength and ShKh15 polished with an EB40 wheel-- the lowest. Fatigue testing of specimens of steel 12KhN3A gave similar results. Polishing with a tool made with conventional abrasives is accomplished by significant local temperatures, which causes the appearance of microcracks and residual tensile stresses which lower fatigue strength. Diamond polishing removes a defective layer, owing to its high cutting ability, and causes residual compressive stresses in the treated surface, which increases a material's resistance to cyclic loads. Polishing with a diamond belt does the same as the diamond wheel but the magnitude and depth of the residual compressive stresses are less. Figures 1; references 2: both Russian.

STUDY AND DEVELOPMENT OF A NEW HIGH-STRENGTH STEEL FOR WELDED STRUCTURES

Moscow STAL' in Russian No 6, Jun 78 pp 548-551

GLADSHTEYN, L. I., BOBYLEVA, L. A., ONUCHIN, L. G. , LITVINENKO, D. A. and ZELICHENOK, B. YU., Central Scientific Research Institute for Planning of Steel Structures, Central Scientific Research for Ferrous Metallurgy and Orsk-Khalilovo Metallurgical Combine

Abstract A new steel has been developed for the manufacture of stronger rolled products. The new high-strength structural steel was based on the chemical composition of earlier thermally improved high-strength steel type 12GN2MFAYu(VS-1). The experiments performed showed that the content of chromium in the steel, which facilitates martensite hardening, should not be very high; however, the content of molybdenum must be increased to produce bainite and decrease the tendency toward strength loss during tempering. Based on these studies, the new steel, 12KhGN2MFBAYu(VS-2) is as follows: (in %): C, 0.09-0.016; Si, 0.3-0.5; Mn, 0.9-1.3; Cr, 0.5-0.9; Ni, 1.4-1.7; Mo, 0.30-0.40; V, 0.05-0.10; Nb, 0.02-0.06; Al, 0.05-0.10; N, 0.02-0.03; P, not over 0.035; S, not over 0.035. The tensile strength of the new steel is 85 kgf/mm², yield point 75 kgf/mm², reduction in area 12%. The steel withstands bending by 108° without fracture on a mandrel with a diameter of 3 h (h= thickness of sheet). Figures 8; reference 9:
4 Russian, 5 Western.

USSR

UDC 669.14.018.44:620.18:620.172

INFLUENCE OF SUPERPLASTIC DEFORMATION ON THE STRUCTURE OF HEAT-RESISTANT NICKEL ALLOY ZhS6KP

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 7, 1978 pp 58-59

KLESHCHEV, A. S., VYALOV, V. A., RYBAKOVA, Yu. A., PETROV, A. P. and DOLBINOV, Yu. D., Moscow Institute of Aviation Technology; All-Union Institute of Light Alloys

Abstract A study is made of the structure of ZhS6KP nickel alloy after extension under conditions of superplasticity at 1100-1180°C, 0.5-10 mm/min, maximum deformation about 500% at 0.5 mm/min and 1150°C. It is found that extension under conditions of superplasticity leads to changes in the quantity and dimensions of the γ' phase, a result of the increase in diffusion processes upon superplastic deformation. The formation of centers of damage in specimens of the alloy during superplastic deformation results from the presence of carbide lines. Figures 2; reference 6: all Russian.

USSR

UDC 621.73.019

STUDY OF THE INFLUENCE OF THE TEMPERATURE EFFECT DURING PLASTIC DEFORMATION ON THE QUALITY OF HEAT-RESISTANT KhN38VT ALLOY

Moscow STAL' in Russian No 6, Jun 78 pp 559-560

YUDOVICH, S. Z., Candidate of Technical Sciences, IVANCHENKO, V. M. and KOVALEV, V. N., Engineers, Zaporozhye Machinebuilding Institute

Abstract A study was made of the influence of temperature and the degree of deformation on the temperature effect (heating during deformation) and its influence on the basic quality characteristics of the heat resistant alloy KhN38VT (0.01% C; 0.44% Si; 0.34% Mn; 20.9% Cr; 36.5% Ni; 3.27% W; 1.08% Ti; 0.27% Al; 0.005% S; 0.014% P). It was concluded that the temperatures and degrees of deformation used in forging of KhN38VT result in a significant temperature effect (deformation heating), which has an unfavorable influence on the quality characteristics of the steel, including its strength. Consideration of the temperature effect during development of a technology for pressure working of hard steels can thus allow an increase in the quality of the metals. Figures 3.

USSR

UDC 621.921.27

PHASE COMPOSITION AND STRENGTH OF POLYCRYSTALLINE SUPERHARD MATERIALS BASED ON BORON NITRIDE

Kiev SINTETICHESKIYE ALMAZY in Russian No 3, 1977 pp 19-23

PRIKHNA, A. I., SOZIN, Yu. I., BELYANKINA, A. V. , GERASIMENKO, V. K. and DAVYDOV, N. A., Institute of Superhard Materials, Academy of Sciences, Ukrainian SSR

/Abstract/ The authors used x-ray studies to investigate the structural features of polycrystalline superhard materials based on boron nitride. The results of the study show that the process of production of polycrystals of cubic boron nitride is unstable, in the sense that a certain quantity of undesirable phase may appear in the polycrystals. The stability of synthesis can be increased by using higher pressures. However, this greatly decreases the service life of the high-pressure chamber, making the process uneconomical. Therefore, until stronger higher-pressure chambers are developed, stabilization of synthesis should be achieved by limiting the minimum and maximum duration of application of pressure and temperature to the initial material. Figures 3; reference 8: all Russian.

MORPHOLOGIC STABILITY OF THIN FILMS ON REINFORCING FIBERS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul/Aug 78
pp 112-116 manuscript received 27 May 77

GOL'DINER, M. G. , MAZUR, V. A., MALINOVSKIY, T. I. and YAGUBETS, A. N.,
Kishinev

Abstract A comparative experimental analysis and evaluation of the temperature and time dependence of the structural and morphologic evolution of thin films applied to flat substrates and to reinforcing fibers are presented. The experiments indicate that when nickel, copper and aluminum films 0.1-1 μm thick are annealed on single-crystal and polycrystalline substrates in a vacuum of 10^{-5} mm Hg, decomposition does not occur in many cases. The morphologic stability of the thin films depends not only on the orienting effect, but also on the geometry of the substrates. Polycrystalline films on oriented substrates, decreasing their interphase and intergrain energy, are transformed to epitaxial films, which are stable in the sense of decomposition. Continuous films on carbon fibers and threadlike crystals of sapphire are less stable than films on flat substrates, and break down into hemispherical islands. Figures 2; references 6: 4 Russian, 2 Western.

USSR

UDC 669.295

USE OF LOW-GRADE TITANIUM SPONGE TO PRODUCE HIGH-PURITY FERROTITANIUM

Moscow TSVETNYYE METALLY in Russian No 5, May 78 pp 51-52

PIMENOV, YU. G., VYATKIN, I. P., and MINOCHKIN, N. V.

Abstract A titanium-magnesium combine has tested and begun operation of a technology for the production of types T and VO (State standard GOST 4761-67) ferrotitanium by melting titanium sponge with steel scrap in induction furnaces. The data produced indicate a tendency toward enrichment of the upper portion of the ingot with titanium. At the face, where the crystallization rate is probably rather high, liquation through the height of the ingot is less. In the center of the ingot, where the melt remains liquid for about 40 minutes after pouring, favorable conditions are created for liquation of titanium; however, the deviations in its content which result do not exceed the limits set by the standard.

USSR

UDC 669.295:669.017.3

AGING OF THE TITANIUM ALLOY WITH THE CRITICAL COMPOSITION VT22M

Moscow IZVESTIYA AKADEMII NAUK SSR, METALLY in Russian No 3, May/June 78 pp 147-151 manuscript received 8 Jul 77

GUSEVA, L. N., DOLINSKAYA, L. K., and MATVEYENKO, A. F., Moscow

Abstract A study is made of the parameters of heat treatment influencing the conditions of attainment of high strength of semifinished goods of VT22M titanium alloy containing, in percent: 4.9 Al, 4.8 Mo, 5.1 V, 0.8 Fe, 0.7 Cr, 1.8 Sn and 0.3 Cu. Phase transitions are studied as a function of mode of deformation and heat treatment of the metal. As the aging temperatures increase from 250° to 550°C, the mechanism of decomposition of the β solid solution changes from $\beta \rightarrow \beta + \omega$ to $\beta \rightarrow \beta + \alpha^{II}$ and then $\beta \rightarrow \beta + \alpha$. The formation of a metastable α^{II} phase, an α solid solution supersaturated in β stabilizers with rhombic distortion of the hexagonal structure, in the process of tempering at 400-450°C is demonstrated for the first time. Effective hardening is achieved upon aging of specimens quenched from temperatures below the temperature of polymorphic conversion. Figures 4; reference 5: 3 Russian, 2 Western.

USSR

UDC 669.295:539.4

INVESTIGATION OF THE SUPPORT CAPACITY OF A MEDIUM STRENGTH TITANIUM ALLOY
ROTATING DISK WITH A CRACK

L'vov FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian No 3, May/June 78
pp 100-104 manuscript received 10 Jun 76

LAKEYEV, B. N., VASIL'CHENKO, G. S. and MOTUZENKO, A. I., Central Scientific
Research Institute of Machine Building Technology, Moscow

Abstract A titanium alloy disk, 650 mm in diameter and 75 mm thick, with two symmetrical notches cut from a 70-mm-diameter hole in the center of the disk, was used to study cracking-resistance strength (I_s) as a function of a derived coefficient of stress intensity (K_s) and the critical magnitude of plastic crack expansion. Using the results of developed mathematical expressions and test data, I_s was plotted against crack length and crack resistance against inverse strength reserve. The plotted graphs confirmed calculations used to determine the number of disk startups that a notched disk can sustain until surface and internal crack magnitudes become critical. For example, 23,700 disk starts opened a surface crack with an initial 1-mm depth to a depth of 4.2 mm. Thus, for this example, if the disk contains surface defects 1 mm deep and 10 mm long or internal defects 2 mm deep and 10 mm long, then 2370 disk starts can be allowed before defect size becomes critical. Figures 2; reference 4: 3 Russian, 1 Western.

USSR

UDC 669.788'539.219.3:669.017

ROLE OF HYDROGEN DIFFUSION IN THE EMBRITTLEMENT OF TITANIUM ALLOYS

L'vov FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian No 3, May/June 78
pp 23-29 manuscript received 7 Feb 77

NAZIMOV, O. P., Moscow Aviation Technology Institute imeni K. E. Tsiolkovskiy

Abstract The directed diffusion of hydrogen in titanium alloys and the resulting hydrogen embrittlement were studied. Analysis of hydrogen content near stress concentrators and compilation of test data testified to the decisive role that hydrogen plays in the development of slow brittle fracture. One of the mechanisms of brittle fracture can be reduced to the fact that in local volumes the hydrogen concentration from directed diffusion remains at a level sufficient for development of hydrogen brittleness although the average content in the metal volume is below the permissible maximum. Cracks in local volumes, enriched with hydrogen, can nucleate for several reasons: in alpha- and (alpha+beta)-alloys with a small amount of beta-phase the

cause of slow brittle fracture results from hydrogen concentration exceeding the maximum solubility in the alloy and hydrides forming in the structure. These hydrides bond poorly with the matrix and have a large specific volume (greater than the matrix metal), and cracks form easily around the hydrides. In beta-alloys and in (alpha-beta)-alloys with a relatively large amount of beta-phase, cracks can nucleate due to the brittleness of the beta-phase itself at points enriched with hydrogen. Figures 5; references 13: 10 Russian, 3 Western.

USSR

UDC 620.187:669.295'24

ELECTRON-MICROSCOPE STUDY OF THE STRUCTURE OF TITANIUM NICKELIDE

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 8, 1978 pp 49-51

KRYLOV, B. S., KUZ'MIN, S. L., LIKHACHEV, V. A., MASTEROVA, M. V. and PONOMAREV, A. P.

Abstract Results are presented from electron-microscope and x-ray spectral studies of specimens of an alloy containing 48 at.% Ti and 52 at.% Ni. Ingots 130 mm in diameter, with a mass of 19 kg, were made by double remelting in a vacuum-arc furnace. The ingots were turned down, placed in a vacuum chamber, sealed in an electron beam installation, heated to 920°C, held for 1.5 hr and extruded to 30 x 80 mm cross section. They were then cut into blanks, annealed at 800°C and rolled at 900-700°C in several passes to a strip 6-7 mm thick. The strip was cut, then rolled to 2 mm thick, annealed at 800°C, 1 hour, cut, sand blasted, etched in 20% HF plus 20% HNO₃ to produce a strip 0.5 mm thick which was cut to shape and etched to 0.25 mm thick in the same acid solution, vacuum annealed at 800°C and cooled. The surface structure was then studied. It was found that a strong structural and chemical micro-heterogeneity arises in the alloy due to segregation of the compound TiNi₂, which may cause great changes in the mechanical properties, and must be considered in selecting optimal modes for working of the metal. Figures 4; reference 6: 1 Russian, 5 Western.

USSR

UDC 621.791.36+669.296

SOLDERING OF PRODUCTS OF VT9 ALLOY

Kiev AVTOMATICHESKAYA SVARKA in Russian No 7, Jul 78 pp 53-55 manuscript received 27 Dec 77 after revision

KOSLOV, V. V., Candidate of Technical Sciences, GORCHAKOV, R. K., Engineer, GRUZDEV, B. L. and KISELEV, O. S., Candidates of Technical Sciences, Ufa Aviation Institute imeni Ordzhzhonikidze

Abstract The purpose of this work was to work out a technology for soldering of box-section products 350 mm long of VT9 alloy. Two design versions were compared: soldered and welded. The welded product consisted of 4 parts, and was produced by electron-beam welding in a vacuum, requiring 4 operations and 1 removal and repositioning of the product in the chamber. The soldered version consisted of 3 parts, with all soldering done in 1 operation. The soldering was performed with gaps between parts of not over 0.1 mm, in a vacuum furnace at a residual pressure of not over $1 \cdot 10^{-4}$ mm Hg, temperature 955-965°C, holding time 90 minutes. The operating life of the soldered parts was found to be significantly longer than that of the welded parts. Economic analysis showed that the replacement of welded joints by soldered joints decreases labor consumption and increases the utilization factor of the material. Figures 3.

USSR

UDC 620.17:669.295'24'3

MECHANICAL PROPERTIES OF ALLOYS OF THE SYSTEM TiNi-TiCu

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 8, 1978 pp 48-49

ERKHIM, V. A., BELOUSOV, O. K. and SHKVARUNETS, T. I., Institute of Metallurgy imeni A. A. Baikov

Abstract A study is made of the interaction of TiNi and TiCu. This system is interesting since it shows promise for the creation of alloys with good ductility in the cold state. It is found that as the TiCu content increases, the temperature at which the effect of "shape memory" begins to appear decreases. The specific work required upon application of a single load increases with an increase in the TiCu content from $0.47 \cdot 10^{-3}$ in pure TiNi to $0.56 \cdot 10^{-3}$ kgf.m/mm² in the alloy with 10% TiCu. Figures 5.

USSR

UDC 621.78:669.295

HARDENING OF VT16 ALLOY BY HEAT TREATMENT UNDER VACUUM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 5, May 78 pp 65-67

VOROB'YEV, I. A. and MAL'TSEV, M. V.

Abstract The feasibility of hardening VT16 titanium alloy by heat treatment under vacuum (10^{-4} mm Hg) was established in an experimental study with various modes of heating, aging, and cooling. The results of mechanical tests, supported by microstructural x-ray diffraction analysis, indicate that a tensile strength of 103-107 kgf/mm² with a yield point of 88-96 kgf/mm² and a relative fluidity of 59-63% can be attained by the following treatment cycle: heating at 775-800°C for 2 hrs, cooling in water, and intermediate aging at 500°C for 8 hrs. Figures 2; references 1: Russian.

USSR

UDC 620.178.2:669.295

DEPENDENCE OF THE TOUGHNESS OF VT3-1 ALLOY ON STRUCTURE

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 5, May 78 pp 67-69

IVANOV, A. S., TOMSINSKIY, V. S., and PATRUSHEV, YE. P., Perm Polytechnic Institute

Abstract A study was made to establish the effect of the structure of the VT3-1 titanium alloy on its toughness. Specimens of the same phase content but different structures, ranging from a fine-grained one to a lamellar one with α -phase precipitation at β -phase grain boundaries, were produced by heating to different temperatures (880-1020°C) before quenching and final tempering. The results of impact tests and microstructural analysis (each specimen with a notch and a fatigue crack) indicate that annealing at or quenching from a higher temperature within the $\alpha+\beta$ -range increases the cracking resistance of fine-grained VT3-1 but decreases the cracking resistance of lamellar VT3-1. Heating within the β -range after preliminary annealing increases the toughness, but after preliminary quenching decreases it. Figures 1; references 7: 4 Russian, 3 Western.

USSR

UDC 669.295:620.178.152.341.4

CONCERNING SOME SPECIFICS OF THE MEASUREMENT OF MICROHARDNESS IN TITANIUM ALLOYS

Moscow ZAVODSKAYA LABORATORIYA in Russian No 5, 1978 pp 612-615 manuscript received 21 Dec 78

ORLOVA, L. M.

Abstract The need is demonstrated to consider such factors as the quality of surface preparation, strain hardening of the surface during mechanical preparation of the specimen, anisotropy related to the type of crystalline lattice, and chemical and morphological peculiarities of the alloy structure in the measurement of HM microhardness in α (or pseudoalpha) titanium alloy. The surface should be prepared by electrolytic polishing to remove the strain-hardened layer. If two diagonals of the imprint are measured, HM is practically independent of imprint orientation in specimens with both fine-grain and coarse-grain structure. Hand loading of the indentor should not be used. The influence of the structural factor must be considered; liquation banding produced a difference in microhardness of 100 kgf/mm^2 in one specimen. The density of alpha-phase plates can also influence HM in coarse-grained specimens. Figures 4; references 7: all Russian.

USSR

UDC 669.295.5:620.172:620.178.1

THE RELATIONSHIP BETWEEN THE HARDNESS OF TITANIUM ALLOYS AND THEIR STRENGTH

Moscow ZAVODSKAYA LABORATORIYA in Russian No 5, 1978 pp 605-608 manuscript received 25 Mar 77

PAVLOV, I. M., TARASEVICH, YU. F., LESHKEVICH, G. G. and SHELEST, A. YE., Institute of Metallurgy imeni Baykov, Academy of Sciences, USSR, Moscow

Abstract Based on the results of tensile testing and measurements of the Brinell hardness, a relationship is established between the hardness and strength of specimens of single-phase and two-phase titanium alloys over a broad range of these properties. The empirical relationship between strength properties and hardness is usually expressed by linear equations such as $\sigma = K \cdot HB$ or $\sigma = K \cdot HB + C$. The correlation between yield point and Brinell hardness is not as strong as that between ultimate tensile strength and Brinell hardness. Figures 2.

USSR

UDC 621.791.01:620.192.46

EFFECT OF HEREDITY ON THE WELDABILITY OF WROUGHT ALUMINUM ALLOY SEMIFINISHED PRODUCTS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 78 pp 37-39 manuscript received 26 Dec 77

ALOV, A. A., Doctor of Technical Sciences

Abstract An analysis is made of the reasons for the tendency of aluminum alloy semifinished products to hot-shortness. Internal stresses and impurity segregations are the main factors in intergranular and interdendritic boundary weakening. The striating and distribution of impurities in the zone of mutual crystallization and any other factors promoting stringer formations increase hot-shortness tendency. By understanding the inheritance of semifinished product structural features, acquired during their production, it is necessary to recognize that hot-shortness of weld joints is determined to a significant degree by the heredity of semifinished products. Gas porosity develops in the mutual crystallization zone from the presence of a nucleus and a relatively high hydrogen content. Microstriation is the basic form of pore nucleation in the mutual crystallization zone, and in the main part of the seam metal microbubbles are suspended in the fused metal. The presence of micronuclei and hydrogen in the base and filler metal evidently determines the heredity of the semifinished products, and the hydrogen content in the seam metal depends on welding conditions. The heredity of both the base and filler metals also strongly affects metal seam properties. The mechanical properties of weld joints are determined by both the composition of the base and filler metals and by the heredity of semifinished products. The subdivision of aluminum alloys into weldable and non-weldable, without reference to type and semifinished product heredity is not scientifically founded. References 10: all Russian.

USSR

UDC 621.791.011:669.715

INCREASING THE QUALITY OF O1420 ALUMINUM ALLOY WELD JOINTS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 78 pp 34-36, 39 manuscript received 17 Jan 78

BOKSHTEYN, S. Z., Doctor of Technical Sciences, BRONFIN, M. B. and KUROCHKO, R. S., Candidates of Technical Sciences, IODA, YE. N., Engineer, and ZHEGINA, I. P., Candidate of Technical Sciences, All-Union Scientific Research Institute of Aviation Materials

Abstract Aluminum alloy O1420 weld joints with and without fatigue cracks were subjected to fatigue testing to refine the effect of thermovacuum

treatment on joint fatigue strength and to explain the action of vacuum heating on joint longevity. Prior to argonarc butt welding, control samples were heated to 450°C, water quenched and artificially aged at 120°C for seven hours, while test samples were heated to 450°C for six hours in a vacuum and furnace cooled. The control samples had a continuous line of pores in the fusion zone while the thermovacuum treated samples had none. Volume of the control samples increased by 12.5 cm³ and hydrogen content in the metal was 1.3 cm³/100, whereas the volume increase in the test samples was 3.3 cm³ and hydrogen content--0.4 cm³/100. After heat treatment of the control samples the minimum number of cycles to fracture was 17,178 and the maximum--46,037; for the thermovacuum samples these values were 50,220 and 100,000 respectively. With the reduced hydrogen content of the vacuum treated samples the local ductility of the joint is increased which in turn slows down the rate of crack propagation. Figures 3; references 2: both Russian.

USSR

UDC 621.791.72

PLASMA FLOWS AND THE THERMAL AND HYDRODYNAMIC PROCESSES IN THE GAS-VAPOR CHANNEL DURING ELECTRON-BEAM WELDING OF METALS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 6, Jun 78 pp 27-30

LESKOV, G. I., Doctor of Technical Sciences, and NESTERENKOV, V. M., Institute of Electric Welding imeni Ye. O. Paton, Ukrainian SSR Academy of Sciences

Abstract The zones of plasma flow formation, their direction and intensity, and the thermal and hydrodynamic processes that take place during electron-beam welding were studied. As plasma vapors are discharged during welding, a vapor-dynamic channel is formed which influences the different processes taking place. The main portion of beam energy is transmitted to the forward wall of the vapor-dynamic channel where the equilibrium form satisfies the requirement of constancy of average power concentration in all its elements. This power is expended in melting and vaporizing each element at the same rate on the average. However, disturbance of the molten layer of the forward wall by the output reaction of vapors leads to deflections of the contact angles of its elements with the beam from equilibrium, resulting in different parts of the wall receiving energy above or below the average. Consequently, these elements of the forward wall, called protuberances, receive more energy and the vapors flowing from them are distributed in space by the cosine law, with the output reaction directed perpendicular to the wall element and the dynamic head--to the weld bath. The output reaction removes the protuberances being formed, resulting in the formation of cavities while the dynamic head of the jet forces a section of the bath back from the beam. Due to the pulsing nature of the plasma ion current set up by the electron beam, any and all measures employed to stabilize the ion current will improve welding quality. Figures 6; references 2: both Russian.

USSR

UDC 621.791.753.9:661.939.1:62-413:669.715

SINGLE-PASS HELIUM-ARC WELDING OF THICK-SHEET AM_g6 ALUMINUM ALLOY USING AN IMMERSSED TUNGSTEN ELECTRODE

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 8, Aug 78 pp 16-17

KOVALEV, A. A. and NIKULIN, V. P., Engineers, SIMONIK, A. G., Candidate of Technical Sciences, and VERESHCHAGIN, S. I., Engineer

Abstract This work was conducted to show that 10- and 18-mm-thick aluminum alloy sheet can be welded with an immersed tungsten electrode in a helium arc to produce quality weld seams. For 10-mm sheet the welding parameters were: current--350-400 amps, arc voltage--11 volts, welding speed--10 m/hr, electrode depth below surface--2.0-2.5 mm. For 18-mm sheet these parameters were: 470-500 amps, 11 volts, 7 m/hr and 3.0-4.0 mm, respectively. X-ray inspection revealed high quality joints with practically no defects. The absence of pores was attributed to degasification of the melt caused by intense circular movement of the molten metal in the plane of the metal edges being welded. Another factor for the low porosity was the reduced hydrogen content. This resulted from the direct polarity welding current which counteracted the accumulation of hydrogen ions on the metal being welded (the anode). Oxide films and inclusions were not detected by metallographic investigations. Samples welded by this method possessed better tensile and impact strengths than when welded by manual argon-arc methods. Figures 3; references 10: 9 Russian, 1 Western.

USSR

UDC 621.791.4.539.378.3

FORMATION OF PHYSICAL CONTACT DURING DIFFUSION WELDING WITH DEFORMATION USING PROGRAMMED LOADING

Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 78 pp 17-20 manuscript received 13 Jul 77

USHITSKIY, M. U., and KARAKOZOV, E. S., Moscow Evening Metallurgical Institute

Abstract A study is made of the formation of physical contact during diffusion welding by deformation of materials differing greatly in their resistance to plastic deformation. It is demonstrated that the process of welding is efficient if the loading is programmed. Equations are presented which can be used to define the rate of increase of loading by solving the problem of plastic deformation of a random rough surface by means of a smooth, rigid stamp. Figures 6; references 10: 9 Russian, 1 Western.

USSR

UDC 621.791.89

INFLUENCE OF THE SHAPE OF AN ULTRASONIC PULSE ON THE QUALITY OF MICRO-
WELDING

Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 78 pp 21-23 manuscript
received 10 Jun 75

KOLESHKO, V. M., and MUZHICHENKO, O. G.

Abstract A study is made of the influence of the shape of an ultrasonic pulse on the mechanical strength, contact area and depth of interaction of joining of an aluminum wire to a silicon single crystal in one case and to an aluminum film crystallized on silicon dioxide in another. It is found that programmed application of ultrasonic energy to the welding zone must be developed in consideration of the kinetics of formation of a good quality joint. Graphs plot the variation in mechanical strength, contact area and depth as functions of ultrasonic oscillation power applied and actually consumed in the process of welding. The optimal pulse shape has high early amplitude, decreasing to approximately 50% of initial amplitude after physical contact is made. Figures 4; references 7: all Russian.

USSR

UDC 621.791.753.042.3

PHYSICAL-MECHANICAL PROPERTIES OF WELDED JOINTS MADE BY WELDING WITH
POWDERED WIRE UNDER WATER

Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 78 pp 48-51 manuscript
received 22 Sep 77

ASNIS, A. YE., SAVICH, I. M., GRISHANOV, A. A., and GLUKHOVA, YE. V.,
Institute of Electric Welding imeni Ye. O. Paton, Academy of Sciences
Ukrainian SSR

Abstract A comparative analysis is presented of the physical and mechanical properties of the metal of joints produced by semiautomatic welding underwater and by manual welding in air using electrodes of UONI-13/45 with calcium fluoride coating. The resistance to the formation of crystallization cracks, size and distribution of nonmetallic inclusions and mechanical properties of the welded joints were compared in low-carbon and low-alloy steels. The results of the comparisons indicate the suitability of underwater semiautomatic welding with powder wire for the manufacture of important structures. Figures 6; references 5: all Russian.

USSR

UDC 621.791.72:621.373.8

PULSED LASER WELDING OF WIRES TO FILMS IN THE PRODUCTION OF MICROCIRCUITS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 78 pp 24-26 manuscript received 23 Mar 77

AVRAMCHENKO, P. F., VELICHKO, O. A. , and MORAVSKIY, V. E., Institute of Electric Welding imeni Ye. O. Paton, Academy of Sciences Ukrainian SSR

Abstract A study is presented of the possibility of using series-produced SLS-10-1 and "Kvant-10" lasers for welding thin wires to metal films, and the process of welding and the basic characteristics of joints produce are studied. The possibility is demonstrated of welding and soldering of copper, gold and aluminum wires to films using the Kvant-10 and SLS-10-1 laser welding machines. The welded joints produced have good strength. No defects were evident. It is possible to create an industrial technology for pulsed laser welding of thin wires of the materials studied to films on dielectric substrates. Figures 5; references 4: 3 Russian, 1 Western.

USSR

UDC 621.791.052.001.5:621.78

INFLUENCE OF WELDING WIRE AND HEAT TREATMENT ON THE MECHANICAL PROPERTIES OF WELDED JOINTS IN VT9L TITANIUM CASTING ALLOY

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 6, Jun 78 pp 20-21

POLYAKOV, D. A., ABRAMOVA, V. N., KULIKOV, F. R., VAS'KIN, YU. V., YASINSKIY, K. K. and PROSTOV, I. A.

Abstract An attempt is made to develop a technology for welding of VT9L alloy to provide properties of joints, as well as zones of welding of defects, close to the properties of the base metal. The influence of the welding wire, as well as heat treatment (annealing) on the mechanical properties of the welded joints, was studied. Wires included type SPt-2 and BT20-2sb, plus the VT9L base metal cut into strands and VT9 bar worked down to 5 mm diameter. Annealing in open furnaces at the usual temperature of 750°C in order to reduce residual stresses decreases the plastic properties, particularly the impact toughness, of the metal around the seam. At 600-650°C the decrease in impact toughness is not as serious. SPT-2 and VT20-sv welded wire and bars cut from the base material are recommended for welding, producing joints with 85-90% or more of the strength of the base metal. Figures 3.

USSR

UDC 666.76

A MATERIAL WITH HIGH IMPACT TOUGHNESS

Moscow STEKLO I KERAMIKA in Russian No 6, Jun 78 pp 32-33

KARPINOS, D. M., GROSHEVA, V. M., DOROSHENKO, R. P., KLIMENKO, V. P. and VASIL'YEV, A. V., Institute of Problems of Material Science, Academy of Sciences, Ukrainian SSR

Abstract The authors of this article have developed a method for producing a ceramet based on aluminum oxide and molybdenum with good impact strength. The impact strength is increased by introducing the reinforcing component in the form of threadlike single crystals of mullite in a quantity of 15-20% by volume. The material is produced by mixing finely ground powders of aluminum oxide and molybdenum in a porcelain drum in a suspension of alcohol with threadlike mullite crystals in a ratio of 60:25:15, respectively. The charge produced is hot pressed in a graphite mold with induction heating at 1750-1800 C, pressure 15-20 MPa, holding time 15-20 minutes, cooling with a mold. The density is lower than the material produced without the mullite crystals, but compressive strength, bending strength, impact strength, residual strength (after heating to 850 C and quenching in water) are all higher. The material is also said to be more resistant to laser radiation and more thermally stable. Figures 1.

USSR

UDC 539.45.669.245

SOME FEATURES OF FATIGUE STRENGTH IN CAST HIGH-TEMPERATURE ALLOYS

Kiev PROBLEMY PROCHNOSTI in Russian No 7, Jul 78 pp 25-30 manuscript received 1 Sep 76

ZHUKOV, N. D., Moscow

Abstract An investigation of the fatigue strength of ZhS3DK, ZhS6K, ZhS6U and VZhL12U alloys with an equiaxial and directed structure in the 20-1100 C interval on a base up to 10^8 cycles was made by x-ray, microstructural and electron microscope analysis to establish the features of fatigue resistance in these alloys as well as to determine the relationship of fatigue to the structural and physical-mechanical properties of them and their phase compositions. For cast alloys of the ZhS type with a coarse grain and rough dendritic structure one would expect an insignificant change of fatigue limit when temperature is increased from 20 to 800-900 C owing to the weak temperature relationship of its yield point in this temperature interval. However, for the investigated alloys a special nature of the temperature function of

fatigue resistance was noted: an increase in the fatigue limit by 1.5-2.0 times with a temperature increase from 20 to 900 C which drops with further temperature increase. The use of directed crystallization provides substantial growth (50% at 20 C and 10% at 900 C) of the average indicators of fatigue. One of the main parameters characterizing the fatigue resistance and determining the shape of a fatigue curve is the angular coefficient of regression. At temperatures above 700 C the fatigue curves of cast high-temperature alloys are well approximated in double logarithmic coordinates by straight lines with a constant angular coefficient, but at temperatures from 20 to 650 C the fatigue curves are formed by two straight lines with different angular coefficients. Residual thermal stresses in the alloys are caused by the presence of second phases, and defects are caused by differences in the coefficients of linear expansion of the phase constituents as well as differences in the elastic moduli of the phase constituents. At temperatures above 900-950 C the processes of creep, coalescence and dissolution of the hardening phase, as well as oxidation of the surface layer, have a decisive effect on the process of fatigue failure. These influences significantly diminish the resistance of the alloys to crack initiation. For the indicated test conditions the formation of microcracks and their development into a mainline crack occurs as a rule along grain boundaries, and in alloys with a directed structure the failure due to fatigue occurs by means of a wave-form slip as opposed to plane slip. Figures 6; reference 10: 5 Russian, 5 Western.

USSR

UDC 620.172

EFFECT OF TECHNOLOGICAL FACTORS ON THE STRENGTH OF HIGH-TEMPERATURE MATERIALS IN RAPID AIR FLOWS

Kiev PROBLEMY PROCHNOSTI in Russian No 7, Jul 78 pp 76-78 manuscript received 26 Apr 77

SOROKIN, V. G. and GUZANOV, B. N., Sverdlovsk, Ural Polytechnical Institute imeni S. M. Kirov

Abstract EI437B alloy was tested in a still air medium and in a rapid air flow (mach 1.4) by loading at a constant rate of tension (0.16 mm/min) and by putting it under a constant tension (35 kG/mm²) at 800 C to study the effects of high-temperature thermomechanical treatment (HTTMT) and vacuum-arc remelting (VAR) on alloy strength. The HTTMT consisted of heating to 1080 C, rolling to a 30% reduction and water quenching. The samples were then aged at 750 C for 16 hours and air cooled. Samples tested prior to HTTMT had a tensile strength loss of 22%, but after HTTMT--only a 9.5% loss. The rate of steady-state creep was 0.05%/min before treatment and 0.02%/min afterward. Time to failure was lengthened from 9 minutes for untreated

samples to 50 minutes for treated samples. In the first stage of creep and at the beginning of the second stage the sample surface is strengthened from the mechanical action of the air flow, but as the air flow continues the surface layers are ruptured and altered substantially, resulting in the accelerated onset of the third state of creep and rupture of the sample. VAR increases alloy strength and its resistance to action of rapid air flow. During tests in the air flow the yield strength of samples after VAR was lowered by 15.2%, and for samples from a conventional commercial melt-- by 22.2%. Alloying elements, such as lead, cadmium and others, in quantities even as small as thousandths of a percent, render a strong negative effect and notably impair hot ductility and heat resistance. Metallographic investigation of the fracture nature showed that development of cracks after HTTMT and VAR is preceded by significant strain in the sample volume which forms as the result of development of intensive multiple slip. Figures 4; references 6: all Russian.

USSR

LASER ACTION ON COATINGS PRODUCED BY THE METHOD OF ELECTRIC-SPARK ALLOYING

Kishinev ELEKTRONNAYA OBRABOTKA MATERIALOV in Russian No 3, May/Jun 78
pp 24-25

LAZARENKO, B. R., MIKHAYLOV, V. V., GITLEVICH, A. YE., YELISEYEV, A. A. and VOLGIN, V. I. , Kishinev, Moscow

/Abstract/ VT6 titanium and St. 45 steel samples, which had been electric-spark coated with Al, Ag, nichrome and T15K6 hard alloy, were laser treated to determine if this treatment could replace mechanical smoothing. Tests were conducted on a combination SLS-10-1 and Kvant-10 unit at energy densities of 60-280 J/cm² created by a 3-4-microsecond pulse recurrence frequency of 0.5-1 Hz. For each type of coating there is a specific radiation flux which produces uniform alloying, defect sealing and a smoother surface. For St. 45 steel coated with T15K6 this flux was $0.8 \cdot 10^6$ W/cm². For the other coatings this flux density vaporized the coating, causing cracks and pores at the epicenter of the laser beam spot. Optimum power density was determined to be $0.1-0.4 \cdot 10^5$ W/cm². Detailed study of the samples revealed intensive mixing of the base and coating materials (mutual diffusion penetration). X-ray microanalysis showed that much of the surface coating penetrates to a depth 3-5 times greater than the thickness of the coating. Figures 5; references 7: all Russian.

ON DETERMINING THE COEFFICIENT OF AREA FILLING FOR GRAINS OF BORON NITRIDE

Kiev SINTETICHESKIYE ALMAZY in Russian No 6, 1977 pp 22-23

BELOSHAPKA, N. I., Kiev Institute of Civil Aviation Engineers

Abstract Using the known relationship that the cross sectional area of a grain is proportional to the square of its linear dimension, $F = C_F \cdot d^2$, where d is the average linear dimension of a diamond-abrasive grain and C_F is the coefficient of degree of filling the area of a grain, an equation is derived for determining the area filling coefficient for boron nitride grains. If a particle of any form can be compared to a cube, its volume and weight can be expressed as $V = C_V \cdot d^3$ and $G = V \cdot \gamma = C_V \gamma d^3$, --specific gravity of the grain, C_V --coefficient of proportionality determining the degree of volume filling. From these expressions C_V can be isolated: $C_V = G_a/G_t = V_a/V_t$ (a --actual, t --theoretical) which characterizes the completeness of filling the volume of a cube, whereas C_F characterizes the degree of filling the area of a square. Thus, the theoretical and actual volumes of a grain are correspondingly equal to: $V_t = d^3$ and $V_a = C_V V_t = C_V d^3$. Since V_a is also equal to b^3 , then $F = b^2 = C_V^{2/3} d^2$ from which $C_F = C_V^{2/3}$. Using this method for boron nitride powders provided the following results:

Granularity	160/125	200/160	250/200	315/250	400/315
Values of C_F	0.40	0.38	0.36	0.35	0.33

References 5: 4 Russian, 1 Western.

STUDY OF THE DEGREE OF REFINEMENT OF CRYSTALS OF HEAT-RESISTANT NICKEL ALLOY

Moscow IZVESTIYA AKADEMII NAUK SSSR, METALLY in Russian No 3, May/June 78 pp 166-170 manuscript received 15 June 77

LYUTTSAU, V. G., KOSTYUKOVA, YE. P., TOLORAIYA, V. N., and KORNILOVA, O. M., Moscow

Abstract A study is made of the orientation agreement between the matrix of the solid solution and eutectic segregations of + ' nickel heat-resistant alloys, and the substructure is studied in various areas of the alloy. Good orientation agreement is found. The alloy produces x-ray pictures characteristic for a well refined single crystal. The branches of the dendrite of the solid solution form the characteristic bloc structure with block dimensions of about 0.1 mm and angles of rotation not over 0.5 . The branches of the dendrite formed ordered formations in the 100 plane. The direction of growth of the dendritic branches coincides with the 100 direction, when the crystal is grown in this direction, or in the 111 direction. Figures 4; references 4: 3 Russian, 1 Western.

USSR

UDC 669.721'884

ON THE POSSIBILITY OF DECREASING OXIDIZIBILITY OF MAGNESIUM-LITHIUM ALLOYS

Moscow TSVETNYYE METALLY in Russian No 5, 1978 pp 72-73

MAKARIN, V. S., SEREBRYANKOV, V. V., BONDAREV, B. I., IVANOV, V. S. and PONOMARENKO, A. M.

/Abstract/ Thermogravimetric studies performed with a spring microbalance showed that at 250-300 C, the interaction of the alloys IMV2 and VMD5 with a gas mixture consisting of argon plus 5% sulphur hexafluoride or 10% freon 12 is satisfactorily described by parabolic equations when the specimens of the alloys are covered with a nonmetallic film of magnesium fluoroide. Figures 1.

USSR

UDC 621.771.23:539.214

ANALYSIS OF FACTORS DETERMINING THE DUCTILITY OF EP220VD ALLOY DURING HOT PLASTIC DEFORMATION

Moscow IZVESTIYA VYSHIKH UCHEBNYKH ZAVEDENIY, CHERNAYA METALLURGIYA in Russian No 5, 1978 pp 77-80 manuscript received 2 Jul 76

DORONIN, I. V., ZAPOROZHTEV, YU. V., ANTIPOV, V. F., and MAKARENKO, V. I., Electrostal' Plant

/Abstract/ A study is made of the reasons for embrittlement and conditions favoring their elimination in the process of hot working of the alloy. EP220VD (0.03% C; 0.10% Si; 0.02% Mn; 0.006% S; 0.008% P; 9.79% Cr; 5.45% W; 5.48% Mo; 0.35% V; 15.35% Co; 2.34% Ti; 4.12% Al; 0.019% B; 0.047% Mg). The temperature interval of greatest ductility (1120-1150 C) corresponds to the area of practically homogeneous solid solution with a slight quantity of excess phases. The main process leading to strain relief and increased ductility during hot mechanical working is the formation of new, easily etched areas (grains or subgrains); this process is developed after 1-time deformation with over 13-15% compression. As a result, if deformation is not over 12% (per operation), partial strain relief occurs due to dynamic recovery. The maximum permissible degree of deformation per operation is 38-42%. Figures 3; references 8: 7 Russian, 1 Western.

USSR

UDC 539.4.0193:669.292

STUDY OF THE INFLUENCE OF TEMPERATURE AND CRYSTALLOGRAPHIC ORIENTATION OF TARGETS ON THE FORMATION OF BLISTERS IN VANADIUM UPON BOMBARDMENT WITH He^+ IONS WITH AN ENERGY OF 10 KeV

Moscow FIZIKI I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May/June 78
pp 9-13 manuscript received 25 Apr 77

GUSEV, V. M., GUSEVA, M. I., ZYKOVA, N. M., KOLTYGIN, V. M., KRASULIN, YU. L.,
KURAKINA, T. S. NEDOSPASOV, A. V., and ROZINA, I. A.

Abstract A study is presented of helium blistering on the surface of a vanadium single crystal with various crystallographic orientations. The dose dependence of blister formations in vanadium upon bombardment with He^+ ions with an energy of 10 KeV is studied. The results of the studies indicate that the basic difference in blister formation on variously oriented targets is manifested as a significant decrease in the dimensions of the blisters, their total area and practically zero erosion at 500°C in the $\{111\}$ plane. This apparently occurs due to the greater difficulty of deformation of this plane than the $\{100\}$ and $\{110\}$ planes of vanadium single crystals. Figures 5; references 8: 2 Russian, 6 Western.

USSR

UDC 535.211

THE EFFECT OF LASER RADIATION ON A MOVING TARGET IN AN ATMOSPHERE OF GASES AT HIGH PRESSURES

Moscow FIZIKI I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May/June 78
pp 23-27 manuscript received 22 Jul 77

UGLOV, A. A. , and GALIYEV, A. L., Moscow

Abstract An experimental study is presented of the effect of a pulsed neodymium laser on a moving metal target with ambient gas pressure (nitrogen, argon, helium) from 1 to 90 atm. The target was a rotating disk of stainless steel 1.5 mm thick and 68 mm in diameter. The target's speed of rotation was controlled by an electric motor and measured by a special instrument designed for the purpose. At pressures of over 60 atm with $q > 3.10^6 \text{ W/cm}^2$, the nature of development of the plasma near the surface of the target was found to be independent of the speed of rotation in the range of 10 to 30 m/s. The plasma is ignited in 5-10 μsec and fully shields the laser radiation. The radiation of the plasma does not cause significant structural changes in the surface of the target; the structure is determined only by the values of q , v and p . The microhardness of the steel is primarily increased by the plasma (in nitrogen) with the metal in the liquid phase. Figures 3; references 5: all Russian.

USSR

UDC 621.039.61

LIMITATION OF CURRENT IN A LOW-PRESSURE DISCHARGE WITH A HOLLOW CATHODE

Moscow FIZIKI I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May/June 78
pp 37-41 manuscript received 14 Mar 77

RYKALIN, N. N., NIKOLAYEV, A. V., and BORZHOV, A. P., Moscow

Abstract Results are presented from an experimental study of the critical discharge current in a low-pressure discharge with a hollow cathode as a function of the flow rate and nature of the plasma-forming gas for various cathode diameters. Experiments were performed on an installation consisting of a cathode with a hollow tungsten electrode and water-cooled copper anode in a sealed chamber. It is found that a given flow rate of plasma-forming gas and inside diameter of hollow tungsten cathode correspond to a critical current at which the discharge is damped. When the flow rate of gas is increased, the diameter of the cathode is decreased and the cross section of ionization of the plasma-forming gas increases, the critical current increases. Figures 2; references 15: 11 Russian, 4 Western.

USSR

UDC 535.211

ON THE DESTRUCTION OF A TARGET WITH INCLINED INCIDENCE OF LASER RADIATION ON ITS SURFACE

Moscow FIZIKI I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May/June 78
pp 159 manuscript received 3 May 77

OREKHOV, M. V., UGLOV, A. A., and SOKOLOVA, T. N., Moscow

Abstract A series of experiments was used to determine the loss of mass by a target struck by a laser beam at angles of 0-60°. The laser pulse length was μsec ; energy of the focused beam 10J. For all of the specimens, the mass of material lost with angles of incidence of 30-50° was 1.5-2 or more times greater than the mass lost with normal incidence. The maximum on the graph varies as a function of the type of surface over a broader range of angles. Specimens with machined surfaces show the highest angles of maximum mass loss. References 2: both Russian.

USSR

UDC 539.376:537.533.9

INFLUENCE OF ELECTRON BOMBARDMENT ON THE CREEP AND DISTRIBUTION OF
DISLOCATIONS IN ALUMINUM

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May/June 78
pp 3-8 manuscript received 10 Aug 77

IVANOV, L. I., LAZORENKO, V. M., and MARTISHIN, O. V., Moscow

Abstract A study was made of the influence of deformation and electron bombardment on the structure of technically pure aluminum in creep tests using the method of extension under constant load. It was found that electron bombardment causes the formation of accumulations of radiation defects and the formation of a cellular dislocation structure, which is discussed in this article. The distribution of the distances between dislocations in accumulations is statistically analyzed during the unstable and stable stages of creep. The electron bombardment, with an energy of 2.3 MeV, decreased the creep rate in a dose-dependent manner. Doses of $4 \cdot 10^{16} \text{cm}^{-2}$ or less had no significant influence, a dose of $1 \cdot 10^{17} \text{cm}^{-2}$ approximately doubled the dislocation density in accumulations, and doses of over $1.2 \cdot 10^{17} \text{cm}^{-2}$ accelerated the process of formation of the polygonal structure characteristic for the stable stage of creep. Figures 2; references 16: 7 Russian, 9 Western.

USSR

UDC 669.2

THE EQUILIBRIUM COMPOSITION OF THE OXIDE FILM FORMED UPON ATOMIZATION AND
HEAT TREATMENT OF Ni-Cr-B-Si ALLOYS

Ordzhonikidze IZVESTIYA VYSHIKH UCHEBNYKH ZAVEDENIY, TSVETNAYA METALLURGIYA
in Russian No 3, 1978 pp 89-92 manuscript received 10 May 77

GERSHENZON, S. M., and BORONENKOV, V. N.

Abstract An attempt is made at thermodynamic estimation of the equilibrium composition of slag in contact with an Ni-Cr-B-Si alloy. This calculation is necessary to refine the mechanism of self-fluxing and interpret the experimental data on loss of elements during smelting, since the accuracy of chemical analysis of boron and silicon in these alloys is not high. A qualitative test of the calculations is performed by infrared analysis of the oxide film produced by holding of the alloy in air at 1400°K for 30-60 sec. Chemical analysis indicated that the content of B_2O_3 in the film is 50%, which is close to the calculated value. References 11: 10 Russian, 1 Western.

USSR

UDC 669.017

INFLUENCE OF INITIAL STRUCTURAL STATE ON APPEARANCE OF THE EFFECT OF SUPER-PLASTICITY IN AN ALLOY OF Zn WITH 22% Al

Ordzhonikidze IZVESTIYA VYSHIKH UCHEBNYKH ZAVEDENIY, TSVETNAYA METALLURGIYA in Russian No 3, 1978 pp 124-129 manuscript received 3 May 76

KAYBYSHEV, O. A., KAZACHKOV, I. V., and SALIKHOV, S. YA., Ufa Aviation Institute

Abstract A study is presented of the influence of texture and structural heterogeneity on the effect of superplasticity in Zn+22% Al. The studies were performed using flat specimens with a gage section measuring 18 x 4 x 0.5 mm for determination of relative elongation and 28 x 7.5 x 0.5 mm in other tensile tests. The crystallographic texture is found to have a significant influence on superplasticity in the fine-grained alloy; structural heterogeneity influences the flow stress in the initial stages of deformation and relative elongation, but has practically no influence on the variation of these mechanical characteristics with deformation rate. Creation of a favorable crystallographic texture in the alloy with identical microstructure can change the optimal speed interval of superplasticity in the direction of increased deformation speeds and may significantly expand the temperature range of superplastic deformation. Figures 4; references 6: 4 Russian, 2 Western.

USSR

UDC 669.018.58:669.85/86

INFLUENCE OF REM ON THE MAGNETIC PROPERTIES, STRUCTURE AND PHASE TRANSFORMATIONS OF THE ALLOY TICONAL

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 8, 1978 pp 56-58

BEZUGLOV, A. A. and FROLOV, M. M.

Abstract A study was made of the influence of the addition of cerium and lanthanum on the magnetic properties, structure and nature of high temperature $\alpha \rightarrow \alpha + \gamma$ and $\alpha \rightarrow \alpha' + \alpha$ transformations in an alloy containing 35% Co, 15% Ni, 8% Al, 4% Cu, 5% Ti, 0.2% S, remainder Fe. The addition of 0.01-0.5% cerium and 0.1-0.5% lanthanum was found to increase the maximum magnetic energy of the alloy from 17 to 21.35 and 20 kJ/m³, respectively, by increasing residual induction, coercive force and the convexity of the demagnetization curve. The REM, in optimal quantities, improve the fine structure of the alloy: they increase anisotropy and packing density of the segregated ferromagnetic α' particles. They increase the resistance of the α -solid solution to high-temperature decomposition and slow high-coercivity transformations. Figures 5; references 6: all Russian.

USSR

UDC 621.923.4:669.14

HARDENING OF STEEL BY DIAMOND WORKING

Kiev SINTETICHESKIYE ALMAZY in Russian No 3, 1977 pp 10-12

DELEVI, V. G. and TKACHENKO, R. K., Institute of Superhard Materials,
Academy of Sciences, Ukrainian SSR

Abstract A study was made of the change in the structure of the surface layer and in the fatigue strength of steel as a function of type of surface working. Specimens for the experiment were made of type 20KhN3A steel, carburized and hardened by heat treatment to HRC 58-60, plus 2Kh13 stainless steel, hardened to HRC 35. The specimens were then treated with a diamond disk, diamond belt, synthetic corundum disk, roller, and hard-alloy tools. The experiments showed that polishing with the diamond belt increased fatigue strength of the specimens in comparison to grinding with a diamond tool or synthetic corundum tool. Disk grinding occurs under more severe conditions than belt grinding, so that the contact temperature in the cutting zone becomes high enough to cause some tempering of the surface layer of the steel as well as partial breakdown of the residual austenite; the overall result is a decrease in fatigue strength. The picture is different for stainless steel. The surface layer is more highly hardened by grinding than by roller treatment, but the fatigue strength is significantly higher following roller treatment, apparently due to the depth to which strain-hardening extends. Figures 2.

USSR

UDC 535.211

CONCERNING THE INFLUENCE OF THE TEMPERATURE OF A METAL TARGET ON THE LASER EROSION OF METALS AND ALLOYS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul/Aug 78
pp 9-13 manuscript received 27 Apr 77

BURAVLEV, YU. M., VOLOSHINA, YE. A., KOVALENKO, YU. I. and NADEZHDA, B. P.,
Donetsk

Abstract High temperature experiments are conducted in an installation with a microfurnace allowing heating to 900°C and higher. Experiments are conducted in argon, with a laser pulse entering through a thick quartz glass window. In experiments with cooling, the specimen was mounted on a massive copper cylinder, a part of which was immersed in liquid nitrogen in a vessel with insulated walls. The temperature of the specimen was regulated by varying the level of liquid nitrogen. It is found that laser

erosion increases with increasing temperature, then decreases sharply as the melting point is reached. Structural changes of the metal in the zone of application of the laser pulse depend on the initial structure of the alloy and its temperature. The reason for this effect is apparently the change in the speed with which heat is liberated from the surface layers of the laser-formed crater. Figures 3; references 8: 7 Russian, 1 Western.

USSR

UDC 539.23

CHANGE IN MICROHARDNESS OF STEEL IN AN ATMOSPHERE OF INERT GASES UPON LASER IRRADIATION

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul/Aug 78
pp 18-23 manuscript received 9 Jan 78

UGLOV, A. A., GNEDOVETS, A. G. and GALIYEV, A. L., Moscow

Abstract Results are presented from an experimental study of the effect of a pulsed neodymium laser with a wavelength of 1.06 μm on type 1Kh18N9T stainless steel in an atmosphere of helium or argon over a broad range of pressures from 1 to 90 atm. The microhardness of the material is found to change in zones melted at high pressures. The change in microhardness depends on the pressure of the inert gases, the characteristics of the plasma cloud and the energy of the laser radiation. The change in microhardness of the steel results from gas absorption in the bath of melted metal. Figures 4; references 5: all Russian.

USSR

UDC 535.211

CUTTING OF GLASS BY CONCENTRATED ENERGY SOURCES

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul/Aug 78
pp 30-36 manuscript received 28 Nov 77

VURZEL', F. B. and NAZAROV, V. F., Moscow

Abstract An analysis is presented of the probable mechanisms of the process of cutting of glass by concentrated sources of energy. A study is made of the cutting of glass preheated to a temperature higher than its brittleness temperature, since this is the only case in which good reproducibility of results and satisfactory cutting quality can be achieved. It is shown that,

depending on the specific heat flux, the chemical composition of the glass and its thickness, the significance of individual channels in the mechanism of the process changes. A mathematical model is developed, in which the process of cutting of glass is described by a heat conductivity equation, the movement of the melted layer and the chemical kinetics. As energy increases in the plasma jet used to cut the glass, the significance of sublimation in the removal of the glass increases until it eventually becomes the primary method of removal of glass from the cutting zone. The threshold at which this occurs is lower for quartz glass than for window glass. Figures 3; references 7: 4 Russian, 3 Western.

USSR

UDC 669.14:621.030.61

COMBINED INFLUENCE OF CARBON AND OXYGEN ON THE ABSORPTION OF NITROGEN DURING PLASMA MELTING OF STEEL

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul/Aug 78
pp 44-48 manuscript received 11 Oct 77

MOKROV, I. A., STOMAKHIN, A. YA. and GRIGORYAN, V. A., Moscow

Abstract The interaction of iron containing up to 1.09% C with an Ar-N₂ and an Ar-N₂-O₂ plasma is studied. The studies are performed by holding metal beneath a nitrogen-containing plasma, with subsequent hardening. The experiments are conducted in a medium of argon. The addition of carbon to the melt causes a significant decrease in the concentration of nitrogen in the iron. The lack of any significant influence of the oxygen of the plasma on the concentration of nitrogen in the metal results from the fact that the presence of CO in the boundary layer of the plasma, formed as a result of interaction of the carbon and oxygen, can decrease the partial pressure of nitrogen at the boundary with the metal, and also help to accelerate the relaxation processes in the boundary layer of the gas. Figures 5; references 6: all Russian.

PHYSICAL-CHEMICAL PROPERTIES OF TiN-VN ALLOYS SYNTHESIZED IN A LOW-TEMPERATURE PLASMA

Moscow FIZIKA I KIMIYA OBRABOTKI MATERIALOV in Russian No 4, Jul/Aug 78
pp 55-57 manuscript received 16 Dec 76

TROITSKIY, V. N. and GREBTSOV, B. M., Moscow

Abstract A study is made of the possibility of producing a continuous series of cation-substituted solid solutions in the quasi-binary cross section TiN-VN by combined reduction of $TiCl_4$ and VCl_4 in a nitrogen plasma produced by SHF discharge, and of controlling the composition of the alloy produced by changing the ratio of the masses of the chlorides in the initial mixture. Solid solutions are produced with the general formula Ti_xV_yN (where $x + y = 1$). The solid solutions produced are finely dispersed powders with mean particle diameter 400 A. Changing the composition of the titanium-vanadium nitrides by changing the mass of the titanium and vanadium chlorides can control the temperature coefficient of resistivity. Figures 2; references 8: 5 Russian, 3 Western.

CSO: 1842

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