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USSR Report

MATERIALS SCIENCE AND METALLURGY

No. 82

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USSR REPORT

MATERIALS SCIENCE AND METALLURGY

No. 82

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WELDING

UDC: 669.762:669.715

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GROMOV, B. A., MATVEYEV, B. I. and ZAGORODNEVA, V. F.

[Abstract] Results are presented from studies of the properties of certain heat resistant aluminum alloys obtained by powder metallurgy methods having high corrosion resistance in water at 250-300°C. An aluminum alloy with nickel, iron and titanium prepared by sintering aluminum powder with an oxide phase has good heat resistance, corrosion resistance and long term strength. The use of alloys with five and seven percent oxide phase in nuclear power plants may yield significant economic effects. References 8: 3 Russian, 5 Western.
[109-6508]

UDC: 621.762:669.715

POWDERED ALUMINUM ALLOYS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 3, Mar 82 pp 45-48

MATVEYEV, B. I. and BARANCHIKOV, V. M.

[Abstract] Powdered aluminum alloys are subdivided into two groups: dispersion hardened deformable aluminum alloys obtained from atomized powder by cold compacting with subsequent hot deformation, and sintered aluminum alloys allowing finished parts to be produced directly from powder by liquid phase sintering. These two types of alloys are briefly described and photomicrographs of structures obtained are presented. It is concluded that powdered aluminum deformable and sintered alloys have good properties which cannot be obtained by alloys produced by traditional smelting methods. Figures 3; references 4: 3 Russian, 1 Western.
[109-6508]

UDC: 669.716:621.745.55

IMPROVEMENT OF VACUUM REFINING OF ALUMINUM ALLOYS

Moscow TSVETNYYE METALLY in Russian No 2, Feb 82 pp 79-81

KHABROV, M. F.

[Abstract] A new vacuum distillation furnace, the model IAKD-6, has been produced for vacuum refining of aluminum scrap to remove zinc and magnesium and allow the material to be reused for the production of high quality casting alloys. The capacity is 6-6.5 t as aluminum, the evaporation chamber consisting of a welded cover with a lining of asbestos, light weight chamotte and an inner layer of chamotte. The volume of the evaporation chamber is 5.6 m^3, inside diameter 1500 mm, length 3200 mm. The power consumption of the furnace is 800 kW, voltage variable between 86 and 518 V, current up to 1510 A. It was found that the evaportaion chamber has dead zones at the junction between the cylindrical surface and the end wall, where the melt never reaches even at maximum power. The stagnant zone in the melt was eliminated by changing the configuration of the side wall lining. Further improvement of the design is planned by equipping the installation with an automatic temperature control system, using electromagnetic stirring in the evaporation chamber and continuing research on the selection of a lining composition. Figures 3; references: all Russian.
[103-6508]

UDC: 669.715

HYDROGEN PERMEABILITY AND COEFFICIENT OF DIFFUSION OF HYDROGEN IN LIQUID ALLOYS OF Al-Zn SYSTEM

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 2, Mar-Apr 82 (manuscript received 9 Jan 80) pp 98-101

MOGILATENKO, V. G., CHERNEGA, D. F. and VASHCHENKO, K. I., Department of Physical and Chemical Principles of Metal Technology, Kiev Polytechnical Institute

[Abstract] The diffusion mobility of hydrogen in melts is a property which indicates the presence of interatomic interactions. The authors attempted to study changes in the structure of melts in binary Al-Zn systems in correspondence with changes in the hydrogen diffusion coefficient. This coefficient was determined from the change in rate of penetration of hydrogen through a layer of liquid metal. The coefficient decreased with increasing zinc content up to approximately 18 at. % at 973-1113 K. At above 1113°K the coefficient practically did not change. Calculation of the cluster index showed that the shape of the curve of hydrogen diffusion coefficient at 40-50 at. % zinc agrees rather well with 3 (Zn_3Al). In zinc-rich alloys

a second minimum of diffusion mobility is observed. The experimental and calculated data thus indicate that the structure of liquid Al-Zn alloys is complex. Figures 2; references 11: 10 Russian, 1 Western.
[119-6508]

UDC: 669.017

INFLUENCE OF HIGH TEMPERATURE THERMOMECHANICAL TREATMENT ON PROPERTIES OF V93 ALUMINUM ALLOY

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 2, Mar-Apr 82 (manuscript received 17 Mar 81) pp 102-105

KAREVA, N. T., RABINOVICH, M. Kh., SMIRNOV, M. A., DOBROLYUBOV, V. I. and KORYAGIN, Yu. D., Chelyabinsk Polytechnical Institute; Ufa Aviation Institute

[Abstract] An estimate is presented of the influence of such factors as initial structure of deformed alloy, temperature and method of deformation on the properties after high temperature thermomechanical working of V93 alloy, one of the strongest aluminum alloys used for closed impression die forging. Similar results were achieved with both rolling and stamping as the final method of deformation. Preliminary working of V93 alloy, producing a polygonal subgrain structure, has little influence on the nature of strength and ductility of the alloy after high temperature thermomechanical treatment. High temperature thermomechanical treatment produces higher structural strength in comparison with ordinary hardening regardless of preliminary deformation. Figures 2.
[119-6508]

UDC: 620.18:621.785.78:669.715

STRUCTURE AND NATURE OF FRACTURE OF V95 ALLOY SHEETS AS FUNCTIONS OF IMPURITIES AND AGING CONDITIONS

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 3, Mar 82 pp 30-33

SENATOROVA, O. G., ZHEGINA, I. P. and RYAZANOVA, N. A.

[Abstract] A study is made of changes in the structure and properties of sheets of V95 alloy. Iron and silicon impurities during crystallization cause the formation of large particles of insoluble iron and silicon containing phases which are stretched upon deformation, causing a row-like structure. As the impurity content increases, the volumetric fraction of insoluble phases and their negative influence on the property of sheets

also increase. Decreased content of impurities results in increased local ductility. Fractographic analysis of sheet specimens with cracks after impact testing has shown that increased impurity results in increased strength due to decreased fraction of brittle fracture between grains. After aging of sheets at 115°C for five hours plus 165°C for sixteen hours, the strength loss is about 40MPa, while after single stage aging at 165°C for sixteen hours it is about 70MPa. Limiting the content of iron and silicon containing excess phases in aluminum alloys such as V95 and the favorable influence of the structure obtained by decomposition of the solid solution in two-stage coagulation aging provides the optimal combination of properties of sheets of such alloys. Figures 5; references 10: 9 Russian, 1 Western.
[109-6508]

UDC: 669.715-417

STRUCTURE, NATURE OF FRACTURE AND PROPERTIES OF V95 ALLOY SHEETS AS FUNCTIONS OF IMPURITY CONTENT

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 18, No 1, Jan-Feb 82 (manuscript received 9 Jan 81) pp 3-10

FRIDLYANDER, I. N., SENATOROVA, O. G., ZHEGINA, I. P. and NOVOSIL'TSEVA, N. I.

[Abstract] V95 aluminum alloy was used in a study of the influence of iron and silicon impurity content on the structure, fracture characteristics and properties of hot rolled sheets, cold rolled sheets and hot rolled sheets with a cold starting strip. Iron and silicon impurities, leading to the formation of the insoluble particles which have sizes of up to 20-30 μm and occupy up to 6% of the volume of the metal, cause deterioration in ductility and static and cyclical crack stability of the alloy. The results show that limiting the content of iron to less than 0.15% and silicon to less than 0.1%, causing a reduction in the volumetric content of large intermetallic excess phases to 1.0-1.2% and increasing the capability of the matrix for local plastic deformation, is an effective means for increasing ductility and crack resistance of sheets of this alloy without decreasing strength. Figures 6; references 20: 14 Russian, 6 Western.
[113-6508]

UDC: 669.715

NEW HIGH STRENGTH V95och ALUMINUM ALLOY

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian
No 3, Mar 82 pp 20-24

FRIDLYANDER, I. N., GORNOVA, T. I., KHOL'NOVA, V. I. and SAVINOVA, T. B.

[Abstract] A new modification of V95 alloy, the high purity alloy V95och, has been developed for use in the forged state. The reduction in iron and silicon impurities is intended to increase toughness and ductility. The iron content is limited to 0.15%, the silicon content to 0.1%. The remaining composition of the alloy is Zn 6.0, Mg 2.2, Cu 1.5, Mn 0.31, Cr 0.12%. Results are presented from studies of experimental production of forgings of the new alloy. The strength and yield point were found to be about the same as the previous alloy, tensile strength and yield point are the same, relative elongation at least 7% (as opposed to 2%), fracture toughness at least 43MPa.$M^{1/2}$ in the longitudinal direction, 33MPa.$M^{1/2}$ in the transverse direction, 27MPa.$M^{1/2}$ in the direction of height, with good corrosion resistance and low-cycle endurance. The alloy is recommended for production of forged semifinished goods with cross sections up to 200 mm for the manufacture of aircraft parts requiring increased fracture toughness and ductility. Figures 2; references 3: all Russian.
[109-6508]

UDC: 669.725:619-172:537.311.31

RESISTIVITY OF BERYLLIUM SINGLE CRYSTALS IN BASE PLANE

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 53, No 2, Feb 82 (manuscript received 22 Sep 80; in final form 9 Dec 80) pp 277-280

PLETENETSKIY, G. Ye., TIKHINSKIY, G. F. and PAPIROV, I. I., Khar'kov Physico-Technical Institute, Ukrainian Academy of Sciences

[Abstract] Testing of single crystals of beryllium has shown that the variation in measured values of relative resistivity $\delta_t = R_t/R_{293}$ along the base plane in the same crystal is sometimes 5-8% at 77°K, significantly greater than the measurement error. This article studies the reason for this variation. The studies were performed on a beryllium single crystal obtained from triple distilled metal with the chemical composition: Al = 0.0006, Fe = 0.0037, Mn = 0.0007, Mg = 0.0006, Ni = 0.0014, Cr = 0.001, Cu = 0.0004, Mo = 0.0015, Co no detected. The crystal, 33 mm long and 20 mm in diameter, was cut on an electric spark machine into two approximately equal parts, one used for study of conductivity in the base plane, the other for manufacture of wire. The results show that the relative resistance is maximum in the $\langle 10\bar{1}0\rangle$ plane, minimal at 5 to 10° from this plane. Relative resistance increases with increasing angle from this plane and passes through a second maximum in the $\langle 11\bar{2}0\rangle$ direction. The anisotropy has a periodicity of 60°. Anisotropy disappears after homogenization and reappears after aging of homogenized specimens, indicating that the most probable cause is some regularity in the location of impurity (segregation) atoms in the beryllium lattice during growth and aging of single crystals. Figures 1; references 12: 5 Russian, 7 Western.
[114-6508]

UDC: 669.24:539.216.2:539.217.1

INFLUENCE OF ISOTHERMAL AND THERMAL CYCLING TREATMENT ON POROSITY AND INTERNAL STRESSES IN NICKEL FILMS AND COATINGS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 53, No 1, Jan 82 (manuscript received 20 May 80, in final form 20 Oct 80) pp 52-59

FUKS, M. Ya., CHEREMSKOY, P. G., BELOZEROV, V. V., CHUVURINA, S. N. and ROSHCHENKO, S. T., Khar'kov Polytechnical Institute imeni V. I. Lenin

[Abstract] This work, a continuation of an earlier study, studies the influence of thermal cycling and isothermal heating to about 3/10 of the melting point on the porosity of nickel films which do not have crystallographic anisotropy of thermal properties, and also determines the significance of internal macrostresses on porosity characteristics. Nickel films ~8 μm thick were produced by thermal evaporation of 99.98% Ni and condensation at ~30 A/s onto flat massive aluminum substrates at 250 and 400°C in a vacuum of ~10^{-5} Pa. The primary method of investigation was low-angle scattering of x-rays. In the initial state the low-temperature films have significantly higher volumetric concentration of submicropores. The hydrostatic density of the films is lower than the calculated density, apparently due primarily to larger pores of significantly greater thermal stability than the submicropores. Thermal cycling and continuous heating both reduce the number of submicropores. Isothermal heating causes more enlargement and spheroidization of submicropores by coalescence than do 10 cycles of thermal cycling. In the higher temperature films even with 1000 cycles no significant changes in hydrostatic density or concentration of larger submicropores is observed, a result of the influence of macrostresses in the film-substrate system. Nickel coatings do not experience thermal fatigue even when precipitated on a material with significantly different coefficient of thermal expansion. In addition, such coatings manifest stable magnetic characteristics and do not fracture under long term thermal cycling conditions. Figures 2; references 11: all Russian.
[101-6508]

UDC: 669-419.4:669.71'691.87

INFLUENCE OF PROTECTIVE COATINGS ON FIBERS ON PHYSICAL AND MECHANICAL INTERACTION OF COMPONENTS IN REINFORCED ALUMINUM-STEEL SYSTEM

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 18, No 1, Jan-Feb 82 (manuscript received 3 Mar 80) pp 69-72

MAKSIMOVICH, G. G., FILIPOVSKIY, A. V., LYUTYY, Ye. M. and AVERBUKH, L. M., Institute of Physics and Mechanics imeni G. V. Karpenko, Ukrainian Academy of Sciences, L'vov

[Abstract] A study is made of the influence of saturation of the surface of steel fibers with silicon, as well as protective coatings of titanium nitride, on the interphase interaction in a reinforced aluminum plus steel system. Silicon was selected because the speed of interaction at the phase division boundary in an aluminum-steel system can be significantly reduced by the introduction of silicon. Titanium nitride was selected because of its stability and chemical inertness with respect to the components of the composite at high temperatures, as well as the technological ease of the formation of the coating. Studies were performed on model composite materials with a matrix of high purity aluminum and unidirectional continuous 12Kh18N10T steel reinforcing wires 1 mm in diameter and 100 μm in diameter (for the silicide and TiN coatings, respectively). Siliciding was performed in a powder mixture of ferrosilicon, aluminum oxide and ammonium chloride 850°C, 45 minutes. Titanium nitride coatings were produced by vapor-gas deposition. Both treatments significantly increased the safe operating time of the composite materials at elevated temperatures or increased the temperature limit of usage. Figures 2; references 9: 8 Russian, 1 Western. [113-6508]

UDC: 539.43:678.067

ESTIMATION OF FATIGUE STRENGTH ANISOTROPY IN COMPOSITE MATERIALS

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 82
(manuscript received 1 Jul 81) pp 57-61

OLDYREV, P. P., Institute of Polymer Mechanics, Latvian Academy of Sciences, Riga

[Abstract] The results of testing of three types of reinforced plastics are used to test for a correlation between the endurance limit and three statistical characteristics - the short-term strength limit, proportionality limit and elasticity modulus. Specimens were cut at three angles to the main reinforcement axis. Composites with different types of reinforcement and composition of binder were studied. Static testing and fatigue testing were conducted and the results analyzed. The traditional estimate of endurance limit is not suitable for individual composites due to the anisotropy of their strength. The values of endurance limit and proportionality limit which yield the best correlation were used to determine the correlation equation for all glass-reinforced plastic and directions of cutting of specimens. With a base of 10^6 cycles this variation is described by the linear equation $\sigma_{-1}=1.1+0.53\sigma^*$ with an empirical correlation factor $r=0.998$ where σ^* is between 17.5 and 200 MPa. The close location of the experimental points to a single line for axial loading and pure flexure indicates the similarity of these deformations, as well as the similarity of experimental conditions. Figures 1; references 15: 14 Russian, 1 Western.
[102-6508]

UDC: 539.4:678.067

FRACTURE OF UNIDIRECTIONAL CARBON-REINFORCED PLASTICS AND REALIZATION OF STRENGTH PROPERTIES OF FIBERS THEY CONTAIN

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 1, Jan-Feb 82 (manuscript received 7 J11 81) pp 34-41

TAMUZH, V. P., AZAROVA, M. T., BONDARENKO, V. M., GUTANS, Yu. A., KORABEL'NIKOV, Yu. G., PIKSHE, P. E. and SILUYANOV, O. F., Institute of Polymer Mechanics, Latvian Academy of Sciences, Riga; "Khimvolokno" Scientific-Production Union, Mytishchi

[Abstract] A study is presented of the realization of the properties of three types of carbon fibers manufactured by the same technology but differing in conditions of formation of the initial fiber and thus having different tensile strengths and strength variation coefficients with approximately identical elasticity moduli in a unidirectional carbon-reinforced plastic. The study also determined that the fracture of a unidirectional carbon-reinforced plastic with a high degree of filling in tension or flexure results from a process of gradual accumulation of fiber failures rather than growth of one or a few large cracks. The strength of the fibers of various lengths can be satisfactorily approximated by a Weibull distribution with some polymodality. The strength of the composite is determined by the fiber strength distribution quantile extrapolated to the effective length. The distribution of fiber sections in a fractured composite has a maximum at an effective length with recovery factor of 0.96 to 0.98. Figures 7; references 15: 7 Russian, 8 Western.
[102-6508]

UDC: 669-494:539.219

DIFFUSION INTERACTION IN FIBER COMPOSITE MATERIALS BASED ON TITANIUM ALLOYS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 82 (manuscript received 20 Mar 81) pp 111-115

SHORSHOROV, M. Kh., MESHCHERYAKOV, V. N., ZHAMNOVA, V. I., BAKARINOVA, V. I. and POPOV, I. A., Moscow

[Abstract] A study of the interaction between the titanium matrix and strengthening fibers consisting of borsik [boron coated with silicon carbide] and silicon carbide shows that the diffusion zone formed at the fiber-matrix boundary is controlled by the alloying elements in the matrix and fiber as well as the temperature-time conditions of preparation of the composite material and subsequent heat treatment. The possibility is demonstrated of producing these materials in a manner which provides the minimum interaction at the fiber-matrix boundary. The composites in question have good thermal stability and, when the degree of interaction is controlled, can be manufactured with their design properties. The use of metal fibers made of

tungsten alloys with various contents of rhenium is also an interesting possibility. Local x-ray spectral analysis on a scanning electron microscope combined with a spectrometer was used to study the distribution of alloying elements in the diffusion zone of a composite material reinforced with VAR5 and VAR27VP wires and annealed at 1200°C for 100 hours. It was found that titanium was present in the diffusion layer, distributed nonuniformly through the width of the zone. This indicates that titanium diffuses into the wire without changing the initial diameter of the wire and that there are thus two zones in the layer formed, an outer zone adjacent to the matrix and an inner zone adjacent to the wire. The inner zone is a single phase solid solution of tungsten, titanium and rhenium, while the outer zone also contains niobium and is a solid solution with segregation of a second phase. The two phase zone at the periphery of the wire and in the adjacent solid solution has little influence on the properties of the composites in question, in contrast to composites reinforced with ceramic fibers, which require more careful monitoring of the degree of interaction at this boundary. The results indicate the promise of further studies of fiber composites based on titanium alloys reinforced with metal wires and ceramic fibers. Figures 3; references 4: 2 Russian, 2 Western.
[104-6508]

UDC: 669.494

SIGNIFICANCE OF MATRIX IN DEVELOPMENT OF FRACTURE PROCESS IN POLYMER FIBER COMPOSITES

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 82 (manuscript received 19 Sep 79) pp 103-110

ORLOV, L. G., LEKSOVSKIY, A. M. and REGEL', V. R., Leningrad

[Abstract] A study is presented of the significance of the matrix in determining the true distribution of stresses on individual fibers in a composite specimen under load and development of the process of accumulation of elementary fractures in a composite from the moment the load is applied to the moment of failure of the specimen. The model objects used were composites in which the fibers consisted of parallel highly oriented amorphous-crystalline polycaproamide and polypropylene fibers, while the matrix was polyvinylbuteral-phenyl resin (BF-6 glue) or polyoxyethylene, with a volumetric content of matrix of ~30%, its strength approximately 150th the strength of the fibers. The matrix is found to distribute stresses among fibers, changing the stress state and properties of the surface layers of the fibers, protecting them from the harmful influence of the environment and from mutual friction with each other. Delamination thus deprives the fiber of all of the useful effects of the matrix. Figures 5; references 22: 21 Russian, 1 Western.
[104-6508]

UDC: 669-494:539.319

RESIDUAL DEFORMATION OF UNIDIRECTIONAL FIBER COMPOSITES IN PROCESS OF THERMAL CYCLING

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 82 (manuscript received 24 Mar 80) pp 97-102

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

[Abstract] A survey of the previous literature leads to the conclusion that the stability of composites is determined by the interaction of a large number of rather complex processes which have not yet been fully studied. This article presents the results of calculation of deformations in unidirectional fiber composites upon thermal cycling based on theoretical analysis previously performed by the same authors. The calculations were performed for two composites: copper-tungsten and thermally stable Zh20N80 nickel alloy-tungsten. The residual deformation of the composites is found to be influenced by maximum temperature and amplitude of cycling, volumetric fraction of fibers, difference in elasticity moduli of fiber and matrix, thermal stability of matrix and the rate of temperature change. Composites with cyclically isotropic matrix plus tungsten should simply elongate upon cycling if the cooling rate is not much greater than the heating rate. Regardless of initial heating and plastic deformation, in the first few cycles a stress field is set up in the composite which remains constant over a large number of cycles. The stability of composites based on thermally stable matrix metals can be improved by selecting an alloy with a low yield point which changes little over the range of temperatures through which thermal cycling occurs. Figures 5; references 10: 3 Russian, 7 Western. [104-6508]

UDC: 669.018.95:621.8

STUDY OF FRICTION PROPERTIES OF CERTAIN METAL-POLYMER COMPOSITES WITH SELF-LUBRICATION

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 18, No 1, Jan-Feb 82 (manuscript received 19 Jan 81) pp 105-106

KARPINOS, D. M., TUCHINSKIY, L. I., VISHNYAKOV, L. R., STUPKO, A. V. and ASKOCHENSKIY, Yu. B., Institute of Material Science Problems, Ukrainian Academy of Sciences, Kiev

[Abstract] Three types of binder were studied: epoxy phthalate, phenol-formaldehyde and phenol-furfural resins. Fillers used were aluminum powder, colloidal graphite and thermoplastic polymers - polyamide, polyformaldehyde, polyethylene and polytrifluorochloroethylene. Composite materials were prepared by hot pressing of the filled thermosetting binder. It was

found that the pressing temperature must exceed the melting point of the thermoplastic filler by 25-30°K to produce a good bond. Friction properties were studied by rubbing two circles in couple with aluminum alloy V95 at 1-5 m/sec, and a pressure of 0.1-0.5 MPa in the self-lubricating mode. The use of phenol-furfural resin was found to be most effective. Wearing in and self-lubiication were clearly manifested. The best of the fillers was polytrifluorochloroethylene. Composite materials made of the phenol-furfural oligomer filled with aluminum powder, colloidal graphite and polytrifluorochloroethylene have a combination of properties, including wear resistance, stability of coefficient of friction, lubricant effect and short wearing-in time, allowing them to be recommended for work in friction couples with aluminum alloys. Figures 2; references 5: all Russian.
[113-6508]

UDC: 620.193.01

OXIDATION OF TITANIUM ALLOYS IN ATMOSPHERE CONTAINING SO_2

Moscow ZASHCHITA METALLOV in Russian Vol 18, No 2, Mar-Apr 82
(manuscript received 1 Jun 81) pp 248-249

SUNTSOV, N. V., BURAVLEV, Yu. M., MILOSLAVSKIY, A. G., ZHURAVLEV, N. L. and ALEKSEYCHUK, I. S., Donetsk State University

[Abstract] A study was made of the oxidation kinetics of the titanium alloys VT1-0, 3M (4% Al) and VT6-S (6% Al + 4% V) in a mixture of $O_2 + CO_2 + SO_2$. The purpose of the study was to check the effect observed upon oxidation of pure titanium of alteration of the parabolic time constant. The presence of Al_2O_3 granules reduces the oxidation constant of 3M in comparison to VT1-0. Introduction of SO_2 vapor to the $O_2 + CO_2$ atmosphere results in an increase in the oxidation content of all three alloys at oxygen pressure lower than 25kPa, with a constant decrease at greater oxygen partial pressure. Figures 1; references 10: 7 Russian, 3 Western.
[106-6508]

UDC: 620.193.27

CORROSION OF LOW ALLOY CHROMIUM IN SEA WATER

Moscow ZASHCHITA METALLOV in Russian Vol 18, No 2, Mar-Apr 82
(manuscript received 25 Feb 80, after revision 8 Jun 81) pp 251-254

YAGUPOL'SKAYA, L. N., RAKITSKIY, A. N., PORYADCHENKO, N. Ye., PADERNO, V. N., SMIRNOV, V. S. and MARINICH, M. A., Institute of Material Science Problems, Ukrainian Academy of Sciences

[Abstract] A study is presented of the influence of slight quantities of lanthanum and tantalum (up to 0.5%) on the corrosion properties of chromium in sea water. Specimens were prepared from ingots obtained by arc melting with a nonconsumable electrode in an atmosphere of purified argon. Corrosion processes were studied under laboratory conditions in samples of water from

the Black Sea at 20°C. The polarization curves and surface condition of the alloys before and after anodic dissolution were studied using a metallographic microscope, interferometer and scanning electron microscope with an X-ray spectral attachment. It was found that alloying with lanthanum and tantalum produces high corrosion resistance in sea water, with selective dissolution of the phase with lanthanum possible only at high anode potentials. Figures 2; references 8: all Russian.
[106-6508]

UDC: 669.721.017

STABILITY OF STRUCTURAL STATE OF MA21 SUPERLIGHT MAGNESIUM-LITHIUM ALLOY

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 2, Mar-Apr 82 (manuscript received 11 Feb 81) pp 94-97

KORYAGIN, Yu. D. and IL'IN, S. I., Department of Metallography, Chelyabinsk Polytechnical Institute

[Abstract] The alloy studied had the following composition, %: 8.0 Li, 5.24 Al, 1.48 Zn, 0.25 Mn, 4.49 Cd, 0.064 Ce, 0.0038 Na, remainder Mg. The phase composition of the alloy was determined at elevated temperature by diffractometry. The distribution of the alloying elements among the structural components and their quantitative relationships were studied by local x-ray microspectral analysis. Metallographic, dilatometric and calorimetric methods were also used, and resistivity was measured. It was found that after hardening from 380°C and long term natural aging (6 months) or artificial aging at 40 to 120°C for 96 hours, MA21 alloy consists of α and β solutions containing some cadmium and aluminum, with approximately twice as much cadmium in the β phase as in the α phase. The kinetics of the process of dissolution, separation and coagulation of the hardening phases $MgLi_2Al$ and AlLi must be considered, since these phases cause instability of mechanical characteristics as time passes. The alloy must always be heated to at least 350°C before hardening or deformation, and the maximum temperature of subsequent aging or working should not exceed 100°C, with holding times minimized. Figures 2; references 4: all Russian.
[119-6508]

UDC: 669.295:539.4.015

VARIATION OF MECHANICAL PROPERTIES AND THERMAL STABILITY OF TITANIUM PLUS ALUMINUM ALLOYS WITH CONCENTRATION

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 53, No 1, Jan 82 (manuscript received 3 Jul 80, in final form 3 Dec 80) pp 157-163

TEYTEL', Ye. I., POTAPENKO, Yu. I., MAKHNEV, Ye. S., NOTKIN, A. B. and ZVEREVA, Z. F., Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences

[Abstract] A study is presented of the mechanical properties in extension and impact flexure of Ti-Al alloys with variations in the content of aluminum from 0.45 to 19 at.%. Alloys were tested both hardened from the α area and after aging at 500°C, with precise determination of the position of the $\alpha/\alpha+\alpha_2$ phase boundary. The yield point was found to increase linearly in the concentration interval from 0.45 to ~11% Al for hardened specimens, to ~9% for aged specimens. With aluminum content 11-15% this parameter is practically independent of concentration. Tensile strength increases smoothly throughout the entire aluminum concentration interval studied. Elongation and reduction in area of hardened specimens show a minimum at 11-12% Al. In the aged state reduction in area decreases continuously. Impact toughness also decreases continuously with increasing aluminum content except for the 10-13.5% area in which there is a slight maximum for hardened alloys. The curve is virtually flat in this area for specimens aged 1 to 100 hours. The curve for KCT is similar to that for KCU. The increase in strength properties and decrease in ductility and toughness of alloys containing over 9.3 at.% Al result primarily from segregation of the α_2 phase. Impurities apparently cause the thermal instability of alloys with lower aluminum content. Figures 4; references 14: 8 Russian, 6 Western.
[101-6508]

USSR NONFERROUS METALLURGY MINISTER DISCUSSES DEVELOPMENTS

Moscow TEKHNIKA I VOORUZHENIYE in Russian No 12, Dec 81 pp 4-5

/Article by P. Lomako, USSR minister of nonferrous metallurgy: "The Ore Base of Nonferrous Metallurgy"/

> /Text/ "In the nonferrous metallurgy industry provide for the strengthening of the raw-material base of existing enterprises and for its further rapid development." (From the Basic Directions for the Economic and Social Development of the USSR for the Years 1981 through 1985 and for the Period Up to 1990)

Nonferrous, rare and precious metals and their alloys, diamonds, semiconductor, rare metal and hard alloy materials, phosphate fertilizers, cement, sulfuric acid, sodium carbonate, quartz sand, crushed rock - these are some of the products that the USSR Ministry of the Nonferrous Metallurgy provides to the national economy, which is one of the base sectors of industry. This ministry significantly determines the technical progress in aviation and the space program, radioelectronics and electronics, computer equipment, atomic energy and other key areas of the national economy.

Significant successes have been achieved by workers of the sector in the 10th Five-Year Plan. The production of nearly 1,000 kinds of product was assimilated. The Soviet Union's national economy received nonferrous metals and other materials and articles valued at 12.5 billion rubles more than in the 9th Five-Year Plan. Large enterprises were put into operation: the Nadezhdinsky metallurgical plant at the Noril'sk mining and metallurgical combine, the Nikolayevskiy alumina plant and the Tadzhikskiy aluminum plant; and production capacity was expanded at the Dzhezkazganskiy, Balkhashksiy, Leninogorskiy and other combines.

During the 10th Five-Year Plan much was accomplished for the development of the ore base of the sector. New capacities were introduced for the extraction of polymetallic ores at the Zhayremskiy, Novo-Zolotushinskiy, Orlovskiy, and Western Tekeliyskiy deposits of the Kazakh SSR; at the copper and nickel deposits of the Noril'skiy

ore region; at the tin and tungsten deposits of the Far East. Construction was started on mines at several new deposits.

During the past five-year plan the raw-material base of the nonferrous metallurgy industry developed in complicated conditions, which were characterized by a reduction in the content of nonferrous metals in the ores at operating deposits, an increase in the depth of open and underground mining operations, a growth in the amounts of barren rock required to be processed to obtain one ton of ore. However, the total volume of extraction in 1980 reached 2.2 billion tons of rock mass (ores and stripped rock). To provide for the extraction of ore in such amounts in difficult mining and geological conditions, it is necessary to make full use of the newest achievements of scientific-technical progress in the mining business and to extensively adopt powerful mining equipment and highly efficient systems for working the deposits.

In open-pit mining operations to drill blast holes greater use is now being made of cutters with a drill bit diameter of 243 - 320 mm, and quarry excavators with buckets that can hold 8 to 12.5 cubic meters, and dumptrucks with carrying capacities of 40, 75 and 110 tons.

In quarries of the Almalykskiy and Tyrnyauzkiy mining and metallurgical combines, as well as the associations Pechenganikel' and Yakutalmaz, the single-bucket giant excavators, the EKG-12.5, with a working weight of 650 tons and a bucket that can hold 12.5 cubic meters, are being successfully used. Their operating productivity on blasted hard rocks is 2 to 2.5 million cubic meters per year.

The large alluvial deposits of heavy minerals, which contain the rare metals, are being worked by sets of continuous operating equipment. They consist of rotor excavators, reloaders and swing chutes. The productivity of a rotor excavator exceeds 10 million cubic meters of rock mass per year.

In 1980 the most productive open-pit method accounted for 65.7 percent of all nonferrous metal ore. The method of working provides the highest technical-economic indicators as compared with the underground: the extraction of one ton of ore costs from 2 to 4-fold less and the labor productivity of the miners is from 5 to 8-fold greater. It is for this reason that the open-pit method of mining is preferred, although the subsequent result of pushing aside the barren rock and the space required for the work do increase the cost of extracting the ore. For example, to fill in the pit after it has been depleted of ore requires the expenditure of tens of millions of rubles; this is true for even a comparatively small quarry with a depth of approximately 100 meters and a diameter of the day surface of 500 to 600 meters. Neither in the Soviet Union nor abroad do we work the deep open-pit quarries a second time. Designs have already been developed for using such quarries for the burial of industrial wastes and for the construction of water storage electric power stations.

At the present time the depth of some quarries reaches 250 to 300 meters. At these depths serious problems arise, which are connected with transporting the ore from the lower beds, guaranteeing the stable condition of the sides of the quarries, and ventilating the inner portion of the quarries. It is sufficient to say that as the depth of a quarry is increased from 100 to 200 meters the productivity of the dumptrucks is reduced 1,5-fold. At the same time there are increased costs for transporting the rock mass and the diesel fuel costs increase nearly 2.5-fold.

Increasing the capacity and carrying capacity of quarry dumptrucks raises the economically rational depth of their use, but does not fully resolve the problem of transporting the ore. In quarries with a depth of 300 to 350 meters motor vehicles do not operate within the limit of their capacities.

One way to solve this problem is to use combined forms of transport: truck-skip and truck-conveyor transport.

Truck-skip transport calls for bringing the ore from the face to the skips at the bed sector using a dumptruck. From the quarry the ore is lifted to the surface in special skip-carts, which travel on rails. The grade can be as much as 60 percent. This equipment can be used in deep quarries with an average productivity. Since 1973 this equipment has been used in the Sibayskiy quarry of the Bashkirskiy copper and sulfide combine. The maximum productivity is 5.2 million tons of rock mass per year. In skips with a carrying capacity of 40 tons the ore and rock are lifted from a depth of 230 meters.

For deep quarries of a large productivity truck-conveyor transport is promising. Ore from the face is fed to the conveyor, which then lifts it to the surface. Such a cyclic-flow line technology is a transfer stage leading to the flow-line technology for the extraction of ores.

In the 11th and 12th five-year plans the problems of deep quarries may become serious barriers to further increasing the extraction of nonferrous metal ores. To solve the problem of transporting the rock mass from deep quarries it is necessary to combine the efforts of branch science, the USSR Academy of Sciences, and the machinebuilding ministries.

One can isolate two basic trends of technical progress in underground mining operations: the use of sets of self-propelled drilling, loading and transport equipment employing the pneumatic-tire system and increasing the relative percentage of ore extraction using systems for working with the flushing of the space that has been worked.

During the years of the 10th Five-Year Plan ore extraction using the underground self-propelled equipment increased 1.6-fold and reached 43 percent of the total underground extraction.

Such large enterprises as the Achisayskiy polymetal, the Dzhezkazganskiy and Noril'skiy mining and metallurgical and Solnechnyy mining and ore enrichment combines, have been almost fully switched to a new technology of ore extraction using diesel loading and delivery pneumatic-tire machines (which move between the face and the ore chute) and self-propelled drilling machines which use the pneumatic-tire system. This has made it possible to raise the productivity of the miners' work and to expand the use of highly-productive systems for the cave-in working of ore with open-pit working space as well. In the 11th Five-Year Plan ore extraction using self-propelled equipment will increase another 1.3-fold.

In this regard it is necessary to solve the problems connected with increasing the operating productivity of the self-propelled equipment, with keeping them in good working condition in the constrained conditions of underground mining, and with the effective neutralization of exhaust gases in combination with intensive ventilation.

The percentage of ore extraction by means of systems of working with the flushing of the worked space increased 1.6-fold during the years of the 10th Five-Year Plan, reaching 23 percent of underground extraction. The use of these systems makes it possible to sharply reduce ore losses within the interior of the earth and to provide for the safe work of the miners at depths of 1,000 to 1,500 meters and deeper.

By 1985 ore extraction using this technology is to be increased 1.4-fold as compared with 1980. The specialists of the sector are faced with several complicated engineering problems: searching for efficient substitutes for cement; the comprehensive mechanization and automation of flushing operations; and so forth.

An important problem in the underground extraction of ore at great depths is the creation of methods and technical means for predicting and preventing mining shocks. Scientists and production specialists are now working to solve this problem.

The adoption of geotechnology - the acid and bacteriological leaching of lean ores in the interior of the earth and in the tailings - is most promising for the ore base.

Along with the assimilation of new deposits measures are planned for making maximum use at existing enterprises of available reserves for increasing the extraction of ore and for reducing their losses in all conversions. The decree of the CC CPSU and the USSR Council of Ministers "regarding the increased effort to conserve and make rational use of raw-material, fuel and power and other material resources" directs us toward this end. By the end of the 11th Five-Year Plan we must provide for the extraction of ore from the interior of the earth at a level of more than 90 percent with the minimum depletion (ratio of mixed rock to ore) of their barren rock. To accomplish this they will more extensively make use of nuclear-physical means for monitoring the content of nonferrous metals in ores, highly-efficient working systems, and new equipment.

All of the achievements of the nonferrous metallurgy industry are the result of the selfless labor of the collectives of the enterprises, particularly of the production leaders. Out of 18 leading brigades-initiators of socialist competition of the first year of the 11th Five-Year Plan, seven brigades of miners - the brigade of drillers of the Zabaykalzoloto Association, which is led by USSR State Prize winner F. Fakhrutdinov; the brigade of miners from the Dzhezkazganskiy mining and metallurgical combine under the leadership of USSR State Prize winner N. Makarov; the brigade of excavator operators of the Sorskiy molybdenum combine, headed by Ye. Kuz'min; the brigade of quarry dumptruck drivers from the Gayskiy mining and enrichment combine under the leadership of V. Sharshukov; and others deserve to be mentioned. They have taken on additional pledges for the high-speed execution of mining work, the extraction of 1,000 and more tons of ore within a 24-hour period using self-propelled equipment, for the highly-productive drilling of blast holes, and for the loading and transport of rock mass in the quarries.

In response to the CPSU Central Committee, USSR Council of Ministers, the All-Union Central Trade Union Council, and the Komsomol Central Committee decree "regarding the all-union socialist competition for the successful fulfillment and overfulfillment of the assignments for the 11th Five-Year Plan" more than 20,000 brigades of the sector have made pledges to fulfill the assignments of the current five-year plan ahead of schedule. In these brigades there are many young people, recently discharged from the Soviet Army. It is they who are building up our supply of gold.

The tasks for the further development of the ore base of the nonferrous metals industry, which have been assigned to the geologists, miners and construction workers in the 11th Five-Year Plan, require the rapid assimilation of new deposits, which have been prospected in the Far East, Siberia, Kazakhstan and in many other regions of our vast nation. They also require the expansion of such famous enterprises as the Noril'skiy, Tyrnyauzskiy and other combines. Today these enterprises are in need of skilled construction workers, mechanics, drivers and other specialists, who have served in the Soviet Army and Navy.

The workers of the nonferrous metallurgical industry, inspired by the historical decisions of the 26th Party Congress, will do everything possible to successfully fulfill the assignments of the 11th Five-Year Plan and to make a worthy contribution to the development of the economic and defense strength of the Soviet Union.

8927
CSO: 1842/88

UDC: 537.312.62

COMPOSITE SUPERCONDUCTING FILMS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 3, Mar 82
(manuscript received 19 Feb 81) pp 80-82

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[Abstract] Composite superconducting films, a heterogeneous disordered system in which particles of superconducting materials form three-dimensional chains of randomly oriented point contacts in a glass matrix, were produced for the first time. The transition temperature is close to the transition temperature of the initial superconducting component of the film. Composite superconducting films are manufactured by preparing a suspension of the initial powder of the superconducting material and glass powder in a solvent to give the paste the required fluidity. Films are produced by contact printing, silk screening or pulverizing. The solvent is then dried and the films are heat treated by heating to the softening point of the glass. Capillary forces help the glass to penetrate into the cavities between particles of the superconducting material, and brief holding at the softening point completely relieves stresses. References: 1 Western.
[117-6508]

UDC: 621.762:621.7.044

HIGH SPEED MOLDING OF CLAD GRAPHITE POWDER

Kiev POROSHKOVAYA METALLURGIYA in Russian No 3, Mar 82
(manuscript received 27 Sep 81) pp 21-25

KOBRIN, V. N., MESHCHERYAKOV, A. N., GRECHKA, V. D. and DYADENKO, N. S., Khar'kov Aviation Institute

[Abstract] A new method has been developed of creating metal ceramic materials - preliminary cladding of solid lubricants with metal. This work studies the process of high speed formation of these materials in order

to produce products with a ratio of H:D>1, where H is the height of the product and D is its diameter. Copper clad graphite in the -016+01 fraction with the composition Cu=50, Fe=4.36 and C=45.6 mass % was studied. Oscillograms were made of the pressure versus time of high speed molding, and the variation in density of the product produced as a function of pressure, energy, speed of impact and relative distance to base of the product are determined. The uniformity of distribution of material density through the height of the pressings produced increased with increasing speed in the range studied (up to 25 m/sec). The speed should not be increased over 15 m/sec, however, since layer separation occurs. Figures 4; references 8: all Russian.
[117-6508]

UDC: 621.762

EFFECT OF ULTRASOUND ON DISTRIBUTION OF HARDENING PARTICLES IN LIQUID MEDIUM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 3, Mar 82
(manuscript received 23 Apr 81) pp 64-68

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[Abstract] Experiments were performed on models with high speed cinematography of the processes which occurred. Transparent liquids with various densities and viscosities were used: distilled water, CCl_4, ethylene glycol and a 50% solution of glycerin in water. Solid insoluble particles of aluminum, magnesium and discrete fibers of aluminum, steel fibers and silicon carbide fibers were introduced to the liquids. The motion pictures made were used to determine the speed of movement of the particles. The studies showed that when ultrasound was applied to the mixtures the distribution of the solid particles in the volume of the matrix changed greatly. Factors influencing uniformity of distribution included amplitude of oscillations, particle size, ratio of liquid to solid densities, and viscosity of the liquid. Knowing the last three parameters, we can determine the amplitude of ultrasonic oscillations necessary to create any required particle distribution. Figures 5; references 3: all Russian.
[117-6508]

UDC: 621.791.754'29:669.295:620.187:539.67:539.015

STRUCTURAL SPECIFICS OF SEAMS IN VT6 ALLOY MADE BY ARGON ARC WELDING USING POWDERED TITANIUM WELDING WIRE

Kiev AVTOMATICHESKAYA SVARKA in Russian No 3, Mar 82
(manuscript received 9 Sep 81) pp 28-33, 70

GRIDNEV, V. N., academician, Ukrainian Academy of Sciences, KUSHNAREVA, N. P., candidate of physical and mathematical sciences, SVECHNIKOV, V. L., candidate of technical sciences, Institute of Metal Physics, Ukrainian Academy of Sciences, ZAMKOV, V. N., candidate of technical sciences, and PRILUTSKIY, V. P., engineer, Institute of Electric Welding imeni Ye. O. Paton, Ukrainian Academy of Sciences

[Abstract] A study is made of the influence of activating welding materials on the structure and mechanical properties of welded joints. The studies were performed on specimens of VT6 titanium-aluminum-vanadium alloy. Specimens 16 mm thick were welded in one pass without finishing of the edges. Current was 480-580 A, and speed 8-10 m/hr. PPT powder welding wire 3.2 mm in diameter containing CaF_2 flux in a medium of high quality argon was used. The structure of the alloy was studied by electron microscopy using foils prepared by polishing in a methanol chloride electrolyte at -30°C. The use of the powdered wire did not influence the condition of the solid solution. A change was observed in the size and shape of segregations in interphase layers, probably related to the specifics of interaction of the hydrogen and fluorine. The mechanical properties are primarily determined by the condition of the α and β phases rather than the interlayers between phases. Figures 3; references 19: 10 Russian, 9 Western.
[115-6508]

UDC: 669.017

INFLUENCE OF HYDROGEN ON PHASE COMPOSITION OF TITANIUM ALLOYS

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 1, Jan-Feb 82 (manuscript received 27 Apr 81) pp 86-91

KOLACHEV, B. A., MAMONOVA, F. S., SEDOV, V. I. and MAL'KOV, A. V.,
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[Abstract] Bars of commercial titanium α alloys VT5, VT5-1, the pseudo α alloys OT4 and VT20, α + β alloys VT3-1, VT6 and VT22 and the β alloy VT30 were studied after vacuum annealing at 800°C for two hours at a pressure of 6.7 mPa. After vacuum annealing a measured quantity of hydrogen was introduced, not causing significant grain growth. After absorption of hydrogen the specimens were held 2 hours at 800°C to allow uniform distribution, then cooled with the furnace. The VT3-1, VT6 and VT30 specimens were also hardened in water from 890, 925 and 700°C and aged. The results of metallographic and x-ray structural analysis indicated that the hydrogen dissolved in the metal distorts the crystalline lattice to varying degrees in the various crystallographic planes. Once a certain hydrogen concentration is reached titanium hydrides are formed. The higher the content of β stabilizers, the higher the hydrogen content must be for formation of hydrides. The morphology and lattice period of the hydrides depends on the concentration of hydrogen introduced to the alloy. For titanium alloys with over 5% β phase as the hydrogen content increases the quantity of β phase increases at room temperature, the β phase is more distorted by the hydrogen than is the α phase, and hydrogen influences the dispersion of the microstructure in the hardened state. Alloys containing over 40% β phase following annealing and thermal hardening may contain some ω phase at certain hydrogen contents. Figures 4; references 7: 4 Russian, 3 Western.
[120-6508]

UDC: 669.295/.296:536.42:539.89

EFFECT OF α→ω TRANSFORMATION AND T-p DIAGRAMS OF TITANIUM AND ZIRCONIUM

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 53, No 2, Feb 82 (manuscript received 31 Oct 80, in final form 5 Jan 81) pp 402-404

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[Abstract] Since the ω high pressure phase of titanium and zirconium is retained at normal pressure, the authors decided to measure the thermal effect of the α→ω conversion in the process of heating the ω phase at normal pressure and to use these data and known coordinates of the triple

points (α-β-ω) to determine the position of the α and ω phase equilibrium line of titanium and zirconium. Cylindrical specimens of zirconium and titanium 3.0 mm in diameter and 4.0 mm high were subjected to quasi-hydrostatic pressure at about 10 GPa for 10 minutes to produce the ω phase. The thermal effects of $\omega \rightarrow \alpha$ conversion were measured on a differential scanning calorimeter. It was found that the $\omega \rightarrow \alpha$ conversion in zirconium is accompanied by absorption of 268±8 J/mol of heat, the thermal effect of the $\omega \rightarrow \alpha$ conversion in titanium is 0 J/mol (with a sensitivity of determination of at least 30 J/mol). Parameters are calculated which determine the position of the equilibrium line, showing that there is a line on the T-p plane on which the thermal effect is equal to 0, this line corresponding to the temperature axis in the case of titanium. References 8: 7 Russian, 1 Western.
[114-6508]

UDC: 667.71:548.6

SUBSTRUCTURAL CHANGES DURING ROLLING OF TITANIUM

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA MEATLLURGIYA in Russian No 1, Jan-Feb 82 (manuscript received 31 Mar 81) pp 73-76

BURKOVSKAYA, L. L., BRYUKHANOV, A. A. and MOROZ, I. Z., Physics Department, Sumy Pedagogic Institute

[Abstract] An x-ray study of the changes in substructure, texture and microhardness was performed on specimens of technical titanium after various degrees of deformation. The initial specimens were 4 mm thick, rolled and annealed, and had completely recrystallized structure. They were then cold rolled with up to 90% deformation. A layer 0.1-0.2 mm beneath the surface was studied. The surface was prepared by grinding and chemical etching. The variation in block size and microdistortions as a function of degree of deformation shows that even in the earliest stage of deformation microdistortions increase and block size decreases, indicating deformation hardening. At over 60% deformation the rate of change of these characteristics decreases, and at high (70-90%) deformation the direction of the curves reverses. The studies indicate that during cold rolling of technical titanium a cellular structure is formed. However, the dynamic recovery which might be observed is obscured by the change in crystallographic texture which occurs. Figures 4; references 4: 3 Russian, 1 Western.
[120-6508]

UDC: 669.295:621.787

RESIDUAL STRESSES IN SURFACE LAYERS OF VT3-1 AND VT22 ALLOY AFTER SHOT PEENING OF SURFACE WITH PLASTIC DEFORMATION

Kiev PROBLEMY PROCHNOSTI in Russian No 3, Mar 82
(manuscript received 20 Apr 81) pp 107-108

GONTAREVA, R. G., POLOSKIN, Yu. V., RODKINA, L. Ye., RYKOVSKIY, B. P., TARASENKO, L. V. and TIKHONOV, L. V., Institute of Metal Physics, Ukrainian Academy of Sciences

[Abstract] A study is made of the change in residual stresses in the surface layers of VT3-1 and VT22 alloys as a function of D, P and τ of shot peening. Specimens measuring 18 x 18 x 7 mm were cut from stampings, annealed at 825°C for 60 sec and aged at 580°C for 240 sec. They were then ground down to 63% of their depth and shot hardened with balls 0.4 to 3mm in diameter. The air pressure at the nozzle varied from $2 \cdot 10^5$ to $4 \cdot 10^5$ Pa. X-ray studies were used to determine the sum of primary stresses $\sigma_1 + \sigma_1$ in the plane of the surface layer of the specimens. The optimal conditions for shot peening are: D=0.4 mm, $P=3 \cdot 10^5$ Pa, τ=90s. This is confirmed by mechanical testing. Figures 2; references 2: both Russian.
[118-6508]

UDC: 669.295.017

STUDY OF SURFACE LAYERS OF VT3-1 ALLOY AFTER ULTRASONIC CAVITATION WORKING

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 2, Mar-Apr 82 (manuscript received 13 Apr 81) pp 137-138

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[Abstract] In this work the method of x-ray structural analysis is used to study the stress state of the surface layers of VT3-1 alloy hardened by ultrasonic cavitation. Specimens cut from hot rolled bars were heat treated by isothermal annealing at 870°C, 1.5 hours, cooling with the furnace to 650°C, 1.5 hours, then cooling in air. Cavitation was performed under excess hydrostatic pressure for 1.5, 3.5, 4.5 and 8.5 minutes. The maximum hardness was reached in 4.5 minutes, but maintained for up to 8.5 minutes. The increase in microhardness in 4.5 minutes with a load of 5 MN is 870 MPa or 24%. Metallographic analysis of the surface layers of the specimens revealed deformation of the structural components, changing the form of the primary α phase. Ultrasonic cavitation thus produces plastic deformation of the surface layers, leading to an increase in microhardness and formation of compressive stresses in the surface layers, while retaining great surface smoothness. Figures 2; references 5: all Russian.
[119-6508]

UDC: 669.017

COMPOSITION AND FINE STRUCTURE OF TITANIUM MARTENSITE

Ordzhonikidze IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: TSVETNAYA METALLURGIYA in Russian No 2, Mar-Apr 82 (manuscript received 2 Mar 81) pp 90-94

KOLACHEV, B. A., FEDOROVA, N. V. and FISHGOYT, A. V., Department of Metal Science and Hot Working of Metals, Moscow Aviation Technology Institute

[Abstract] The chemical composition of martensite crystals and the fine structure of the martensite were studied in titanium alloys with 2, 4.4, 5.8 and 8.3% Mo, produced in an experimental laboratory vacuum-arc furnace. X-ray phase analysis, light and electron microscope studies were performed, and the chemical composition was determined by x-ray spectral microanalysis. The composition of the martensite corresponded to the initial β phase in the microscopic analyses. In the Ti alloy with 5,8% Mo, massive (packet) martensite is primarily formed, in the alloy with 8% Mo plate type (twinning) martensite is formed. Martensite formed at high temperatures has a dislocation structure, while martensite formed at lower temperatures contains conversion twins. Figures 2; references 6: 4 Russian, 2 Western.
[119-6508]

UDC: 669.295:669.094.3

SPECIFICS OF GROWTH OF INTERFERENCE-COLORED OXIDE FILMS ON VT5 TITANIUM ALLOY IN AIR

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 2, Mar-Apr 82 (manuscript received 24 Jun 80) pp 183-185

KIRILLOVA, O. L., VORONTSOV, Ye. S. and SPICHKIN, Yu. V., Voronezh

[Abstract] Some specifics of the kinetics of oxidation of VT5 in air are studied by the method of interference indication, supplemented with ellipsometric measurement, metallographic, electronographic and microscopic x-ray analysis. Plate specimens 20 x 10 x 2 mm were cut from a 30-mm rolled bar material parallel and perpendicular to the direction of rolling. Isothermal oxidation of specimens by oxygen of the air at 823-898°K was performed on an installation allowing continuous visual observation of changes in interference coloration of the films. Aluminum concentration was 5.7%, its distribution in the alloy was uniform. A significant change in activation energy during the course of the process of oxidation, increasing with increasing thickness of the oxide film, was discovered. Significant anisotropy of oxide film growth in relationship to the direction of rolling of the metal was noted. Figures 1; references 5: all Russian.
[116-6508]

UDC: 669.295.5:620.193/.196

CORROSION RESISTANCE OF TITANIUM-BASED ALLOYS IN SULFURIC ACID, SODIUM CHLORIDE AND CAUSTIC SODA SOLUTIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 2, Mar-Apr 82 (manuscript received 27 Jan 80) pp 186-188

MANDZHAGALADZE, S. N., MIKABERIDZE, M. P., NARTOVA, T. T., LORDKIPANIDZE, I. N. and PIRTSKHALAVA, D. N., Moscow, Tbilisi

[Abstract] The influence of copper and nickel on the corrosion resistance and electrochemical properties of titanium was studied in solutions of hydrochloric acid, sodium chloride and caustic soda. The copper content varied from 0.35 to 5 wt. %. The alloys were hardened from the β area, had comparatively large grains of transformed β phase, within which needle structure α' phase was formed. The copper was found to reduce the corrosion resistance in all three solutions. Copper had practically no influence on development of the cathodic process, and increased anodic currents. Introduction of nickel improved corrosion resistance in all three solutions. The minimum rate of dissolution was observed at 8% Ni. Figures 3; references 6: 4 Russian, 2 Western.
[116-6508]

UDC: 669.295:621.785.78

DECOMPOSITION OF METASTABLE PHASES IN TWO-PHASE TITANIUM ALLOYS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 53, No 1, Jan 82 (manuscript received 28 Oct 80, in final form 28 Jan 81) pp 95-103

D'YAKOVA, M. A. and L'VOVA, Ye. A., Urals Polytechnical Institute imeni S. M. Kirov

[Abstract] An attempt is made to determine the pattern of decomposition of the metastable β and α" phases under various conditions in three industrial two-phase titanium alloys - VT3-1, VT8 and VT23. The chemical composition of the alloys studied was (wt.%), VT8 - 6.8 Al, 2.88 Mo, 0.16 Fe, 0.30 Si; VT3-1 - 6.7 Al, 2.78 Mo, 1.78 Cr, 0.30 Fe, 0.27 Si; VT23 - 6.3 Al, 2.56 Mo, 1.24 Cr, 4.28 V, 0.74 Fe, 0.25 Si. Specimens were cut from hot rolled bars 25 mm in diameter, annealed for two hours at 820°C, cooled with the furnace, then hardened from various temperatures in a 10% solution of sodium chloride. The phase transformations occurring in the alloys during tempering after hardening and during continuous heating of hardened specimens were determined by x-ray structural analysis, and measurement of elasticity modulus as a function of temperature. The processes occurring during continuous heating or tempering are determined by the content of high temperature β phase, the most unstable of the metastable phases present in the specimens.

Orthorhombic α" martensite formed upon hardening undergoes reverse martensite α"→β conversion upon heating. The α" martensite produced upon hardening from the two phase area breaks down to liberate the enriched β phase. Low alloy α" martensite formed upon hardening from the β area breaks down, primarily liberating the α phase. The transition from the metastable hardened state to the stable α+β state occurs through a number of intermediate stages, the sequence of which is determined by the phase composition and degree of alloying of the phases in the hardened alloys. Figures 2; references 15: all Russian.
[101-6508]

UDC: 620.184.6:669.295

RELATIONSHIP OF VT20 TITANIUM ALLOY FRACTURE MICROSTRUCTURE WITH FATIGUE CRACK PROPAGATION RATES

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 15, No 1, Jan-Feb 82 (manuscript received 29 Jan 81) pp 114-115

GRICHKO, V. V. and ABRAMOVA, A. A., Institute of Physics and Mechanics, imeni G. V. Karpenko, Ukrainian Academy of Sciences, L'vov

[Abstract] Fractures produced during testing of disk specimens with a central aperture located transverse to the rolling direction during crack resistance studies were investigated. The method of testing provided for the maximum stress intensity of the cycle and consequently maximum crack growth rate in individual sections 2 to 15 mm long on the path of crack propagation. Fractures were analyzed using plastic-carbon replicas on an electron microscope at 10,000 X. Different micromechanisms of fracture are observed for different fatigue crack growth speeds. Figures 1; references 4: all Russian.
[113-6508]

UDC: 621.791.72.01:621.373.826:548.5

SEAM FORMATION DYNAMICS DURING WELDING WITH CO_2 LASER

Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 82
(manuscript received 18 May 81, in final form 12 Aug 81) pp 22-25

MITKEVICH, Ye. A., candidate of technical sciences, LOPOTA, V. A. and GORNYY, S. G., engineers, Leningrad Polytechnical Institute imeni M. I. Kalinin

[Abstract] Model experiments were performed using optically transparent materials (fused quartz and its modifications) which absorbed the radiation of a CO_2 laser to study the formation of the seam during laser welding. The process of melting was recorded by a high speed motion picture camera and light filters. Photographs of the melting of the quartz glass are presented. Analysis of the films indicates that the dimensions and shape of the channel change periodically at a frequency of about 2Hz. The lower portion of the channel may be outside the area irradiated by the incident beam. The process of transfer of the liquid over the surface of the channel is studied. An ascending flow of fluid is observed in the middle portion of the channel, with a horizontal flow at the root of the seam. The results of the study indicate that the hydrodynamic phenomena occurring in the welding bath are quite similar in laser welding and electron beam welding. Figures 2; references 13: 9 Russian, 4 Western.
[107-6508]

UDC: 621.791.16.052.004.12

INFLUENCE OF CHANGE IN OSCILLATIONS OF TOOL ON FORMATION AND QUALITY OF JOINTS IN ULTRASONIC MICROWELDING

Kiev AVTOMATICHESKAYA SVARKA in Russian No 2, Feb 82
(manuscript received 8 Jun 81) pp 29-34

GUSEV, O. V., candidate of technical sciences, RYDZEVSKIY, A. P., engineer, and SHORSHOROV, M. Kh., doctor of technical sciences, Institute of Metallurgy imeni A. A. Baykov, USSR Academy of Sciences

[Abstract] A study is presented of the influence of programming of ultrasonic oscillations of the welding tool on the quality of joints produced in ultrasonic welding of aluminum conductors to the contact areas of semiconductor devices. An EM-423M device with a resonant frequency of 66 KHz, ultrasonic generator with frequency modulation and automatic search for resonant frequency were used. A995 aluminum wire 40 micrometers in diameter alloyed with 0.5 to 0.9% Si was welded to plates of pure or thermally oxidized silicon, rectangular specimens of fused quartz, DMDS structures. The area of optimal conditions for welding was determined and is shaded in a graph showing the variation of characteristics of the joint produced as a function of pressure, oscillating frequency and amplitude. Increasing the amplitude increases the specific energy applied to the welded zone and improves the quality of the joint. The amplitude should be at its maximum at the beginning of welding, then decrease by the end of the process. Best joints are produced with initial high amplitude of oscillation, reducing to about 70% of the maximum as the joint is formed. Figures 3; references 5: all Russian. [107-6508]

UDC: 621.791.4.539.378.2

SPECIFICS OF FORMATION OF PLATINUM-TITANIUM COMPOUNDS UPON VACUUM DIFFUSION WELDING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 3, Mar 82 pp 14-16

DZHUR, Ye. A., engineer, KVASHA, A. N., candidate of technical sciences, KEDRIN, I. D., candidate of technical sciences, OGDANSKIY, N. F., candidate of technical sciences, and FESENKO, A. G., engineer, Dnepropetrovsk State University imeni The Three Hundredth Anniversary of Union of the Ukraine and Russia

[Abstract] The microstructure of specimens in cross section was studied and the phase composition of diffusion zones determined in copper radiation for VT1-0 sheet titanium alloy 3 mm thick and P1-99.97 platinum foil 0.05 mm thick welded under a vacuum of 10^{-5} mm Hg. Special 3-layer specimens were produced to test the strength of the welded joints. The microstructure showed that when platinum is welded to titanium a diffusion zone

of complex composition is formed, in which the phases cannot be differentiated. Increasing holding time to forty five minutes results in the gradual formation of three types of intermetallides: Ti_3Pt, TiPt and $TiPt_3$. The strength of welded joints produced at 860°C and P=0.65 kgf/mm^2 increases when holding time is increased from fifteen to thirty minutes, then decreases when holding time is increased to forty five minutes, due to the formation of the third type of intermetallide. Fractures occur through this intermetallide. Figures 4; references 5: all Russian.
[105-6508]

UDC: 621.791.75.03

SOME PROBLEMS OF TECHNOLOGY AND EQUIPMENT FOR TWO-ARC (TWO-SIDED) WELDING OF RIBBED TITANIUM ALLOY PANELS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 1, Jan 82 pp 29-31

ZHUKOV, M. B., candidate of technical sciences, MOROZOVA, T. V., engineer, ABRAMOVA, A. A., engineer, REDCHITS, V. V., candidate of technical sciences, VESELOV, A. A., engineer, LEONT'YEVA, L. M., engineer

[Abstract] A description is presented of equipment used for a progressive welding technique: dual-arc welding producing a single bath on both sides of the welded joint. Photographs and diagrams of the arrangement, as well as photomicrographs of joint fracture surfaces, are presented. The particular device described and diagrammed is used to attach ribs to plates, and is based on a type FP-17M programmed milling machine. Short cycle fatigue and fractographic studies indicate that when defects are present in a T joint produced by the machine and the load is increased there is a tendency for the point where cracks develop to shift. Surface defects become dominant in crack development under very high loads. Figures 6; references 2: both Russian.
[108-6508]

UDC: 621.791.052:539.4.014

RESIDUAL STRESSES AND STRAINS OF VT6 TITANIUM ALLOY WELDED JOINTS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 1, Jan 82 pp 23-25

ZOLOTAREV, B. B., candidate of technical sciences, deceased, SHUBLADZE, T. G., candidate of technical sciences, TIKHONOVA, A. F. and VACHIBERADZE, G. S., engineers

[Abstract] VT6 titanium alloy widely used in welded structures, was selected for a study of residual stresses and strains. The study was performed on welded joints made by electron beam welding, immersed arc

welding and slot welding with oscillating curved nonfusible tungsten electrodes in plates 28 by 300 by 240 mm in size. Before welding, the specimens were annealed in a vacuum at $1.34 \cdot 10^{-2}$ Pa at 750°C for two hours. A second pass of electron beam welding was used to smooth the surface; immersed arc welding was performed in two passes on both sides; slot welding was performed in five passes on one side of the seam using SPT-2 wire 2.0 mm in diameter. Residual uniaxial stresses and strains were determined by an experimental and calculation method. The greatest residual stresses arise in joints made by electron beam welding, the least in joints made by slot welding. The second pass in electron beam and immersed arc welding decreases residual stresses by not over 10%. Immersed beam welding produces less shrinkage than slot welding, and electron beam welding still less. The greatest angular deformations occur in slot welding, with far fewer occurring with immersed arc welding and electron beam welding. Equations are derived which can predict the deformations of the welded joints and structures produced. Figures 6; references 5: all Russian.
[108-6508]

UDC: 621.791.72:621.373.826

WELDING OF MARTENSITE AGING STEEL TYPE 03Kh11N10M2P BY VACUUM ARC MELTING WITH CONTINUOUS CO_2 LASER BEAM

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 1, Jan 82 pp 19-20

TOSHCHEV, A. M., TOCHILKIN, V. A., TRUSENEVA, G. P., VASYANOVA, T. I., engineers, and BELEN'KIY, A. M., candidate of technical sciences

[Abstract] Results are presented from studies of laser welding conditions for Martensite aging steel type 03Kh11N10M2P produced by vacuum arc melting, up to 5 mm thick. The work was performed with an LSU-5 laser welding machine, beam power adjustable from 0.5 to 5 kW. The lens had a focal length of 500 mm and produced a spot 0.5-0.6 mm in diameter, and had an angle of convergence of the beam of 6°. No heat treatment was performed after welding. The mechanical properties of the joints were studied by butt welding circular specimens with wall thickness 2, 3 and 4 mm. Good quality single pass formation of joints was achieved over a broad range of welding conditions. The optimal conditions were welding rate 60 to 80 m/hr, beam power 1.3 kW per mm of material thickness. The joints have a softened area 1/3 to 1/4 as wide as those produced by argon arc welding with 8 to 10 times less welding deformation. The corrosion resistance of joints produced by the new method is equal to the old method. Figures 4; references 6: all Russian.
[108-6508]

UDC: 621.793.72:533.9

WELDING OF TITANIUM-STEEL BIMETAL THROUGH PLASMA COATING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 3, Mar 82 pp 16-17

SANNIKOV, V. I., IVANOV, B. V., KONYUKHOV, A. V., engineers, "Uralkhimmash" Production Union, and SEMENOV, B. G., candidate of chemical sciences, Ukrainian Scientific Center, USSR Academy of Sciences

[Abstract] Studies were performed to select the optimal material for plasma coating to be used in welding of steel-titanium bimetals. Type St3 steel and VT1-0 titanium were explosively joined with clad metal thickness 8mm, base metal thickness 25mm. Metallography, X-ray phase and spectrochemical analyses were used, as well as measurements of microhardness in atomized layers of ZrO_2+15% VO_2 and molybdenum 0.2mm thick, revealing cracks and a clear zone of interaction of molybdenum with titanium. It is found that ZrO_2 0.15 mm thick with a sublayer of Mo and pure atomized Mo 0.2mm thick cannot serve as a barrier to prevent interaction of titanium with steel. Interaction of surface titanium with ZrO_2 forms solid solutions of oxygen in the titanium causing spontaneous failure of the welded joints. The use of tungsten carbide as a separating layer does achieve good mechanical and corrosion properties of the seam. Figures 4; references 6: all Russian. [105-6508]

UDC: 621.791 052.08:620.179.16

ACOUSTICAL TESTING OF EXPLOSIVELY WELDED TITANTIUM JOINTS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 3, Mar 82 pp 22-23

GERGEL', P. I. and ODINOKIKH, A. V., engineers

[Abstract] A study is made of acoustical testing of joints obtained by explosive welding of two-layer VT1-0 titanium alloy sheets. The mirror-shadow method and echo method were used to estimate defects. Comparison of the results of ultrasonic testing, graphs of variation of signal amplitude as a function of reflector area and results of metallographic studies indicated that great testing sensitivity is necessary to reveal complete delamination. The two tested methods were found to be equivalent in sensitivity with complete delamination. The echo method was more sensitive in revealing areas with microporosity. Figures 2; references 4: all Russian. [105-6508]

UDC: 621 791.75.024

USE OF ETCHING PASTES TO PREPARE TITANIUM ALLOY SURFACES FOR ARGON ARC WELDING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 3, Mar 82 pp 29-31

MIKHLAYLOV, A. T., engineer, STEKLOV, O. I., doctor of technical sciences, TSVILEV, A. V., engineer, BERSENEV, L. N., engineer, ZAKHAROVA, T. A., engineer, and MEZRIN, V. V., engineer

[Abstract] In order to remove the oxide layer and simultaneously fluorinate the surfaces to be welded, experiments were performed on preparation of surfaces for argon arc welding using a paste to etch titanium and its alloys. Two compositions of etching pastes were used containing sulfuric acid, nitric acid, ammonium fluoride, polyvinyl butyral, titanium dioxide, cintanol and water. The surfaces were treated with the paste for twenty minutes, then cleaned and degreased with acetone or held in the paste for twenty four hours, cleaned and degreased with acetone, or welded without degreasing. The use of the paste was found to decrease seam porosity when degreasing was used. Simple removal of visible traces of paste was not sufficient. No difference in mechanical strength of the seams produced was noted, however. Figures 2; references 3: all Russian.
[105-6508]

UDC: 621.791.75.052:669.15-194.2-413-181.2:539.38

FORMATION OF TERMINAL CRACKS DURING ARC BUTT WELDING OF LARGE SHEETS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 3, Mar 82
(manuscript received 24 Apr 81, in final form 24 Sep 81) pp 16-19

GATOVSKIY, K. M., doctor of technical sciences, MARKOV, S. P. and NALETOV, V. S., engineers, Leningrad Ship Building Institute

[Abstract] The stress-strain state during welding of large sheets is studied using the theory of nonisothermal flow by the numerical method of finite elements. Considering the local nature of plastic deformations and the great rigidity of the sheets, relatively small areas in the vicinity of the seam can be studied by dividing them into a dense network of finite elements and studying the deformation cycles of elements in the plastic deformation zone far from the boundaries of the areas. The case studied is that of single pass welding of sheets 1800 x 500 x 16 mm of type 09G2 steel at 0.61 cm/s and 45 kJ/cm. The results indicate that the mechanism of terminal crack formation is as follows: transverse tensile stresses develop in advance of the welding arc with a sine wave curve. In unidirectional welding the tensile force is recieved by the clamps. As the clamp is approached, the tensile force increases and may reach the critical value, breaking the clamp open. This is a

dynamic phenomenon and causes a significant increase in welded bath width. Beyond the bath in the crystallization area a longitudinal crack develops. Cracks can be prevented by barring an increase in bath width upon opening of the clamp. For this purpose comb clamps are used. The clamps are strengthened by preliminary compression with screw or hydraulic jacks. Positive results are also achieved by compressing the softening zone by thermal stress created by special additional heat sources on each side of the seam or increasing heat flow to the end of the welded joint. Figures 4; references 7: all Russian.
[115-6508]

UDC: 621.791.75.011:669-419.4:621.791.76:621.7.044.2

INFLUENCE OF WELDED HEAT ON PROPERTIES OF 10Kh17N13M3T+VT1-0 BIMETAL

Kiev AVTOMATICHESKAYA SVARKA in Russian No 3, Mar 82
(manuscript received 6 May 81, in final form 28 Jul 81) pp 24-27

YUSHCHENKO, K. A., candidate of technical sciences, AVDEYEVA, A. K., engineer, and KOROTEYEV, A. Ya., candidate of technical sciences, Institute of Electrical Welding imeni Ye. O. Paton, Ukrainian Academy of Sciences

[Abstract] The influence of the thermal cycle of welding on the properties of the boundary layer of a bimetal produced by explosive cladding is studied. The thickness of the VT1-0 titanium layer was 19 mm, and that of the 10Kh17N13M3T stainless steel layer 5 to 15 mm. Metallographic studies on a microanalyzer and electronographic analysis indicate that a finely dispersed $TiFe_2$ phase is formed throughout the zone of fusion at comparatively low temperatures (500-600°C). Welding conditions must be selected such that the boundary layer of the metal in the zone of thermal influence is not heated to higher than 600°C for more than 30 minutes. Brief heating to 600°C during welding does not lead to the formation of a solid intermetallide layer nor does it significantly affect the separation resistance. Separation occurs through the titanium adjacent to the hardened contact zone, where there is no continuous intermetallide phase. A typical viscous fracture occurs. Where there is a continuous intermetallide phase, brittle fracture occurs through this phase. Figures 7; references 11: all Russian.
[115-6508]

RENOVATION DELAYS AT TAGANROG METALLURGICAL PLANT

Moscow EKONOMICHESKAYA GAZETA in Russian No 11, Mar 82 p 7

[Article by Pavel Yefimovich Osipenko, director, Taganrog Metallurgical Plant: "Strategy and Tactics of Renovation"]

[Text] The Taganrog Metallurgical Plant underwent major renovation in the 9th and 10th Five-Year Plans. Retooling and renovation of this enterprise is continuing in the 11th Five-Year Plan. Plant director Pavel Yefimovich Osipenko relates how this is progressing and what kind of economic return it is producing.

He began his career in 1937 at the Kuznetsk Metallurgical Combine. He worked as a millwright, foreman, mechanical engineer, and open-hearth shop assistant superintendent. He graduated from the Siberian Metallurgical Institute in 1943. He has been working in Taganrog for more than 30 years now. He has served as plant director since 1963. P. Ye. Osipenko is a Hero of Socialist Labor, a USSR State Prize recipient, and is a candidate of technical sciences.

Our plant's metallurgical workers view technical retooling of production as a sure method in the campaign for high production efficiency and for improving product quality. Looking back at what we have already accomplished, each of us sees those big changes which have taken place in the old shops.

Many metallurgical jobs involving heavy manual labor have become a thing of the past -- hauler and trimmer, scaler and pipe sizer. New jobs have appeared -- operator, setup man and others. An automated process control system has come on-line in Tube Welding Shop No 2. A modern electric welding unit has also been constructed in this shop. The tire shop, the finishing section and the rolling shop, plus many other facilities have been renovated and refurbished. A department has been built for producing pipe with new types of threaded connections.

In the 11th Five-Year Plan we are endeavoring to advance further in technical retooling, in order to turn out more metal products of improved quality and with lower labor and material expenditures. As a supplement to the centralized

capital investment sums allocated to this plant, in the current five-year plan we are allocating 20-25 million rubles from the production development fund for placing advanced equipment in existing shops and sections.

Last year a tube baling unit went into operation in Tube Rolling Shop No 1. A second bundling machine is being installed in this same shop. High-output tube-cutting equipment is being installed in Tube Welding Shop No 3. Renovation of the machine shop is being continued, and an electrical equipment repair shop and centralized machinery repair shop are going into operation. Expansion has begun on Open-Hearth Shop No 2.

Call of the Times

Our concern is focused on automation of production processes. This is a call of the times. Automation is essential, just as is total mechanization, since we have set for ourselves the goal of reducing the total number of jobs at the plant and of boosting the level of labor productivity. It would be difficult for me to single out any of the specialists and worker-innovators taking part in this plant's technical retooling. In most cases innovations are the result of collective innovative thinking.

The continuous tube furnace welding unit developed by Mintyazhmash [Ministry of Heavy and Transport Machine Building] would be the summit of sophistication, one would think. When it was being installed in Tube Welding Shop No 4, however, plant engineers and technicians, working together with scientists from the All-Union Scientific Research Institute of Metallurgical Machine Building, suggested a totally new layout and designed the appropriate equipment. As a result we were able to automate the tube production process.

We might discuss this in greater detail. Our plant receives tube-mill stock, or so-called skelp, from subcontractors, with the skelp deviating significantly from the specified thickness. Thickness varies not only within the same batch of skelp but practically from one coil to the next. Plant specialists, with the assistance of scientists, designed and built an instrument which continuously measures skelp width. It issues commands to the mill on the basis of skelp width and the specified wall thickness of the finished pipe. High-precision rolling is obtained. As a result the shop work force saves 19 kilograms of skelp per ton of pipe and turns out each year an additional 6500 tons of product.

The production process automated control system in Tube Welding Shop No 2 (we shall note that it is the first such system in operation in the Soviet metallurgical industry) ensures reliable equipment operation and improves the quality of pipe cutting. But the innovators are not resting on their laurels. They are continuing to work enthusiastically on further improving the industrial process automated control system, with the employment of electronic computer hardware in the principal operation -- high-frequency welding. This effort will enable us to improve the quality of the electric-welded pipe and will enable us to achieve additional savings in tube-mill stock.

One of the reheating furnaces has been reworked and improved through the efforts of workers and technical services specialists. Thanks to this it consumes one third less fuel than previously. Total annual savings exceed 25,000 tons. Measures to achieve savings in fuel and electricity are being carried out throughout the enterprise. Precisely such an approach is demanded of us by the CPSU Central Committee and USSR Council of Ministers decree entitled "On Intensification of Work to Achieve Savings and Efficient Utilization of Raw Materials, Fuel-Energy and Other Material Resources."

The tube welders of the brigade led by G. Drenov have come forth with an initiative entitled "From Savings in Metal and Energy Resources to Above-Target Output." Having calculated possibilities, the work force pledged to produce above target 300 tons of pipe in the 11th Five-Year Plan, including 100 tons from metal savings. The brigade is keeping its word. Last year it achieved savings of 40 tons of steel.

Many other work forces are following this example. New possibilities pertaining to producing steel, pipe and railcar tires have been found in the sections and shops. These possibilities form the basis of our counterplan for 1982. This plan specifies for the first two years of the five-year plan, above and beyond the ministry target, producing 5500 tons of steel, an equal quantity of rolled stock, 9000 tons of pipe of various diameter, as well as exceeding the labor productivity growth target.

The Taganrog metallurgical workers successfully fulfilled the January plan. There were difficulties, but we surmounted them.

Ties With Science Become Stronger

The plant's productive ties with more than 20 scientific organizations foster mobilization of internal reserve potential. We are working together with the All-Union Scientific Research and Technological Design Institute of the Tube Industry on improving the technology of manufacture of seamless tube. The quality of pipe for the oil and gas industry is improving as a result of adoption of new innovations, and pipe production is increasing.

The people at the metallurgical industry branch institute (Dnepropetrovsk), working closely with plant innovators, have adopted a new method of processing steel. Pipe manufactured of this steel is distinguished by high strength. It is used in drilling extremely deep wells, including on the Kola Peninsula.

Strong, meaningful ties have been established between this plant and a number of other scientific research establishments. In particular, modern devices for quality control on manufactured pipe and tube have been designed and built with the assistance of the Scientific Research Institute of Introscopy. And as a result of productive cooperation with the Kishinev Polytechnic Institute, plasma cutting of seamless tube has been adopted. Scientists at the Georgian SSR Academy of Sciences Institute of Metallurgy helped our work force adopt an efficient method of improving the quality of steel from which tires for subway car wheelsets are made.

I am not inclined, however, to present our relations with institutes in an entirely rosy light. Commercial contracts are not always carried out on schedule, through the fault of both parties. Sometimes innovations fail to generate the anticipated savings.

It Depends on the Construction People

The technical retooling plan for the 11th Five-Year Plan includes many different measures. Their execution depends both on the efforts of the plant work force and on a number of other organizations. I have in mind first and foremost Glavsevkavstroy of USSR Mintyazhstroy [Ministry of Construction of Heavy Industry Enterprises]. It is very difficult to establish a normal working relationship with this organization.

For the sake of a briefer presentation, I shall cite some facts. USSR Minchermet [Ministry of Ferrous Metallurgy] planned to install at our plant and bring on-stream in 1975 the branch's first tube blank continuous casting department. The construction people failed to meet this schedule. Minchermet was forced to postpone completion of this department to 1980. And once again the organizations of Mintyazhstroy failed to meet the deadline.

We cannot put up with the fact that average annual plan fulfillment for construction and installation work at plant facilities in the last five-year plan amounted to only 57 percent, and only 21 percent in 1981. As a result the volume of uncompleted construction at our enterprise has reached almost 13 million rubles.

At the same time demand for high-strength pipe manufactured at Taganrog is increasing. Therefore construction of the tube blank continuous casting department has become exceptionally urgent. It is now scheduled to come on-stream in 1983. But will this deadline be met? We have no assurance as yet.

The existing lime kiln shop is one of this city's principal air polluters. The plant's renovation and expansion plan calls for construction of a modern lime kiln shop. Ukrgipromez has delivered the complete working drawings. Minchermet has included this facility in the five-year plan, just as the new tube welding unit.

Judging by the state of affairs at Taganrog Construction Trust No 1 of Glavsevkavstroy, however, one should not make any optimistic forecasts regarding completion and startup of both facilities. The trust is chronically behind schedule. Nor can one note a change for the better. It has 25-26 million rubles tied up in uncompleted construction, with an annual construction and installation work plan of almost the same amount. When the client constantly encounters difficulties of this kind, difficulties caused by shortcomings in construction, it is wrong to remain silent.

Glavsevkavstroy has boiled down its entire "concern" about the trust to replacing its top executives. In the last five years four different persons have held the position of trust manager, and there have been an equal number of chief engineers. At the same time, like a chain reaction, there have been

replacements of 22 construction administration chiefs and 18 chief engineers. The construction worker turnover rate is high. One cannot help but conclude that Glavsevkavstroy has sadly neglected work in the area of selection, placement and indoctrination of cadres. There are also deficiencies in drawing up the trust's work program.

We should like to believe that USSR Mintyazhstroy will help Glavsevkavstroy put its "house" properly in order and that it will improve the economic mechanism in a resolute and businesslike manner.

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UST'-KAMENOGORSK LEAD-ZINC COMBINE IMPROVES EFFICIENCY

Alma-Ata KAZAKHSTANSKAYA PRAVDA in Russian 4 Feb 82 p 2

[Article by A. Kulenov, director, Ust'-Kamenogorsk Lead and Zinc Combine imeni Lenin, deputy to the USSR Supreme Soviet, Vostochno-Kazakhstanskaya Oblast: "Comprehensively Means Profitably"]

[Text] The work force at the twice-decorated Ust'-Kamenogorsk Lead and Zinc Combine imeni Lenin successfully completed the program of the first year of the 11th Five-Year Plan. The plan target pertaining to production of refined lead, zinc, blister copper and sulfuric acid was overfulfilled. There was additional production of many rare and noble metals, and tens of millions of rubles of profit were generated. First place in competition is being solidly retained by the lead plant, managed by L. Slobodkin, an honored Kazakhstan metallurgical worker. The work forces of the sintering, smelting and refining shops are standing a shock-work duty shift, producing above-target output every day and improving product quality.

One of the main areas of emphasis in the production and creative activities of metallurgical workers is efficient utilization of material resources by processing industrial products and waste of past years, and intensification of an economy regimen. Comprehensive utilization of the raw ore has become one of the principal indices in totaling up competition results and determining winners. Today the waste products of one production operation have become a valuable raw material for another. During the years of the 10th Five-Year Plan the combine obtained tens of millions of rubles from metal slags, gas and particulates. Two new products were added to the list -- zinc whites and cuprous oxide. Employing the latest advances in science and technology, enterprise innovators are constantly increasing recovery of nonferrous, rare and noble metals from the raw materials. Last year alone recovery of zinc increased by 0.2, and sulfur by 0.9 percent. Lead recovery from concentrates and waste is steadily increasing. It is not mere happenstance that the coefficient of comprehensiveness of utilization of raw material at the lead plant is three and a half percent higher than the branch average. Each and every fraction of a percent means tens of tons of metal -- enormous reserve potential is being identified for boosting labor productivity and reducing product cost.

The combine's innovators, working jointly with staff personnel at a number of this country's scientific research and design institutes, are developing

little-waste industrial processes and have an ultimate goal of shop and plant operation without waste material to be dumped. Electrothermal processes in the production of lead and zinc, with utilization of solid fuel, generate considerable savings. They increase the percentage of recovery of metals and greatly reduce ejection of gases into the atmosphere. Recovery of nonferrous and rare metals is increasing appreciably as a result of skilled utilization of so-called extraction-sorption and vacuum processes, as well as modernization of smelting units.

An especially large number of valuable technical innovations have been adopted at the lead plant, where one out of every three employees is an efficiency innovator or inventor. Meriting attention is preparation of oxidized materials charge by rolling lead cake and dust from granulated slag and coke fines. Such a charge is processed well in the furnaces and makes it possible most fully to "select" useful constituents. Mixer-accumulators for melting furnace slags have been adopted. The contents of these accumulators are reminiscent of a layer cake, the upper part of which contains slag, with copper matte in the center, and the heaviest metal, lead, at the bottom. Slag goes from the sedimentation tank for further processing to a slag sublimation unit, the copper matte is fed into converters, and the crude lead goes to refining. Thanks to this innovation, there has been achieved a significant reduction in volume of circulating products within the smelting shop, with an increased metal yield per square meter of usable space.

All melting furnaces in the lead production operation have been converted to evaporative cooling, which extends their service life severalfold and makes it possible to save thousands of tons of fuel. An entire installation for oxygen-suspended cyclone electrothermal melting of lead charges -- KIVTsET-TsS -- is targeted to come on-stream in the 11th Five-Year Plan. The new installation will increase recovery of lead, copper and sulfur and will improve the overall sophistication of metallurgical production.

The designing and building of high-output furnaces for roasting zinc concentrates can be considered the main thrust of technological advance at the zinc plant. This is dictated by a vital necessity: metal content in the concentrates hauled to the plant is steadily declining, and total zinc production volume can be maintained and even increased only by improving processing of the concentrate. This work is being conducted jointly with scientists at the All-Union Scientific Research Institute of Nonferrous Metallurgy and specialsts at the Uralenergotsvetmet Production Association. The great advantages of modernized furnaces became obvious in the course of full-scale tests. The productivity of roasting units increases by 30-35 percent, flows of waste gases are substantially reduced, and air quality improves. The renovated furnaces have equipment for secondary utilization of energy resources. Last year the roasting departments of two hydrometallurgical shops obtained for production uses approximately 140 gigacalories of heat and saved more than 18,000 tons of standard fuel. A prototype waste-heat boiler is successfully in operation in the Waelz process department. Furnace productivity has increased by 9 percent, with an improvement in removal of particulates and gas scrubbing. In a year's time this "mini-boiler" has generated more than 20,000 gigacalories of secondary energy resources. Overall production of

secondary energy resources during this time exceeded 280,000 gigacalories. Our economists and power engineers calculated that during two of the last five years the combine was operating on thermal energy obtained as a result of recovering formerly lost energy. The year before last, the enterprise met 40 percent of its heat requirements with its own reserve potential, while last year this indicator increased by an additional 7 percent.

It seems that until quite recently we were rapidly building up the dark slag piles, while today we are reducing them by secondary processing. In 1981 more than 40,000 tons of slag was taken from the old slag heaps and transported to the sintering shop, with the resultant recovery of several thousand tons of lead and zinc plus a large quantity of blister copper. Presently on the agenda is the matter of waste-free combine operation. The present level of development of metallurgical production enables us to accomplish this task, which is of national importance.

The rated output capacities of the principal equipment have been surpassed by 50 to 100 percent, but this does not satisfy the enterprise's innovators; they are continuing their innovative search and are accomplishing a great deal to modernize and renovate the shops and departments. It has been decided to increase the unit output capacity of the process equipment at the zinc plant, to mechanize and automate labor-intensive processes, and to achieve maximum processing of oxidized concentrate. Plans also call for renovating sulfuric acid production, which will result in boosting output of this "grain of the chemical industry" and improving its quality. Initiators of the nationwide competition for comprehensive utilization of raw ore, the combine's work force is continuing to improve production equipment and technology and is synthesizing and disseminating the experience and know-how of competition winners, those who, with equal and sometimes smaller expenditures, produce more output. Our efficiency innovators and inventors are helping us utilize most correctly and efficiently our raw material and fuel-energy resources. More than 1600 persons are involved in innovative search activities. Approximately 1200 valuable suggestions and 16 inventions were authored and adopted in the first year of the five-year plan, resulting in savings of 3 million rubles. Innovator teams and volunteer design offices are successfully operating, accomplishing very important and difficult tasks pertaining to production growth and improving production efficiency. It seems that until quite recently we were merely dreaming about processing "nonmobile" industrial products but did not know how to begin. Today these products have been included in the combine's raw materials budget and are providing us with refined metal. The innovator teams headed by engineers I. Bagayev, Yu. Ognev, and N. Baydukashev are to be given the primary credit for these achievements.

The innovator teams headed by experienced specialists G. Svad'bin, A. Shpekht, I. Yelizarov, V. Nikolayenko, Yu. Zinde, M. Batyukov, A. Morozov, G. Komissarov, and O. Kozin can be called genuine bearers of technological advance. Their collective projects are being rapidly incorporated into the production process and are generating enormous savings. The members of the innovator teams have initiated competition for the title of best innovator brigade, best inventor, and innovator of the five-year plan. They are helping develop initiative in young metallurgical workers and are teaching them to work

efficiently and to recover more fully all usable constituents from hauled-in raw materials and production waste. This combine, designed to produce lead and zinc, is today putting out 28 different products. The task consists in more fully recovering rare metals and reducing their losses to a minimum. Comprehensively means profitably! This is the permanent motto of our metallurgical workers, who are fighting tenaciously for each and every gram of additionally recovered metal; such is the call of the times.

3024
CSO: 1842/96

UDC: 669,27'28'849'297'784

STRUCTURE AND PROPERTIES OF DEFORMED ALLOYS IN TUNGSTEN CORNER OF W-Mo-Re-Hf-C SYSTEM

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 2, Mar-Apr 82 (manuscript received 12 Feb 80) pp 217-223

SAVITSKIY, Ye. M., POVAROVA, K. B., TOLSTOBROV, Yu. O., MAKAROV, P. V., ZAVARZINA, Ye. K., KOSACHEV, L. S., SEMILETOV, S. S., BALASHOV, V. A., Moscow

[Abstract] Ingots 70 mm in diameter were pressed at 1600-1800°C into bars 14-16 mm in diameter, in two passes with intermediate recrystallization annealing at 1800°C for 30 minutes. The alloys were then annealed for 1 hour at 1600-1800°C for stress relief and 60-80% recrystallization of the structure. The bars were then forged to 3-2.75 mm diameter with temperature dropping from 1450 to 1250°C, drawn down to 0.4 mm in diameter at 1100-1450°C, then to 0.1 mm cold. The microstructure of the alloys was studied in various stages of deformation by light and electron microscopy and mechanical testing was performed. Photomicrographs and diagrams of mechanical properties as functions of the specimen diameter are presented. It was found that introduction of up to 0.2 at. % Hf and 0.15 at. % C improves the mechanical properties of the alloys. During hot and particularly during warm deformation a fiber structure is formed, gradually decreasing the temperature of plastic-brittle transition, and at over 95% deformation almost all alloys are plastic at room temperature. Hot deformation at 1450-1350°C, 92-93% compression does not significantly increase the short term tensile strength of the alloys. Subsequent hot and cold deformation increases short term ensile strength as a logarithmic function of specimen diameter. Figures 5; references 8: 5 Russian, 3 Western.
[116-6508]

UDC: 620.178.38

FATIGUE RESISTANCE OF EI698VD HEAT RESISTANT ALLOY UNDER HIGH TEMPERATURE CONDITIONS

Kiev PROBLEMY PROCHNOSTI in Russian No 3, Mar 82
(manuscript received 2 Feb 81) pp 95-98

ZHELDUBOVSKIY, A. V. and ISHCHENKO, I. I., Institute of Mechanics, Ukrainian Academy of Sciences, Kiev

[Abstract] A study is presented of the influence of structural changes in EI698VD alloy on its fatigue resistance in the 873-1073°K temperature range. The influence was studied by testing specimens in various structural states--the initial state (after typical heat treatment) and after aging for 500 hours at temperature corresponding to the test temperature. Specimens (gage section 7 mm diameter) were tested in symmetrical pure flexure with rotation at 50 Hz. Metallographic and electron microscope analyses were performed, as well as studies of the structure-sensitive characteristics of hardness and microhardness. Aging of the alloy for 500 hours did not influence the nature of the fatigue curves, but at 873 and 973°K it resulted in an increase in fatigue limit by 18 and 8%, respectively. The primary influence on fatigue resistance of this alloy is that of the structural state reached during preliminary isothermal holding, during which the structure of the alloy is relatively stabilized. This is related to the instability of the hardening γ' phase. There are two areas of characteristic fatigue resistance. In the first, 873-1023°K, the alloy is hardened and fatigue limits are slightly increased, while in the second alloy is partially softened and fatigue limits decrease. Figures 4; references 5: all Russian. [118-6508]

UDC: 546.28

INFLUENCE OF VACUUM ANNEALING ON ELECTROPHYSICAL PROPERTIES OF POWDERED CdS AND CdSe

Moscow IZVESTIYA AKADEMII NAUK SSSR: NEORGANICHESKIYE MATERIALY in Russian Vol 18, No 3 Mar 82 (manuscript received 23 Oct 80) pp 363-365

MELLIKOV, E. Ya., KHIYE, Ya. V., KUKK, P. L. and KARPENKO, I. V., Tallinn Polytechnical Institute

[Abstract] A study is presented of the possibility of using vacuum heat treatment to produce powdered cadmium sulfide and selenide with predetermined homogeneous properties. The initial materials were CdS and CdSe synthesized from the elements in the gas phase. The charges were poured into an open quartz ampule and placed in an evacuated quartz tube. During heat treatment the ampule was rotated to avoid the influence of powder layer thickness.

Vacuum heat treatment was performed at 870-1070°K. The initial and treated materials were analyzed by comparing the current passing through a powder column, particle size distribution, photoluminescence spectra, dielectric losses and the properties of phototransducers made from the powders. The kinetics of sublimation of powdered CdS and CdSe during vacuum annealing was studied by determining the diffusion of the excess component to the surface of the crystals. Figures 1; references 8: 7 Russian, 1 Western. [110-6508]

UDC: 536.421.1,536.422.1

CALCULATION OF MELTING AND EVAPORATION KINETICS OF SOLID UNDER INFLUENCE OF ENERGY FLUX

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 82 (manuscript received 8 Oct 80) pp 13-18

LYUBOV, B. Ya. and SOBOL', E. N., Moscow

[Abstract] This work studies the three dimensional problem of evaporation and melting of a semilimited body occupying the area where $z>0$ and absorbing a constant flow of energy. Quasisteady conditions are assumed under which the initial temperature distribution can be ignored and the phase division boundary while retaining its shape penetrates into the material at a constant speed. A precise solution of the three dimensional quasisteady heat conductivity problem of melting and evaporation of such a body is produced. Consideration of the solid to liquid phase transition does not result in significant changes in the rate of melting and evaporation but does signficantly influence the thickness of the melt and the temperature field. Conditions are evaluated under which the solution can be used to analyze the process of cratering in a material absorbing a concentrated energy beam. References 6: all Russian. [104-6508]

UDC: 669.24.669.25:536.423.1

RATE AND MECHANISM OF EVAPORATION OF NICKEL AND COBALT AT 1750-2000°C AND CHANGE IN INERT GAS PRESSURE

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 1, Jan-Feb 82 (manuscript received 8 Jun 81) pp 75-80

BURTSEV, V. T. and GRIGOR'YEV, A. M., Moscow

[Abstract] Results are presented from an experimental study of the evaporation rate of nickel and cobalt at 2000°C with argon and helium pressures of 10 to 10^5 Pa. The method of melting in the suspended state was used to eliminate contact with the crucible lining and create favorable conditions

for evaporation with maximum ratio of surface area to volume of metal. Two series of melts were performed, one studying the evaporation of nickel in argon and helium, the second studying cobalt in argon and helium. The variation in evaporation rates of the metals was found to be: for nickel at 1740°C $W_{Ni}=0.003\ P^{-0.738}_{He}$ and 1940°C $W_{Ni}=0.003\ P^{-0.706}_{Ar}$; for cobalt at 1790°C $W_{Co}=0.003\ P^{-0.706}_{He}$ and at 2010°C $W_{Co}=0.003\ P^{-0.368}_{Ar}$, $g \cdot cm^{-2} \cdot s^{-1}$. Figures 3; references 11: 9 Russian, 2 Western.
[104-6508]

UDC: 669.15'24'779'781:535.33/.34:539.213

ELECTRON STATE OF IRON ATOMS IN $Fe_{40}Ni_{40}P_{16}B_4$ METAL 'GLASS'

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 53, No 1, Jan 82 (manuscript received 27 Dec 79, in final form 23 Mar 81) pp 204-207

NABEREZHNYKH, V. P., SAMOYLENKO, Z. A., and DAROVSKIKH, Ye. G., Donets Institute of Physics and Technology, Ukrainian Academy of Sciences

[Abstract] A study is made of the amorphous alloy $Fe_{40}Ni_{40}P_{16}B_4$ obtained by very rapid cooling of a jet of melt flowing from a rapidly spinning copper disk. The specimen was a strip 30 μm thick, a strong ductile magnetically soft material. The electron state of the Fe was studied in the initial amorphous state and following crystallization by annealing at 420°C for 90 minutes in a vacuum by x-ray emission and absorption spectroscopy. The iron atoms in the amorphous state can be represented as doubly ionized with electron configuration $3d^6$. The position of the ionized iron atoms in the amorphous metal glass state is statistically spread about a certain mean value. The electron structure of the iron atoms is inherited upon crystallization of the alloy. Figures 2; references 5: all Russian.
[101-6508]

UDC: 669.849

PRODUCTION OF RHENIUM FOIL BY ELECTROLYSIS OF MELTED SALTS

Moscow TSVETNYYE METALLY in Russian No 2, Feb 82 pp 69-70

YERMAKOV, V. I., NEUSTROYEV, V. I. and VINOGRADOV-ZHABROV, O. N.

[Abstract] The Institute of Electrochemistry, Urals Scientific Center, USSR Academy of Sciences, has developed a technology for electrolytic production of rhenium foil and has produced experimental batches on nonstandard equipment at the experimental plant of "Unipromed'" Institute. The technology is based on electrolysis of a melted salt bath containing, %: 41.0-42.0 NaCl, 45-46 KCl, 12-13 K_2ReCl_6 at 800-900°C in an inert

atmosphere with a current density of up to 0.2 A/cm^2. The process is performed in a sealed 2-chamber electrolyzer with a metallic rhenium consumable anode in a carbon-reinforced glass vessel with quartz glass and carbon-reinforced glass screens to prevent contamination of the electrolyte by the walls of the electrolyzer. The cathode consists of polished tubes of carbon-reinforced glass, with electricity applied to the cathode through a stainless steel rod covered with quartz glass and to the anode through the body of the electrolyzer, the graphite base and the carbon-reinforced glass container. A drawing of the electrolyzer is presented. The duration of the technological cycle including preparation of the matrix, evacuation of the electrolyzer, creation of the protective atmosphere, preparation and electrolysis averages two hours. The mass of the foil produced is 4-5 g per operation depending on the thickness and area of precipitation. The rhenium foil was produced as rectangular sheets 70 to 150 cm^2 in area, with a matte finish on the electrolyte side, shiny on the matrix side, yield per unit current 82-86%. Sheets of acceptable quality were found in 60 to 70% of the cases. The advantages of the method include high chemical purity of the products, reduction in power consumption due to the decrease in temperature of the process, elimination of later mechanical working, and high raw material usage factor due to reutilization of rejected foils and scrap as anode material. Figures 1.
[103-6508]

UDC: 669.24:621.77

DEFORMABILITY OF REFRACTORY NICKEL ALLOY COMPACTS

Moscow TSVETNYYE METALLY in Russian No 2, Feb 82 pp 87-89

YERMANOK, M. Z., SOBOLEV, Yu. P., BONDAREV, A. A., KRYKINA, G. S. and SKUDNOV, V. A.

[Abstract] Deformation of blanks consisting of powder refractory nickel alloy granules compacted at temperatures above the point of complete dissolution of the γ' phase leads to the development of cracks, pores and other defects in the areas of maximum stress. Earlier works have shown the effectiveness of stamping of low plasticity powder compacts under high hydrostatic pressure. Deformations of 50% and more have been achieved by high hydrostatic pressure working. Tensile testing of specimens in the 1050-1250°C range at mean deformation rates of $6.6 \cdot 10^{-2}$-$6.6 \cdot 10^{2}$ s^{-1} was used to determine σ_s for powder compacts thus produced. The data indicate significant predominance of velocity hardening over deformation hardening, indicating that the plastic flow stress during hot working of a powder compact is independent of the degree of deformation. It is found that very high values of the stress state index can be achieved by increasing lateral pressure during deformation, allowing the temperature-speed range of deformation of low-plasticity powder compacts to be expanded. Figures 4; references 5: all Russian.
[103-6508]

UDC: 669.27:621.774.38

EXPANSION OF REFRACTORY METAL TUBING

Moscow TSVETNYYE METALLY in Russian No 2, Feb 82 pp 75-76

POTAPOV, I. N. and KRAVCHENKO, S. G.

[Abstract] A study is presented of the expansion of hollow refractory metal tubing blanks, particularly molybdenum. Pressing was performed on a vertical 16,000 kN hydraulic press. A penetrating aperture 25 mm in diameter was drilled through ingots 125 mm in diameter. The tool used was a 48-mm-diameter needle with an expander tip on the free end with a gage section 53 mm in diameter. The lubricant used was a graphite ring 100 mm in height placed on the upper end of the blank. Pressing was performed through a die 80 or 85 mm in diameter. Studies of the macrostructure and microstructure of the tubing produced showed that there were not cracks or other defects on the inside or outside. The grain size and structure were found to change little during the process, though the grain in the direction parallel to the pressing axis was reduced in size, a result of the nature of flow of the metal during expansion. Visual inspection indicated that the products could be successfully used as semifinished goods for later pressure working without intermediate mechanical treatment, since the height of projections on the pipe surface was not over 0.5-0.7 mm, 0.3-0.5 mm on the inside. Variation in wall thickness over the length of the pipe was not over 0.7-0.9 mm, within the limit of tolerance for this type of product. The expander tips used were found to have short operating life.
Figures 1.
[103-6508]

UDC: 620.184.6

BREAKAGE OF CRYOGENIC STEEL AT LOW TEMPERATURES BY SHORT CYCLE FATIGUE

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 2, Mar-Apr 82 (manuscript received 2 Jul 80) pp 157-158

DURYAGIN, V. A., KUSLITSKIY, A. B., KOKOTAYLO, I. V. and KATSOV, K. B., L'vov

[Abstract] A study is presented of the specifics of the process of deformation and fracture of 9% nickel steel (0.03C, 0.56Mn, 0.33Si, 9.52Ni, 0.05Al, 0.28Mo, 0.03Cr, 0.008S%) under low cycle low temperature fatigue conditions. Sheet specimens were bent 0.75-1.25% in the +20 to -196°C temperature interval, using liquid nitrogen as the cooling agent. Decreasing the temperature to -160°C was found to increase the durability of the steel. As the amplitude of deformation increased and temperatures

decreased, the area of the zone of propagation of a fatigue crack diminished and the zone of brittle fracture enlarged. At low temperatures the dominating factor in limitation of durability is the duration of the stage of crack formation rather than the duration of the stage of crack propagation as at room temperature. Figures 3; references 3: all Russian. [116-6508]

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