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USSR AND EASTERN EUROPE SCIENTIFIC ABSTRACTS  
MATERIALS SCIENCE AND METALLURGY

No. 43

This serial publication contains abstracts of articles and news items from USSR and Eastern Europe scientific and technical journals on the specific subjects reflected in the table of contents.

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Analysis and Testing

USSR

UDC 621.318.1:538.22.082.78

METHOD OF INVESTIGATION OF CONCENTRATION DEPENDENCES OF THE MAGNETIC PROPERTIES OF FERRO- AND FERROMAGNETIC POWDERS

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 42, No 10, 1976 pp 1191-1194  
manuscript received 5 May 75

GALKINA, O. S., ZAKHAROVA, N. N., and LAZAREVA, L. V., Moscow State University

[Abstract] The authors have developed a new method allowing measurement of the magnetic properties of a specimen of powder over a broad range of concentrations. A special chamber has been constructed, operating on the principle of a device for production of variable forces. The powder is compressed to the required concentration by a piston moving in a calibrated channel of the chamber. The chamber is made of diamagnetic materials which do not interfere with the results of the measurement. The method suggested can be used both in laboratory studies and in the performance of rapid analyses of powders under production conditions. References 13: 8 Soviet and 5 non-Soviet.

USSR

A METHOD OF MEASUREMENT OF THE POROSITY OF FOIL

Moscow ZAVODSKAYA LABORATORIYA in Russian No 11, 1976 pp 1376-1377

VYACHESLAVOV, P. M., BORTSOV, N. N., TERESHKIN, V. A., and SMEKALOVA, V. V., Leningrad Technological Institute

[Abstract] The method suggested by the authors is based on the electrochemical reaction of anodic oxidation:  $2I^- \rightarrow I_2 + 2e^-$ . The iodine formed causes blue coloration of starch. This qualitative reaction for the presence of iodine is very sensitive, allowing the resolving capacity of the method to be increased greatly. Galatin is added in order to fix the colored spots in the indicator starch solution. The method can determine only penetrating pores, regardless of the foil material. When a constant voltage is applied to the electrodes, the current which flows depends on the number of pores and is proportional to their total area. References 4: all Soviet.

USSR

UDC 669.3-416:546.56'21:543.2.062

A METHOD OF DETERMINATION OF OXIDES ON THE SURFACE OF A COPPER ELECTROLYTIC FOIL

Moscow ZAVODSKAYA LABORATORIYA in Russian No 11, 1976 pp 1353-1355 manuscript received 22 May 75

KOCHEROVA, A. V., GOLOVINA, YE. S., and KOROTKOVA, T. S., State Scientific Research and Planning Institute for Alloys and Working of Nonferrous Metals, Moscow

[Abstract] The purpose of this article was to find a simple and rapid method for testing of foil before pressing, to determine the galvanic stability of the foil-coated dielectric, i.e. the degree of etching. It was found that the galvanic stability of foil-coated dielectrics is determined by the absence of oxides on the surface of the copper foil. Therefore, the method of determination of oxides on the surface of the copper foil can serve as an indirect method of determination of the galvanic stability of the foil-coated dielectric. Electrometric and electronographic methods of investigation were used to study the phase composition of the surface of the copper foil. The use of the method over the course of two years has indicated that it can successfully test foil before it is pressed onto the dielectric.

USSR

SPECTRAL DETERMINATION OF ALUMINUM AND IRON IN POWDERS WITH HIGH CHROMIUM CONTENT (60-70%)

Moscow ZAVODSKAYA LABORATORIYA in Russian No 11, 1976 pp 1346-1347

MAGRILOVA, I. M., IVANOVA, I. S., MUSATOVA, A. A., and SURIS, K. G., Scientific Research Institute for the Technology of Tractor and Agricultural Machine Building, Moscow

[Abstract] The suggested method of analysis of powders containing 60-70% Cr is based on photography of the spectrum of the dry residue of a drop of solution of the powder in sulfuric acid (1:4). Specimens of solution were applied to a hot carbon electrode; after evaporation of the liquid phase, the radiation spectrum was photographed. Determination was performed on an ISP-28 spectrograph (slit width 0.015 mm, three-lens illumination, circular diaphragm), excitation source -- IG-3 spark generator, constant electrode -- carbon rod sharpened to a cone; analytic gap 1 mm; exposure 10 s.

USSR

UDC [546.74+546.73]:543.422.063

DETERMINATION OF NICKEL AND COBALT IMPURITIES IN PURE METALS AND ALLOYS BY THE METHOD OF FLAMELESS ATOMIC ABSORPTION SPECTROPHOTOMETRY

Moscow ZAVODSKAYA LABORATORIYA in Russian No 11, 1976 pp 1331-1332 manuscript received 26 Jan 76

MERZLYAKOV, A. V., MALININA, R. D., SOLOMATIN, V. T., and NUZHDINA, V. N., Central Scientific Research Institute for Ferrous Metallurgy imeni Bardin

[Abstract] Determination of the content of cobalt in metallic nickel, nickel and cobalt in metallic copper and molybdenum, and nickel in cobalt-based alloys is difficult. The authors used the method of flameless atomic absorption spectrometry with a graphic cuvette for this purpose. The work was performed on a Perkin-Elmer spectrophotometer model 305 B. The elements were determined in a three-stage program involving drying, thermal decomposition and atomization, without preliminary separation of impurities from the base metal. The macrocomponent has almost no influence on the atomization of the nickel and cobalt. A linear dependence is observed between the concentration of the elements studied and the magnitude of the signal in the interval of concentrations of 0.1 to 0.5  $\mu\text{g/ml}$ . The limit of detection of nickel is about 0.05  $\mu\text{g/ml}$ , of cobalt about 0.1  $\mu\text{g/ml}$  with a volume of the specimen studied 100  $\mu\text{l}$ . Reproducibility for nickel is about 6%, for cobalt about 5% (exception: cobalt in nickel, 10%).

USSR

UDC 621.791.053-462:620.179.16

ULTRASONIC QUALITY TESTING OF WELDED SEAMS IN LARGE DIAMETER PIPES

Moscow ZAVODSKAYA LABORATORIYA in Russian No 11, 1976 pp 1379-1381 manuscript received 21 Apr 76

STIPURA, A. P., ZAGORUL'KO, V. S., SHCHIPANOV, V. A., and V'YUNICHENKO, V. N., All-Union Scientific Research and Design Technology Institute for the Pipe Industry, Dnepropetrovsk

[Abstract] Quality testing of welded seams in pipe is performed using an ultrasonic "SNUP" installation, which includes: an electronic section, portable generator-preamplifier unit, mechanical-pneumatic-hydraulic system to mount and orient the sensors during tuning and testing and devices to mark defects in the welded seam and zone around the seam. The defectoscope operates in the pulse mode by the echo method. Shear waves propagating in the wall of the pipe along a zigzag path at an angle of  $20^\circ$  to the surface are used. The defectoscope operates in three cycles, two testing and one AGC cycle.

USSR

UDC 620.179.16

USE OF RAYLEIGH WAVES TO ESTIMATE THE QUALITY OF SURFACE HARDENING

Sverdlovsk DEFEKTOSKOPIYA in Russian No 5, Sep-Oct 76 pp 18-22 manuscript received 15 Jul 75

BOBRENKO, V. M., and RUBLEV, YA. A., All-Union Institute for Aviation Materials; All-Union Scientific Research Institute for the Development of Nondestructive Methods and Instruments for Quality Control, Kishinev

[Abstract] Results are presented from studies of the effect of acoustoelasticity of surface waves for certain aluminum alloys. Acoustoelastic coefficients are defined for this type of waves, relating the change in velocity to stress. Methods are discussed for ultrasonic testing of the stress-strain state of materials subjected to strain hardening. The experimental results produced allow two versions of strain hardening quality testing to be suggested. The first involves qualitative selection (rejection) on the basis of a preliminarily established reject characteristic for each material based on the resultant change in velocity of surface waves measured before and after strain hardening; the second requires determination of the stresses produced as a result of this technological operation, i.e., differential determination of the relative change in velocity of Rayleigh waves as a result of plastic deformation and as a result of the effects of the elastic stresses themselves. References 6: all Russian.

USSR

UDC 669.14:538.22.082.78:620.178.3

STUDY OF THE MAGNETIC PROPERTIES OF STEELS IN THE PROCESS OF FATIGUE

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 42, No 12, 1976 pp 1488-1491 manuscript received 4 Jan 76

KASIMOV, G. A., and POKROVSKIY, A. D., Moscow Power Engineering Institute

[Abstract] The authors have developed a nondestructive method of recognition of structural damage in important parts, based on a study of the influence of cyclical loading of structural steels on their magnetic characteristics. Circular specimens of rectangular cross section are used. A motor rolls the specimens around the motor shaft and a pulley and the changes in magnetic characteristics in the process of fatigue is determined by the method of compensation using a standard specimen. The purpose of the experimental study was to determine the influence of the degree of fatigue damage to steel specimens on the basic magnetization curve and symmetrical cycles of magnetic hysteresis. A schematic diagram of the installation used to measure the magnetic characteristics and mechanical diagram of the installation for fatigue testing of circular specimens are presented.

USSR

UDC 620.178.2-41

METHOD OF TESTING OF SHEET MATERIALS FOR RUPTURE VISCOSITY

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 42, No 12, 1976 pp 1497-1499  
manuscript received 31 Oct 75

ZAKHAROV, YU. V., GORBACHEV, V. I., REZNIKOV, YU. A., and PARAYEV, S. A.

[Abstract] This work deals with the determination of the moment of initiation of a crack and the kinetics of its development in rupture testing of sheet materials by a method based on simultaneous use of the methods of bias and electric potentials. This is a fortunate combination, since the method of bias is sensitive to the appearance of plastic deformation at the tip of a crack, while the method of electric potentials, though insensitive to this effect, reacts to changes in crack length. The work also studies the influence of placement of potential contacts on the sensitivity of the method of electric potentials. A block diagram of the installation used is presented. The results presented show that the method allows reliable and objective determination of the moment of initiation of a crack and determination of the values of the parameters required for calculation of the characteristics of viscosity of rupture during testing of sheet materials. References 4: 3 Soviet and 1 Western.

USSR

UDC 621.791.053:620.178.38

THERMAL FATIGUE TESTING OF WELDED JOINTS OF DISSIMILAR STEELS

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 42, No 12, 1976 pp 1503-1505  
manuscript received 10 Nov 75

KOROLEV, N. M., BUTOV, YU. A., and KOVYAZIN, A. K., All-Union Scientific Research and Planning-Design Institute for Petroleum Machine Building, Moscow

[Abstract] The authors' institute has studied the thermal fatigue properties of welded joints in type 15Kh5M chrome-molybdenum steel, made using type EA-2 austenitic electrodes. A test stand has been developed allowing automatic repeated heating and cooling of a tubular specimen under internal pressure within a predetermined temperature interval. In contrast to experiments performed earlier with solid composite specimens, the testing of a tubular specimen allows the joint influence of residual welding, working and thermal stresses caused by differences in coefficients of linear expansion of the perlitic and austenitic metals on the strength of the welded joint to be determined upon thermal cycling. The pressure in the specimen is created when water poured into it is heated by electric current passing through it.

USSR

A SPECIMEN FOR STUDYING CHANGES IN MECHANICAL PROPERTIES DURING HEAT RESISTANCE TESTING

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 42, No 12, 1976 pp 1524-1525

DORONIN, I. V., Moscow Institute of Steels and Alloys

[Abstract] Specimens usually used for long-term strength testing have small gage section diameter and cannot be used for the determination of such important characteristics as impact toughness. The author suggests a new specimen of a greater diameter, 15 mm, which can be used to manufacture a specimen for determination of impact toughness and another specimen for tensile testing at room or elevated temperatures. References 2, both Russian.

USSR

UDC 620.179.16

OPTICAL EXCITATION AND RECORDING OF NANOSECOND ACOUSTICAL PULSES DURING NONDESTRUCTIVE TESTING

Sverdlovsk DEFEKTOOSKOPIYA in Russian No 6, Nov-Dec 76 pp 85-88 manuscript received 23 Mar 76

BONDARENKO, A. N., DROBOT, YU. B., and KRUGLOV, S. V., All-Union Scientific Research Institute of Physical Engineering and Electronic Measurements

[Abstract] An electronic-optical device is described for excitation and recording of acoustical signals in the nanosecond range. The signals are excited by a ruby laser in the Q pulse resonator mode. They are recorded by means of a dual beam interferometer, allowing measurement by a contactless method with a sensitivity of  $10^{-7}$  cm with a transmission band of the recording device of 5 kHz-150 MHz. Possibilities for using the device in thickness measurement, high resolution defectoscopy and determination of the speed of sound and modulus of elasticity are noted. References 2: both Soviet.

Coatings

USSR

UDC 669.24'784.018.44

APPLICATION OF ELECTROCHEMICAL NICKEL COATINGS TO CONTINUOUS CARBON FIBERS

Moscow VOLOKNIST. I DISPERSNOUPROCHEN. KOMPOZITSION. MATERIALY [Fiber and Dispersion-Resistant Composition Materials] in Russian, Izd-vo Nauka, 1976 pp 38-40

YAGUBETS, A. N. and PONOMAR', V. V.

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 12, 1976 Author's Abstract No 12I684]

[Text] Protective coatings 0.05-0.40  $\mu$  thick were deposited from various electrolytes for subsequent introduction into a metal matrix. The authors studied the conditions for improving evenness of distribution of nickel coatings, and also some of their properties. 2 Illus. 5 Biblio.

## Composite Materials

USSR

UDC 669.27.018.44

### CONTINUOUS FIBERS OF REFRACTORY COMPOUNDS

Moscow VOLOKNIST. I DISPERSNOUPROCHEN. KOMPOZITSION. MATERIALY [Fiber and Dispersion-Resistant Composition Materials] in Russian, Izd-vo Nauka, 1976 pp 16-20

KOSOLAPOVA, T. YA.

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 12, 1976 Author's Abstract No 12I681]

[Text] The advantages and disadvantages in connection with mechanical properties are given for the most widely used groups of reinforcing refractory materials; also, the chemical compatibility which these substances have with matrix materials. The basic laws involved in the processes of the formation of continuous refractory fibers are presented: extrusion of plasticized mixtures of powders, and precipitation from the gaseous phase. The process of obtaining continuous fibers from silicon carbide is discussed in detail. The properties and structure of such fibers are determined. The promising character of these fibers, and the expedience of applying coatings to them in order to achieve the utmost improvement in properties, are pointed out. 10 Biblio.

USSR

UDC 669.245'71'784.018.44

### A STUDY OF THE PHENOMENA TAKING PLACE ON THE SURFACE OF A GRAPHITE FIBER-METAL COATING INTERFACE

Moscow VOLOKNIST. I DISPERSNOUPROCHEN. KOMPOZITSION. MATERIALY [Fiber and Dispersion-Resistant Composition Materials] in Russian, Izd-vo Nauka, 1976 pp 41-43

GOL'DINER, M. G. and YAGUBETS, A. N.

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 12, 1976 Author's Abstract No 12I685]

[Text] The raster method of electron microscopy is used to study the effect of alloying on the spontaneous separation of a coating into islets. It is shown that separations of a coating do not occur when the amounts of evaporated and condensed substances are equal. The authors believe in the possibility of reinforcing liquid aluminum with graphite fibers having nickel coatings following an appropriate improvement in the apparatus for impregnation. 1 Illus. 5 Biblio.

USSR

UDC 669.292'871.018.9

PREPARATION AND PROPERTIES OF COMPOSITES ON THE BASIS OF SUPERCONDUCTING COMPOUNDS

Moscow FIZ.-KHIMIYA SVERKHPROVODNIKOV [Physical Chemistry of Superconductors, a Collection of Works] in Russian, Izd-vo Nauka, 1976 pp 65-72

SAVITSKIY, YE. M., YEFIMOV, YU. V., MIKHAYLOV, B. P., and ZVOLINSKIY, O. I.

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 12, 1976 Author's Abstract No 12I699]

[Text] This is a survey of modern methods for the production of composition materials from superconducting compounds of type A15. The authors examine the basic technological variants of obtaining cable from composition materials based on  $V_3Ga$  and  $Nb_3Sn$  with use of the method of diffusion in the solid phase; they also study the relationship between conducting capacity, and the temperature and time of thermal processing. The possibility of obtaining cable by the method of deformation of compounds in a plastic matrix is discussed. 5 Illus. 1 Table. 17 Biblio.

USSR

UDC 669.018.9

THE ROLE OF COMPOSITION MATERIALS IN TECHNICAL PROGRESS

Moscow VOLOKNIST. I DISPERSNOUPROCHNEN. KOMPOZITSION. MATERIALY [FIBER AND DISPERSION-RESISTANT COMPOSITION MATERIALS] in Russian, Izd-vo Nauka, 1976 pp 5-9

TUMANOV, A. T.

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 12, 1976 Author's Abstract No 12I676]

[Text] Given are the properties of composition materials on the base of metallic, polymeric and ceramic matrices reinforced with high-molecular, high-strength, continuous fibers, filament-type crystals or dispersion particles. The multiplicity of the properties of reinforcers and matrices offers wide possibilities for the purposeful regulation of strength and rigidity qualities, and also of the level of working temperatures of materials. The author demonstrates the advantages of metallic and polymeric materials now in use in the manufacture of aircraft and other products of the machine-building industry. 3 Tables.

USSR

UDC 539.377

METHOD OF DETERMINATION OF TEMPERATURE DEFORMATIONS IN COMPOSITE POLYMER MATERIALS

Kiev PROBLEMY PROCHNOSTI in Russian No 12(90), Dec 76 pp 97-101 manuscript received 13 Feb 75

ESKIN, E. A., FEDCHUK, V. K., PETROV, A. S., and VENGZHEN, V. V., Institute of Problems of Strength, Acad. Sci. UkSSR

[Abstract] A method was developed to eliminate the shortcomings of existing methods of studying temperature deformations using rod specimens. The method is based on the use of specimens in the form of thin, solid disks. The entire picture of change of linear and shear temperature deformations can be traced from the results of testing a single specimen by the new method. Testing of asbotextolite indicates significant anisotropy of temperature deformations on the axes of elastic symmetry. Type SSFT glass-reinforced textolite, due to the more even distribution of fabric and its fibers by direction, has less temperature deformation anisotropy. There is significant divergence among the quantitative estimates of temperature deformations of these materials by the old rod method. The method using circular specimens eliminates the influence of the effect of cut fibers and allows shear deformations to be determined. Studies of the shrinkage of asbotextolite have shown that it has shrinkage anisotropy, which is of the same nature as the anisotropy of temperature deformations. Furthermore, the shrinkage of asbotextolite is closely related to the weight loss of the material.

USSR

UDC 621.763:669.15

STRENGTH PROPERTIES OF POROUS FIBER MATERIALS WITH ORIENTED STRUCTURE BASED ON STAINLESS STEEL

Kiev PROBLEMY PROCHNOSTI in Russian No 12(90), Dec 76 pp 82-84 manuscript received 4 Jan 76

GORB, M. L., ZORIN, V. A., IVANCHUK, A. A., and RUTKOVSKIY, A. YE.

[Abstract] Data are presented on the tensile strength and impact toughness of fiber materials as functions of porosity and test temperature. The porous material tested was based on wire made of Kh18N9T steel 30  $\mu\text{m}$  in diameter. The specimens tested were manufactured by overlaying several knitted fabric layers, cold pressing and subsequent sintering at 1350°C for 3 hr at a pressure of  $10^{-4}$ - $10^{-5}$  mmHg. Pressing at pressures of 0.5 to 11 t/cm<sup>2</sup> produced varying

porosity (from 10 to 80%). The material was found to have higher strength characteristics than materials based on powder or discrete fibers of the same steel. This results from the oriented placement of the fibers and great evenness of distribution. Detailed study of the mechanism of deformation and rupture of the porous material requires further investigation. References 5: all Soviet.

USSR

UDC 669.71:539.4.019

THE PROPAGATION OF CRACKS ON COMPOSITE MATERIALS

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 12, No 6, Nov-Dec 76 pp 78-80

MAKSIMOVICH, G. G., LYUTYY, YE. M., YELISEYEVA, O. I., and KADYROV, V. KH., L'vov Physico-Mechanical Institute, Academy of Sciences Ukrainian SSR, and Kiev Institute of Problems of Materials, Academy of Sciences Ukrainian SSR

[Abstract] The possible schemes of crack propagation for statically elongated composite materials are studied, in connection with the strength and deformation properties of the matrix and of reinforcing fibers, and also with the strength of their bond along the interface. Several combinations of properties are considered: brittle matrix-plastic fiber, brittle matrix-brittle fiber, plastic matrix-brittle fiber, and plastic matrix-plastic fiber.

## Conferences

USSR

UDC 621.791:061.3:693.814.25:621.791:669.295

SEMINAR ON WELDING OF TITANIUM AND OTHER NONFERROUS METALS AT CONSTRUCTION SITES

Kiev AVTOMATICHEKAYA SVARKA in Russian No 10(283), Oct 76 p 77

VOLKOV, V. B., and YEVALENKO, S. I., Engineers

[Abstract] The seminar was held 25-26 May 1976 in Zaporozh'ye, with the participation of 12 organizations. Of the total number of reports presented at the seminar, 12 were on welding of titanium alloys, with emphasis on titanium pipes. The remaining reports were concerned with the welding of copper and aluminum alloys. Most of the participants were from the Ukrainian SSR, representing various organizations dealing with construction projects. Proceedings of the seminar are to be published separately.

## Forming

USSR

UDC 621.73.043:621.979-82

### INFLUENCE OF HOLDING UNDER PRESSURE ON PRECISION OF FORGINGS OF LIGHT ALLOYS WITH ISOTHERMAL DEFORMATION

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 10, Oct 76  
pp 9-10

KOPYSKIY, B. D.

[Abstract] When light alloy panels are stamped on hydraulic presses, the die moves quite rapidly for 90 to 95% of the working stroke, followed by a "prestamping" stage with extremely slow die movement speed, 2-3 orders of magnitude lower than the initial speed. This stage occurs under isothermal conditions and is of particular interest for the achievement of high precision of shape and dimensions of products. In practice, in this "pre-stamping" stage, the forging is held under pressure at a temperature significantly higher than the recrystallization temperature of the alloy, causing significant softening of the forging material, which was hardened during the first, high-speed stage of deformation. A reduction in flow resistance of the material to a value near the creep limit is possible during this stage. The peculiarities of shape change upon isothermal deformation after filling of the stamp and their influence on the precision and quality of products are studied. This stage not only increases the precision of products, but also allows the required pressure to be decreased to values assuring long life and strength of stamps. References 4: all Soviet.

## Graphite

USSR

UDC 541.1

### EFFECT OF GASEOUS MEDIA ON GRAPHITE FIBERS AT HIGH TEMPERATURES

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, CHERNAYA METALLURGIYA in Russian No 11, 1976 pp 10-14

VARENKOV, A. N., GOLOSHCHAPOV, F. A., and MOZZHUKHIN, YE. I., Moscow Institute of Steel and Alloys

[Abstract] The method of thermogravimetric analysis is used to study the interaction which exists between graphite fibers and gaseous media heated to temperatures below 1000 C°. The fibers used were obtained from polyacrylite prepared at 1000, 2000, 2750 and 3000°C.

It was found that the fiber-air chemical interaction depends primarily on the structure of the fiber, determined, in its turn, by the temperature of manufacture: the higher the temperature the less the rate of interaction. The interaction was also found to be nonuniform. In a vacuum ( $10^{-3}$  mm Hg), and also in an atmosphere of industrial argon at 1000°C, no interaction whatever was observed between the fiber and the residual active gasses. Figures 3; references 12: 6 Russian and 6 Western.

USSR

UDC 546.26-162

### INFLUENCE OF PHOSPHORUS COMPOUNDS, METAL IMPURITIES AND STRUCTURAL DEFECTS ON THE RESISTANCE OF GRAPHITE TO OXIDATION

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 12, No 12, Dec 76 pp 2155-2158 manuscript received 27 Feb 75

VASIL'YEV, YU. N., and YEMEL'YANOVA, V. M.

[Abstract] This work presents a study of means for increasing the oxidation resistance of graphite by considering the effects of phosphorus compounds, metal impurities and the defects present in the structure. The studies were performed on a circulating flow installation in which temperature and concentration gradients were eliminated. The oxidizer used was oxygen or air. After each experiment, the specific surface of the specimens was measured using the low temperature adsorption of nitrogen by the chromatographic method. The rate of oxidation of graphite materials is determined to 90-95% by catalytic metal impurities, the content of which in graphite is  $10^{-3}$ - $10^{-5}$  wt.%. The oxidation rate of carbon materials is proportional to defect structure if the influence of impurities is eliminated. References 15: 6 Soviet and 9 Western.

## Heat Treatment

USSR

UDC 621.789:669.018.5

HEAT TREATMENT OF YUNDKT-TYPE ALLOYS CONTAINING 38-40% Co and 8-8.5% Ti

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 12, 1976 pp 13-16

BLATOV, V. G., SAMARIN, B. A., and SHUBAKOV, V. S., Moscow Institute of Steel and Alloys

[Abstract] To simplify the thermomagnetic treatment of alloys of types YuNDK38T8 and YuNDK40T8, it is necessary to delineate the "nucleation" stage from the decomposition stage. In these alloys the formation of nuclei of the alpha-prime stage can be accomplished without having a magnetic field, with cooling in the 900-600°C range at 125-280 degrees per minute. The devised method described here for thermomagnetic processing consists in cooling of the single phase region to 800-600°C, at a rate of 125-280 degrees per minute, with high-temperature tempering in a magnetic field at 830-850°C for 12 minutes. Processing threefold tempering is accomplished at 650-550°C. The proposed method makes possible superior magnetic properties in alloys of the two types mentioned. Figures 1; references 4: all Soviet.

Instrumentation and Equipment

USSR

UDC 666.76.4:620.178.143.3

STUDY OF MICROHARDNESS OF CARBON MATERIALS BY THE SCLEROMETRIC METHOD

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 42, No 10, 1976 pp 1253-1255  
manuscript received 10 Sep 75

KHRISANOVA, L. B., and TELEGIN, V. D.

[Abstract] The Institute of Machine Building has developed an instrument and corresponding method for sclerometric testing of metals, alloys, minerals and plastics. The instrument is a modified type PMT-3 microhardness meter, adapted for scratch testing. Loads of 3 to 200 g can be used, with scratching in both directions. The optical system of the microscope allows the scratches to be measured with great accuracy. The studies performed show that the method of determination of microhardness by scratching is usable for carbon materials, expanding our knowledge of their properties.

References 4: 3 Soviet and 1 Western.

USSR

A DEVICE FOR TESTING OF MOLDING MATERIALS AT HIGH TEMPERATURES

Moscow ZAVODSKAYA LABORATORIYA in Russian No 11, 1976 pp 1377-1378

USTINOV, V. I., and MIKHAYLOV, A. M., Moscow Institute of Steels and Alloys

[Abstract] Existing instruments for the testing of mold materials at high temperatures suffer from a high natural coefficient of thermal expansion of the system and nonlinearity of the output characteristic of the measuring sensor. The authors suggest a device based on a Panov dilatometer for determination of deformation and volumetric changes in a specimen at constant load or under zero load at temperatures up to 1400°C. The instrument can produce a curve characterizing the deformation as a function of temperature directly on a strip-chart potentiometer. A diagram of the instrument is presented. Coefficients of thermal expansion of materials can be determined with the instrument to an accuracy of  $0.25 \cdot 10^{-6} \cdot \text{C}^{-1}$ .

USSR

UDC 621.791.037:678.029.46

THE USPE-1 INSTALLATION FOR WELDING OF REINFORCED MATERIALS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 8 (502), Aug 76 p 46

SOLOV'YEV, V. P., SMIRNOV, G. M., and KISELEV, V. P.

[Abstract] A description is presented of an installation designed for spot welding of reinforced materials based on thermoplastic materials up to 2.5 mm thick. The machine consists of a support carrying a stage, cabinet, two stress stabilizers and a transformer panel, and two low-inertia heaters. The support carries the hydraulic cylinder driving the upper heater. The shaft of the hydraulic cylinder can rotate the heater by 90° to weld circular and line joints. A photograph and schematic diagram of the device are presented.

Magnesium

USSR

UDC 669.72:669.018.2

DISLOCATION SLIPPING DURING SUPERPLASTIC DEFORMATION OF THE MA8 ALLOY

Moscow FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 5, Nov 76  
pp 1102-1105

VALIYEV, R. Z., and KAYBYSHEV, O. A., Ufa Aviation Institute imeni S.  
Ordzhonikidze

[Abstract] The action of dislocation slipping in conditions of superplasticity is studied on the basis of textural changes. The MA8 alloy (Mg, 1.5% Mn, 0.3% Ce) is used as the object of study.

It is concluded that dislocation slipping in the superplastic deformation state does not affect the possibility of grain-boundary slippage such as is observed in many materials. Apparently the action of those processes should be regarded in close interconnection; while it appears that intra-grain slipping determines breaks along the boundaries of slip as has been specified in an earlier work (Phys. Stat. Sol. (a), 1976, 35, p 403).  
Figures 3; references 9: 7 Soviet and 2 Western.

## Mechanical Properties

USSR

UDC 620.1722:669.295:669.268

### THE INFLUENCE OF CHROME COATINGS ON THE MECHANICAL PROPERTIES OF TITANIUM

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 76  
pp 86-89 manuscript received 3 Jul 75

AZHAZHA, V. M., VASYUTINSKIY, B. M., KARTMAZOV, G. N., and SHCHERBAK, S. P.,  
Khar'kov

[Abstract] A study is made of the influence of chrome coatings and the degree of oxidation on the mechanical properties of titanium at room temperature, as well as the influence of coatings on the titanium creep at 700°C. It is shown that titanium with a chrome coating has higher plastic properties, with considerably greater relative elongation (by a factor of 3-5), depending on the thickness of the coating, and also twice as low an endurance limit, than do uncoated specimens. Figures 1; tables 3; references 7: 6 Soviet and 1 Western.

USSR

UDC 669.14.018.41:620.172.251.1

### INFLUENCE OF NICKEL ON THE MECHANICAL PROPERTIES OF CHROME-MANGANESE STEELS WITH NITROGEN

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, CHERNAYA METALLURGIYA in  
Russian No 12, 1976 pp 108-110 manuscript received 28 Oct 75

KHOROSHAYLOV, V. G., SHINKARENKO, YE. T., DEMCHUK, I. S., and ANTROPOV, N. P.,  
Leningrad Polytechnical Institute

[Abstract] A study is made of the influence of nickel, nitrogen and carbon on the mechanical properties of type Kh13G18 chrome-manganese steel. The specimens were produced in an induction furnace. Ingots (25 Ka) were forged into rectangular billets with a cross section of 5 x 28 mm, which were then hardened from 950°C by quenching in water. Holding time at 950°C was 40 minutes. Flat 3 x 4 mm specimens were then made from the billets, and heat-treated by heating to 950°C, holding 15 minutes and quenching in water. Tensile testing was performed at 1 mm/min at +20, -78 and -196°C. The steel without carbon and nitrogen is quite ductile, has a low yield point (28 kg/mm<sup>2</sup>) and is greatly hardened by plastic deformation. At low temperatures, the yield point remains low. Alloying the solid solution of this steel with nitrogen and carbon increases the strength properties but decreases ductility. Both elements, when present in large quantities cause the metal to become brittle at low temperatures. Additional alloying with nickel (2.5-6.5%) decreases the yield point and increases ductility. Nickel reduces the embrittlement produced by nitrogen and particularly carbon at low temperatures.

The steel, alloyed with 0.08-0.1% C, 0.20-0.23% N, 6.0-6.5% Ni has the optimal combination of strength and ductility properties after austenitization, both for use at room temperature and at low temperatures, and can be used at temperatures as low as -196 C.

USSR

UDC 621.762

INCREASE IN THE HEAT RESISTANCE OF SAP MATERIALS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12(168), Dec 76 pp 70-76  
manuscript received 3 Dec 75

LITVINTSEV, A. I., RAKOVSKIY, V. S., SHINYAYEV, A. YA., and SHMAKOV, YU. V.,  
All-Union Institute of Light Alloys

[Abstract] A study is made of the basic regularities of formation of the framework structure in order to allow production of products with superior mechanical properties at room temperature and 500°C in comparison with SAP intermediate products. The process of sintering of aluminum powder briquettes in this process is studied, and data on changes in density, resistivity and structure indicate that the aluminum oxide framework structure can be produced in briquettes cold pressed with subsequent sintering as well as hot pressed. The study of the mechanical properties of SAP materials shows a significant increase in heat resistance when the framework structure formed consists of aluminum oxide. References 5: 4 Soviet and 1 Western.

USSR

UDC 519.272:541.123.3[546.82+546.17+546.26]

STRUCTURAL PARAMETERS, X-RAY AND PYCNOMETRIC DENSITY OF TITANIUM CARBONITRIDE  
IN THE AREA OF HOMOGENEITY

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12(168), Dec 76 pp 42-48  
manuscript received 2 Feb 76

VIL'K, YU. N., and DANISINA, I. N., All-Union Scientific Research Institute  
of Abrasives and Grinding

[Abstract] An attempt is made to reduce the multitude of available data on changes in structural parameters and density, as well as a great deal of other data, to a single system, based on equality of defect densities in alloys. The method of isodeflect cross sections is used to study the concentration dependence of changes within the limits of the area of homogeneity of titanium carbonitride in structural parameters, particularly the lattice period and degree of filling with partial components, as well as density. A method is suggested for digital computer calculation of available experimental data, making it possible to approximate the correlation dependence between properties and compositions over the entire area of homogeneity of titanium carbonitride with good reliability. Equations are produced, allowing simple calculations based on the known chemical composition of an alloy within the field of homogeneity to determine rather reliably the lattice period, x-ray and pycnometric density, as well as degree of filling of the unit cell of the alloy and its partial components. References 25: 17 Soviet and 8 Western.

USSR

UDC 661.665.2

TUNGSTEN-FREE HARD ALLOYS BASED ON BINARY CARBIDES. II. STUDY OF PHYSICAL AND MECHANICAL PROPERTIES OF ALLOYS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12(168), Dec 76 pp 37-41  
manuscript received 14 Jan 75

SAMSONOV, G. V., VORONKIN, M. A., LINNIKOV, A. P., and LOKTIONOV, V. A.,  
Institute of Problems of Material Science, Acad. Sci. UkSSR

[Abstract] A study is made of the physical and mechanical properties of tungsten-free hard alloys based on binary carbides of titanium and the transition metals of group V with nickel-molybdenum binder as a function of the content of the secondary carbide (2-25 mol.%). The bending and compressive strength, hardness, impact toughness, modulus of elasticity, coefficient of thermal expansion, oxidation resistance and antifriction properties with chromium cast iron are studied, as well as the internal friction background of these alloys. It is shown that addition of up to 5 mol.% VC and 5-15 mol.% NbC or TaC causes some increase in ductility of the carbide grain of the hard alloy, thus having a favorable influence on many properties. The alloys are promising for use as metal working tools, as well as high temperature structural materials. References 6: all Soviet.

USSR

UDC 621.762

PLASTIC DEFORMATION OF PARTICLES OF ZIRCONIUM AND TITANIUM CARBIDE SUBJECTED TO VIBRATION GRINDING

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12(168), Dec 76 pp 30-36  
manuscript received 8 Jan 76

KRAVCHIK, A. YE., NESHPOR, V. S., SAVEL'YEV, G. A., and ORDAN'YAN, S. S.,  
State Institute for Applied Chemistry, Leningrad Technological Institute

[Abstract] A study is made of the influence of stoichiometry on the characteristics of microplastic deformation in powders of zirconium and titanium carbide subjected to vibration grinding. The carbide powders were produced by direct synthesis from the pure materials: metallic titanium and zirconium and acetylene black. As to the nature of their elastic deformation, zirconium and titanium carbides can be considered elastic-isotropic materials. During vibration grinding, the primary fracture planes are the [110] planes. Carbides of nonstoichiometric composition are more brittle. The change in deformation in the area of homogeneity of the carbides is determined by the combination of structural

and electronic factors which in group IV carbides act in different directions, in group V carbides -- in the same directions. Taking the mean square deformation as a measure of microplasticity, stoichiometric carbides can be arranged in the following sequence of increasing brittleness: NbC, ZrC, TiC. References 18: 13 Soviet and 5 Western.

USSR

UDC 621.762.4,47:669.71(043)

DEFORMATION FACTOR AND ROLLING PROPERTIES OF GRANULATED ALUMINUM

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12(168), Dec 76 pp 13-16  
manuscript received 10 Feb 76

SHEPEL'SKIY, N. V., GORBUNOV, YU. A., and DRANISHNIKOV, S. V., Krasnoyarsk  
Institute of Nonferrous Metals

[Abstract] A study is presented of the influence of the primary parameters of the rolling process on the deformation factor and properties of rolled products. Granules were rolled in a closed roller groove on a duo-200 mill with vertical material feed. The width of the groove was 50 mm. One of the rolls contained point dynamometers which were used to determine the rolling angle and contact stresses. The deformation factors are the primary indicators defining the formation of properties of granulated rolled products. The optimal combination of strength and ductility of rolled products of aluminum alloy granules is determined not only by favorable deformation conditions, but also by the physical and chemical phenomena which occur on the surface of the granules. The rolling rate influences parameters of the process and properties of the products by changing the coefficient of contact friction. As rolling speed increases, the rolling angle decreases, particularly in the speed range 0.01-0.15 m/s. References 2: both Soviet.

USSR

UDC 621.762

PHASE COMPOSITION OF FE-AL POWDER COMPOSITES PRODUCED IN A LOW TEMPERATURE PLASMA

Kiev POROSHKOVAYA METALLURGIYA in Russian No 12(168), Dec 76 pp 1-4  
manuscript received 2 Oct 75

GAL', A. I., and GAL', V. V., Institute of High Temperatures, Acad. Sci. USSR

[Abstract] A study is made of the influence of cooling rate of a high enthalpy jet of gas ( $10^2-10^5$  C·s<sup>-1</sup>) on the structure of Fe-Al composites

produced by treating a mechanical mixture of Fe and Al in a low-temperature Ar plasma with a mean mass temperature of 5000-7000°K. It is found that composites produced at cooling rates of  $10^4$ - $10^5$  C·s<sup>-1</sup> consist of a solution of Al in  $\alpha$ -Fe and a metastable  $\gamma$ -(Fe+Al) phase. The decomposition of the  $\gamma$  phase in a composite with 2.2 wt.% is studied upon heating at 20 C·min<sup>-1</sup>. References 11: all Soviet.

## Single Crystals

USSR

UDC 539.124.6:537.311.33

### POSITRON ANNIHILATION IN SILICON AND GALLIUM ARSENIDE SINGLE CRYSTALS WITH A PROCESSED SURFACE

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 76  
pp 28-30 manuscript received 8 Sep 75

AREF'YEV, K. P., VOROB'YEV, S. A., and KARETNIKOV, A. S., Tomsk

[Abstract] In a study of the influence of various degrees of mechanical processing of Si and GaAs single crystal surfaces on the angular distribution of annihilation gamma-quanta, the result was obtained that mechanical processing perceptibly changes the shape of the correlation curves of annihilation radiation in Si single crystals, in which the narrow component appears, and does not bring about a change in the shape of the correlation relationships in GaAs single crystals. The appearance of the narrow component in the correlation curves of annihilation radiation in Si single crystals with a processed surface is explained by the formation of positronium atoms in the disrupted layer of the samples and ortho-paraconversion of the positron atoms. The absence of such an effect in GaAs single crystals points to a much lower degree of oxygen adsorption in the developed surface of these samples. The obtained experimental results show that the positron annihilation method may be useful in determining the adsorption properties of semiconductor surfaces. Figures 2; references 9: 4 Soviet and 5 Western.

## Superalloys

USSR

UDC 539.54:669.548.4

### INFLUENCE OF PRELIMINARY THERMAL CYCLING ON THE STRUCTURE AND THERMAL FATIGUE RESISTANCE OF EI617 ALLOY

Kiev PROBLEMY PROCHNOSTI in Russian No 12(90), Dec 76 pp 26-29 manuscript received 8 Oct 75

GONTAREVA, R. G., KOZYRSKIY, O. I., and TIKHONOV, L. V., Institute of Metal Physics, Acad. Sci. UkSSR

[Abstract] A study is presented of the influence of several modes of preliminary thermal cycling on the structure and thermal fatigue resistance of EI617 alloy. Specimens 30 mm in diameter and 5 mm thick were heat treated then thermally cycled in two shaft furnaces placed one above the other and maintained at 900°C and 700°C. The specimens were held 5 minutes at each of the two temperatures then cooled to 20°C by quenching in water. The Vickers hardness was measured with a load of 20 kg and microstructural studies performed, as well as x-ray subgrain orientation analysis. It was found that preliminary thermal cycling can favorably influence the thermal fatigue resistance of this alloy. References 5: all Soviet.

USSR

UDC 539.216.019

CHANGE OF THE ADHESION PROPERTIES OF THIN FILMS AFTER IRRADIATION BY ELECTRONS WITH AN ENERGY OF 10 MEV

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 76 pp 24-27 manuscript received 14 Jul 75

BORISENKO, YU. N., and GRITSYNA, V. T., Khar'kov

[Abstract] A study was made of the adhesion of silver and copper films, applied on glass substrates by one method of vacuum evaporation, before and after irradiation by electrons with an energy of 10 MEV. The atomized metal was precipitated onto the substrate at room temperature at a pressure of  $3 \cdot 10^{-5}$  mm Hg. The thickness of the films was evaluated on the basis of the evaporated metal, and ranged from 250 to 1100 Å for various experiments. Irradiation brings about a decrease in the adhesion of silver films by a factor of 1.75, regardless of the dose. The degree of change of the adhesion in this case does not depend on the film thickness within the limits of 250-1100 Å. Irradiation of copper films leads to a decrease of the adhesion which, however, then grows with a rise of the dose. The results are discussed within the framework of a model of a dual electrostatic layer. The increased adhesion of copper films at large irradiation doses is explained by oxidation processes at the interface. Figures 4; references 6: 3 Soviet and 3 Western.

USSR

UDC 539.23:546.621:620.179.16

THE PHYSICO-CHEMICAL PROPERTIES OF THIN METAL FILMS SPRAY-COATED ON NONMETALLIC SUPPORTS. V. A METHOD FOR DETERMINING THE ADHESION OF THE METALLIC FILM TO AN ELASTIC POLYMER BASE

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR -- SERIYA KHIMICHESKAYA in Russian No 5, 1976 pp 569-573 manuscript received 7 Jul 75

KADEK, V. M., RUDIK, T. A., RUBESS, Z. G., LUSIS, A. KH., SOKOLOV, YU. N., and LEPIN', L. K., Institute of Inorganic Chemistry, Academy of Sciences Latvian SSR

[Abstract] A method for determining the adhesion of a metallic film to an elastic polymer based on the effect of ultrasound on the sample was developed. A 50-nm-thick polymer spray-coated with 0.5 nm of aluminum film was subjected to stabilized ultrasound transmitted through 96% ethanol. Light transmission before and after three minutes of ultrasound was used to indicate the amount of film removed. Four types of relationships between light transmission and quantity of impulses were found: poor stability and adhesion; strong, undisturbed stability and adhesion; good adhesion with poor stability; and

good stability with poor adhesion. Thus this method can be used for comparative studies of samples and to indicate relative strength of metal-metal and metal-polymer bonds. Six samples of 12 nm polyethylene terephthalate coated with 0.03-0.05 nm aluminum showed all but the fourth type of result. After 15 minutes, mechanical destruction of the polymer was observed. Figures 3; tables 1; references 12: 11 Russian, 1 Western.

USSR

UDC 539.23:546.621:620.193.91

THE PHYSICO-CHEMICAL PROPERTIES OF THIN METAL FILMS SPRAY-COATED ON NONMETALLIC SUPPORTS. VI. THE INITIAL RESISTANCE OF ALUMINUM FILMS

Riga IZVESTIYA AKADEMII NAUK LATVSKOY SSR -- SERIYA KHIMICHESKAYA in Russian No 5, 1976 pp 574-579 manuscript received 7 Jul 75

LEPIN', L. K., KADEK, V. M., SOKOLOV, YU. N., LUSIS, A. KH., and KOZHAN, L. P., Institute of Inorganic Chemistry, Academy of Sciences, Latvian SSR

[Abstract] The electrical resistance of aluminum films vacuum deposited on polyethylene terephthalate supports was studied. Decreasing resistance over time was found only for those samples whose initial resistance did not exceed 10-15 ohm/sq., which were formed at a pressure greater than  $10^{-3}$  mm Hg. The decrease was relatively small, 10-12%, due to the high chemical activity of aluminum and its rapid oxidation, which decreases layer thickness and inhibits the processes of grain growth and defect annealing. In most samples, even with deposition vacuums of  $10^{-7}$ - $10^{-8}$  mm increasing resistance over time was observed. Introduction of atmospheric gases into the deposition chamber led to a sharp intensification of the oxidative process and marked increase in resistance. Aluminum films prepared and stored under high vacuum have a more orderly structure, which retards their oxidation. Figures 5; references 12: 7 Russian, 5 Western.

USSR

UDC 539.23:546.57:620.193.91

THE PHYSICO-CHEMICAL PROPERTIES OF THIN METAL FILMS SPRAY-COATED ON NONMETALLIC SUPPORTS. VII. SILVER FILMS ON A POLYMERIC BASE

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR -- SERIYA KHIMICHESKAYA in Russian No 5, 1976 pp 580-584 manuscript received 7 Jul 75

SOKOLOV, YU. N., KADEK, V. M., and LEPIN', L. K., Institute of Inorganic Chemistry, Academy of Sciences Latvian SSR

[Abstract] The physico-chemical properties of silver films deposited on elastic polyethylene terephthalate bases were studied. Vaporization of

the silver was accomplished with a tungsten spiral at  $10^{-3}$  to  $10^{-8}$  mm Hg. Both increase and decrease in electrical resistance were observed after storage under vacuum, with increase occurring in very thin films, 50-70 Å thick, with large initial resistance. Thicker films exhibited a decrease in resistance from 20 to 50%, with the decrease greater for larger initial resistance and rate of decrease decelerating sharply with time. Increasing the pressure of atmospheric gases to several mm had no effect. In samples stored under atmospheric conditions increasing resistance was found, sometimes after an initial decrease. This indicates that the products of oxidation have poor protective properties. Only samples with small initial resistance remain electrically intact over long periods. Figures 5; references 9: 5 Russian, 4 Western.

USSR

UDC 539.23:546.56:620.193.91

THE PHYSICO-CHEMICAL PROPERTIES OF THIN METAL FILMS SPRAY-COATED ON NONMETALLIC SUPPORTS. VIII. COPPER FILMS ON POLYMERIC BASES

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR -- SERIYA KHIMICHESKAYA in Russian No 5, 1976 pp 585-589 manuscript received 18 Jul 75

SOKOLOV, YU. N., KADEK, V. M., and LEPIN', L. K., Institute of Inorganic Chemistry, Academy of Sciences Latvian SSR

[Abstract] The results of investigations of the electrical properties of thin copper films deposited on elastic polyethylene terephthalate bases are presented. Both increase and decrease in resistance were observed with increase occurring in samples with large initial resistance. Increasing the pressure to  $10^{-2}$  mm Hg or more intensified the increase in resistance. Decreasing resistance was observed in samples with initial resistance of 100 ohm/square or less, maintained in the deposition vacuum. The rate of decrease fell off sharply with time and the samples became stable after several hours. Introduction of air at pressures to  $10^{-2}$  mm Hg into the system led to increases in resistance for all samples. While the rate of increase decelerated with time the samples never became stable. The rate of increasing under atmospheric conditions was usually greater for samples with greater initial resistance. This increase is due to oxidation resulting in a smaller conductive layer. The oxidation products did not have adequate protective properties. Figures 5; references 14: 7 Russian, 7 Western.

## Titanium

USSR

UDC 621.791.3:669.295

### ELECTRIC RESISTANCE BRAZING OF TITANIUM ALLOYS USING 100 $\mu\text{m}$ THICK COPPER INTERLAYER

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11 (50), Nov 76 pp 43-44

BESEDNYY, A. V., All-Union Scientific Research Institute of Pressure Vessels

[Abstract] High strength Ti alloys VT3-1, VT6S, AT6, VT14 and VT5-1 were used as plates for brazing, with a 100  $\mu\text{m}$  thick copper interlayer between them. The brazing was done at 850-955°C and it was followed by cooling from a liquid state and homogenizing at the lowest possible temperature. At 850°C in vacuum, the formation of  $\text{Ti}_2\text{Cu} + \text{TiCu}_3$  (72% Cu) was observed, while at 955°C, the eutectic phase  $\text{Ti}_2\text{Cu} + \text{TiCu}$  (50% Cu) was formed. The yield strength of joints obtained at 850-870°C was low, of the order of 20 kg/mm<sup>2</sup>. Homogenizing at 850-900°C for 20 hours decreased still further the strength of joints. The best results were obtained when plates were brazed at 960°C for 5-15 min and homogenized at 900-950°C for 8 hours. The structure of joints in this case was uniform, with good mechanical properties. Figures 2; tables 1; references 2: both Russian.

USSR

UDC 669.295-52

### CONTROL OF BATCHING OF TITANIUM SPONGE

Moscow TSVETNYYE METALLY in Russian No 10, Oct 76 pp 44-46

ZAKHAROV, YU. A., POPLAVKO, V. G., and YATKO, M. YE.

[Abstract] The study of the process of the batching of titanium sponge as an object of control consists in classification, determination of statistical characteristics of technological parameters and construction of a mathematical economics model. The process of formation is studied in an n-dimensional phase space. Variations in the quantity of impurities in sponge titanium, hardness, mass of blocks by fractions varies from batch to batch according to the laws of probability. Formulas are presented for construction of a mathematical model of the characteristics of raw materials arriving for processing in order to predict the processing parameters necessary to produce a consistent end product -- titanium sponge.

USSR

UDC 669.721

REFINING OF MAGNESIUM WITH TITANIUM TETRACHLORIDE IN A SEALED STEEL APPARATUS

Moscow TSVETNYYE METALLY in Russian No 10, Oct 76 pp 43-44

PUTINA, O. A., GULYAKON, A. I., VYATKIN, I. P., BRANDMAN, O. I., and PUTIN, A. A.

[Abstract] The investigations herein described were dedicated to development of a technological mode for the refining of magnesium with titanium tetrachloride in a sealed steel apparatus with a magnesium capacity of 4-5 tons. Two versions of technology were tested: with titanium chloride fed to the surface of the metal with subsequent mixing by means of a vacuum ladle (three times lifting and draining the magnesium) and with simultaneous feed of  $TiCl_4$  to the surface of the metal and argon beneath the layer of the melt. The argon bubbling method achieves a significant reduction in the quantity of  $TiCl_4$  required to achieve adequate refining. A comparison of the product produced with the product from series production shows that titanium sponge of higher quality can be produced by the process described in this article.

USSR

UDC 546.824'261

PRECIPITATION OF TITANIUM CARBIDE FROM THE GAS PHASE DURING PYROLYSIS OF CYCLOPENTADIENYL COMPOUNDS OF TITANIUM

Moscow NEORGANICHESKIYE MATERIALY in Russian Vol 12, No 12, Dec 76 pp 2166-2167 manuscript received 26 May 75

VYSHINSKAYA, L. I., MAR'IN, V. P., LATYAYEVA, V. N., BALAKIN, E. I., and LEBEDEV, A. N., Gor'kiy State University, Scientific Research Institute for Chemistry, All-Union Scientific Research Institute for Hard Alloys and Refractory Materials

[Abstract] The goal of the present study was to produce films of TiC from the gas phase by pyrolysis of cyclopentadienyl derivatives of titanium in the 950-1050°C interval. Cyclopentadienyl Ti compounds were chosen due to their resistance to oxygen and moisture in the air. Pyrolysis of  $(C_5H_5)_2Ti(CH_3)_2$ ,  $(C_5H_5)_2Ti(C_6H_5)_2$  and  $(C_5H_5)_2TiCl_2$  produced films of titanium carbide on a hard alloy substrate. The best results were achieved by using  $(C_5H_5)_2TiCl_2$  at a hydrogen pressure of 2-3 mm Hg, hydrogen feed rate 5-12 l/hr. References 5: 1 Soviet and 4 Western.

USSR

UDC 669.245.018.44 + 669.295.5.018.44

A STUDY OF THE WORKABILITY, SURFACE QUALITY AND OPERATIONAL RELIABILITY OF ARTICLES MADE FROM HEAT-RESISTANT AND TITANIUM ALLOYS

Kuybyshev ISSLED. OBRAVATYVAYEMOSTI ZHAROPROCH. I TITAN. SPLAVOV [A Study of the Workability of Heat-Resistant and Titanium Alloys, a Collection of Works] in Russian No 3, 1976 pp 3-15

URYVSKIY, F. P.

[From REFERATIVNYY ZHURNAL, METALLURGIYA No 12, 1976 Author's Abstract No 12I660]

[Text] The results are given of a study of the workability of high-strength steel and heat-resistant nickel and titanium alloys used in the manufacture of cutting and abrasive tools. Some recommendations are made for the selection of grades (brands) of alloys, fast-cutting steels, and diamond and Elbor disks. The effect of self-oscillations on the strength and durability of cutting tools is shown. The author makes clear the special features of the formation of a surface layer during polishing with diamond and Elbor wheels, and during smoothing with the use of diamond. It is shown that these operations, when applied to high-strength steel and heat-resistant nickel and titanium alloys, offer an improvement in the surface quality of the processed article, and also an improvement in the strength characteristics of parts. 5 Illus. 1 Table. 7 Biblio.

USSR

UDC 669.295:620.182

THE EFFECT OF HEATING AND COOLING RATES ON THE STRUCTURE OF TITANIUM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 12, 1976 pp 2-4

LIPCHIN, N. N., TOMSINSKIY, V. S., and POLOVNIKOV, V. M., Perm' Polytechnic Institute

[Abstract] The authors study the structural changes taking place in VT1-00 industrial titanium during the reversible alpha-beta transformation, as they depend on heating and cooling conditions. It is shown that it is the heating rate which determines the alpha-to-beta transformation: with a high rate, the transformation proceeds according to a shift mechanism, and with a slow one, in an irregular manner independently of the initial state of the sample. The reverse transformation, however (beta-to-alpha) proceeds on the shift mechanism in practically every situation.

It is established that thermal circulation intensifies any defects in the structure of the titanium; this effect, however, is unstable even at room temperature.

USSR

UDC 639.4.015:669.295

PHASE COMPOSITION OF THE VT22 ALLOY AND ITS CYCLIC STRENGTH

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 12, 1976 pp 4-8

GRINBERG, N. M., ZMEYEVETS, S. G., and OSTAPENKO, I. L., Physicotechnical Institute of Low Temperatures, Academy of Sciences, Ukrainian SSR

[Abstract] This study is a follow-up of the first author's earlier work on the behavior of materials in a vacuum at low temperatures (1972). The conclusions reached are as follows: Transformation of the beta-phase in the VT22 alloy may proceed with formation of the open-hearth alpha-prime phase of needle-type form, or the non-open-hearth circular alpha-phase; this determines the life of the alloy when subjected to cyclic loads. Increase in the tempering temperature from 740 to 780°C, and in content of the beta-phase from 25 to 70%, has no effect on the character of the transformation characteristic of the given metal. The amount of the residual beta-phase is independent of the transformation mechanism. References 10: all Soviet.

USSR

UDC 669.295:620.18:620.17

CHANGE IN THE STRUCTURE AND PROPERTIES OF VT25 TITANIUM ALLOY DURING THERMOMECHANICAL TREATMENT

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 12, 1976 pp 8-10

SOLONINA, O. P., KURAYEVA, V. P., and SAZONOVA, T. N., All Union Scientific Research Institute of Aviation Materials

[Abstract] The new VT25 heat-resistant refractory material, for use at temperatures in the 500-550°C range, is definitely superior to the VT8 and VT9 refractory currently in use.

The yield strength at 20°C is almost entirely independent of deformation conditions, and plasticity following deformation in the beta-region is significantly lower than in the alpha-plus-beta region. An increase in the degree of deformation in the beta-region leads to an increase in plasticity of this alloy, whose thermal stability is higher than that of the VT9. The long-term strength of the alloy depends largely on the conditions of deformation; when deformation occurs in the beta-region, there is higher long-term strength than in the case of deformation in the alpha-plus-beta region. Increase in the degree of deformation more definitely lengthens the duration of long-term strength than in the case of the beta-region. Creep resistance of the VT25 alloy varies in connection with the conditions of deformation in a manner analogous to that of long-term strength. Figures: 1.

USSR

UDC 620.186.1:669.295'293

STRUCTURE AND PHASE TRANSFORMATIONS UPON AGING OF COLD-DEFORMED ALLOYS  
OF A Ti-Nb SYSTEM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 12,  
1976 pp 10-12

KADYKOVA, G. N., Moscow Institute of Electronic Machine Building

[Abstract] At the present time a number of titanium-based alloys are being used in the state following cold deformation. Cold deformation of tempered alloys, and also those with additives of zirconium, iron, molybdenum and vanadium, leads to the formation of tau-phases within them. In addition, deformation facilitates the formation of alpha-phases during aging, and suppresses the formation of the omega-phase. The appearance of an alpha-phase proceeds heterogeneously at the points with the most defective structure. All of the researched additives diminish the magnitude of the tau- and alpha-phases in alloys following cold deformation and aging. The strongest effect is from iron and molybdenum, with weak effects supplied by zirconium and vanadium. Figures 1; references 2: both Soviet.

USSR

UDC 539.374:699.295

ANTIFRICTION PROPERTIES OF TITANIUM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 12,  
1976 pp 47-50

GOROKHOV, V. A., Chernigovsk Branch of the Kiev Polytechnic Institute

[Abstract] To improve the antifriction properties of titanium, the use of cleaning under pressure and combined treatment with pressure and vacuum oxidation is recommended. The antifriction properties of a titanium-steel pair are improved by use of a sulfidized steel anode.

USSR

UDC 669.295.5:620.193

THE EFFECT OF ALUMINUM ON THE SUSCEPTIBILITY OF TITANIUM TO SALT CORROSION

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 12, No 6,  
Nov-Dec 76 pp 60-64

KOLACHEV, B. A., and TRAVKIN, V. V., Stupino Branch of the Moscow Aviation  
Technological Institute

[Abstract] A number of recent works have suggested that increasing the amount of aluminum in titanium alloys increases their susceptibility to salt corrosion. However, the suggestion of the primary role of aluminum in salt corrosion has not been substantiated, since the studies in question were made with industrial alloys which contained a number of elements other than aluminum. The present study was made with the use of binary alloys of the Ti-Al system at various temperatures, and also with technically pure titanium and various other titanium-aluminum alloys. The results were as follows: Technically pure titanium is not subject to salt corrosion; however, alloying titanium with aluminum does lead to salt corrosion, which is especially evident if the aluminum content exceeds 4%. Certain reasons are adduced to explain this increase in susceptibility to salt corrosion: 1) the hydrogenation of the titanium in the vicinity of slow development of cracks increases with an increase in the amount of aluminum; 2) at temperatures favoring corrosion, the aluminum diminishes the solubility of hydrogen in the titanium, and thereby increases its tendency to hydrogen embrittlement; and 3) the aluminum concentrates at the grain boundaries, and if it has a content greater than 2%, a separation of the alpha-2 phase takes place on the boundaries, and this in turn hinders plastic deformation and facilitates the development of chemical reactions which proceed with the separation of hydrogen. Figures 3; references 6: 3 Soviet and 3 Western.

USSR

UDC 621.78.794

SURFACE ALLOYING OF TITANIUM ALLOYS TO INCREASE WEAR-RESISTANCE

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 12, No 6,  
Nov-Dec 76 pp 107-109

LYAKHOVICH, L. S., PANICH, G. G., PRESMAN, YU. M., GOL'DFAYN, V. M., and  
KULIK, A. YA., Central Scientific-Research Diesel Institute, Leningrad

[Abstract] In many instances machine parts made from titanium or its alloys are called upon to withstand high-temperature oxidation and corrosion, and also wear, during the application of high specific loads. Diffusion coatings obtained by the impregnation of titanium with low-atomic covalent nonmetals

(carbon, nitrogen) satisfy the anticorrosion requirement fairly well, but do not suffice to supply a strong, low-soluble subbase which can protect the surface layer from puncturing.

An attempt was made to remedy this weakness using combined saturation of titanium alloys with silicon and niobium. This assures good heat-resistance at 950°C--a 150-300% increase over unstrengthened titanium--and an increase in corrosion-resistance of 100% (when tested in concentrated solutions of hydrochloric and orthophosphoric acids).

These data indicate the great promise of the use of two-component diffusion impregnation of titanium and its alloys. The application of two diffusants of different nature and diffusion mobility assures formation of a multi-zone layer with optimal properties.

## Welding

USSR

UDC 621.791.6:669.295:621.78.063/.065

### PRESSURE WELDING OF TITANIUM ALLOYS IN LIQUID MEDIA

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 11 (50, Nov 76 pp 34-35

GORBUL'SKIY, L. F., MOLCHANOV, B. A., KARAKOZOV, E. S., and VIGDORCHIK, S. A., Moscow Evening Metallurgical Institute

[Abstract] Welding of OT4 and VT6 titanium alloys was done in a mixture of 70% BaCl<sub>2</sub> + 30% KCl heated to 850-950°C. Specimens for welding were fixed in a special device capable of compressing specimens against each other with a force of 30-600 kg. The optimum welding conditions for OT4 alloy are: T = 950°C, p = 0.5 kg/mm<sup>2</sup>, t = 10 min; and for VT6 alloy, T = 950°C, p = 1 kg/mm<sup>2</sup> and t = 15 min. Deformation of specimens during welding was no greater than 7%. Subjecting the specimens to 850-950°C for  $\leq 3$  min did not produce any surface damage. However, if the exposure time was 3-15 min, distinct damage was observed at a depth of 0.2 mm. The strength of specimens was only insignificantly affected by the liquid medium. The liquid salt bath was heated to the melting temperature before specimens were submerged in it for a predetermined time. After cooling in air for 10 min, welded specimens were removed from the compressing device and tested for mechanical properties. Figures 2; references 3 Russian.

USSR

UDC 621.791.052.4:621.791.052.7

### WELDING OF BUTT AND TEE JOINTS WITH OPPOSING ARCS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 10 (504), Oct 76 pp 13-14

ZHUKOV, M. B., Scientific Research Institute for Aviation Technology

[Abstract] Plates made of steel 1Kh18N9T, EI712 and Ti alloy OT6 were welded with opposing arc (uniaxial position of electrodes), in order to increase the depth of penetration. Welding with opposing arcs increases the depth of penetration by approximately 2-2.5 times in comparison with a single arc the power of which is equal to the power of two opposing arcs. This increase amounts to 1.4-1.6 times in comparison with two-sided welding in two passes. Opposing arc welding is very suitable for tee joints. Welds in this case are uniform, with low residual stresses. When electrodes are located axially, the through penetration produces a rectangular welding bath in the case of 4-8-mm-thick plates. When the welding current was 40, 50 and 130 A for each arc, the depth of penetration was 4.0 (steel), 5.0 (Ti alloy) and 7.5 mm (steel), respectively. Figures 5; tables 1.

USSR

UDC 621.791.052:539.4:669.715

INFLUENCE OF SEAM SHAPE ON STRENGTH OF WELDED JOINTS OF ALUMINUM ALLOYS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 8(502), Aug 76 pp 34-35

KAZAKOV, V. A., SHIGANOV, N. V., and SKACHKOV, YU. N.

[Abstract] A study is made of the influence of seam shape on the strength of welded joints in the alloys O1381, 1201 and M40. The sensitivity of the welded joints to seam shape depends on the difference in strength and ductility of the seam metal and the metal in the heated zone, as well as the geometric parameters of the seam. The higher the ratio of width of seam strengthening to width of melting and the ratio of the thickness of the welded metal to the width of the seam, the more probable it is that the welded joint will be sensitive to the shape of the seam. The more sensitive the welded joint is to stress concentrators and seam shape, the more effective mechanical working of seams is for increasing their strength. The shape and dimensions of hardening and melting may have both positive and negative influence on the strength of the welded joint, depending on the sensitivity of the joint to seam shape. References 3: all Soviet.

USSR

UDC 621.791.75.048:669.721.5

FAM-1T FLUX FOR WELDING OF MAGNESIUM ALLOYS MA2-1, MA8, MA12 and MA15

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 8(502), Aug 76 pp 46-47

PLISKO, V. N., BUSHUYEV, YU. G., IVANOV, V. YA., SHIGANOV, N. V., MAMON, M. D., SHIMCHENOK, L. A., POPOV, O. P., and PANFEROV, N. M.

[Abstract] The purpose of this work was to develop a flux capable of eliminating or greatly reducing oxide inclusions in welded joints and improving the shape of the rear side of welded joints produced by argon-arc welding of the magnesium alloys mentioned in the title, and also to determine its influence on the mechanical properties and corrosion resistance of the welded joints. The most effective flux found was 80% eutectic (32.5%  $MgF_2$ -25.2%  $LiF$ -42.3%  $SrF_2$ ) plus 7.5%  $CaF_2$  plus 12.5%  $AlF_3$ . In order to increase softening, 2% titanium powder was added. The experiments indicated good opposite side formation (through melting) and high effectiveness of the flux on the oxide film.

USSR

UDC 621.791.052:669.295:620.169.1

EFFECT OF THE QUANTITY AND QUALITY OF BACKING RUNS ON EFFICIENCY OF WELD JOINTS OF TITANIUM ALLOYS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 10(504), Oct 76 pp 37-38

BORISOVA, YE. A., SHASHENKOVA, I. I., and MANUYLOV, N. N.

[Abstract] Results are presented on reliability of weld joints of VT20 alloy with various number of backing runs produced by manual argon-arc welding, with two-side gas shielding, without shielding and with inert gas shielding of only the back side. Principal welds were produced by automatic argon-arc welding with nonconsumable electrode without any alloying additions. Welding of 2-mm-thick sheets with only one side shielded produced joints which are vulnerable by a low-cycle fatigue tests. This is attributed to saturation of the metal surface with oxygen at the depth of 180-250  $\mu\text{m}$ . The unshielded side can also be influenced by nitrogen and hydrogen. A double pass decreases the endurance limit of joints by 6% in comparison with a single pass (only 3%). The low-cycle fatigue life of a weld produced by a double pass decreased 2.5 times, as compared with a single pass. The reliability of a weld with several backing runs with a two-sided shielding can be increased if the weld is subjected to annealing at 660°C for 1 hr. The annealing at this temperature removed stresses in individual metal zones and reduces them to 3 kg/mm<sup>2</sup>. Figures 3.

USSR

UDC 621.791.011

EFFECT OF RESIDUAL MICROSTRESSES IN WELDS ON THE MECHANISM OF FRACTURE

Kiev AUTOMATICHESKAYA SVARKA in Russian No 10(283), Oct 76 pp 24-27

ETINGOV, V. I., and MIKHAYLOVA, N. N., Irkutsk Scientific Research Institute of Chemical Machine-Building

[Abstract] The effect of oriented microstresses on crack propagation under loads was studied. Specimens for this study were prepared from a weld produced by automatic multipass welding of a pressure vessel (10G2S1 steel). Specimens were prepared from various areas of the weld; some of them had 0.04- and 0.1-mm-wide cracks, with 0.02 and 0.05 mm radii at the crack top, respectively. All specimens were subjected to axial tension. The results obtained indicated that residual microstresses have an effect on the distribution of deformation. The local deformation at the crack top and the deformation concentration decrease with increasing compressive oriented microstresses. This shows that the role of the deformation concentrator (cracks) decreases when residual compressive oriented microstresses are

present. Metallographic studies showed that a fracture originating from a crack follows along the bodies of the grains. The residual compressive oriented microstresses are localized in the near-boundary grain regions and they do not influence the fracture mechanism because of the low mechanical properties of the internal grain structures. Figures 7; references 6: 5 Soviet and 1 Western.

USSR

UDC 621.791.72

#### TRENDS IN THE DEVELOPMENT OF ELECTRON BEAM WELDING

Kiev AVTOMATICHESKAYA SVARKA in Russian No 10(283), Oct 76 pp 1-8

PATON, B. YE., BERNADSKIY, V. N., NAZARENKO, O. K., ZHURAVKOV, V. V., and LOKSHIN, V. YE., Institute of Electric Welding imeni Ye. O. Paton

[Abstract] This article reviews the application fields and directions in the development of electron beam welding (EBW). The versatility of EBW makes this method applicable for (a) welding high-melting alloys that are widely used for different purposes in the electronics industry, atomic reactors, and for building various kinds of instruments, devices and vessels for the chemical industry; (b) production welding of automobile parts, frame components and whole units; (c) aircraft frame welding; (d) welding of units and precision devices used in the power-production machinery (turbines); (e) production of semi-finished items in metallurgy and for other purposes. In order to broaden the field of application of EBW, the existing welding equipment must be improved and, in many instances, redesigned. The main shortcoming of the EBW used for thick pieces is the presence of defects in welds produced with a single pass. This problem can be solved by a more definite evaluation of the present technology requirements and by improvements in the EBW equipment. Newcomers to welding technology are microplasma and laser welding. These methods can be used for joining thin pieces of which EBW is not very suitable. Laser welding will compete successfully with EBW in inert gases. Figures 8; tables 5; references 13: 5 Soviet, 6 Western, 2 Japanese.

## COLD WELDING OF ALUMINUM-STEEL AND TITANIUM-ALUMINUM PIECES

Kiev AVTOMATICHESKAYA SVARKA in Russian No 10(283), Oct 76 pp 38-39

SAPRYGIN, V. D., and KARAKOZOV, E. S.

[Abstract] The object of this work was to develop the cold welding technology for bimetal joints which would satisfy the requirements of the cryogenic industry. Stainless steel 12Kh18N10T, titanium alloy VT1-0 and aluminum alloy AMts were used in these experiments. The method developed includes the preparation of tubular steel or titanium (support) specimens on which the bell-shaped Al specimens are superimposed. Grooves are made on steel and Ti specimens for a better contact between the two metals. An upsetting ring is put over the Al piece and high pressure is applied on it as it moves down and presses the Al alloy into the grooves. Optimum cold welding conditions are: rate of deformation 60-100 mm/min, upsetting ring conical angle  $5^\circ$  and the average upsetting of Al piece 37-43%. Joints remained leakproof when subjected to 1000 cycles of cooling in liquid nitrogen and heating to  $100^\circ\text{C}$ , with a rate of  $200-450^\circ\text{C}/\text{min}$ . They also remained leakproof and highly reliable when tested by the hydro-pneumatic method, with loading of  $0-50\text{ kg}/\text{cm}^2$  for up to 500 cycles. The load was applied under vibration and joints were tested in helium and corrosive media. The hydraulic pressure to rupture did not damage joints; rupture always occurred in Al pipe. This method has already been incorporated in the production of cryogenic devices. Figures 1; references 2: both Soviet.

Miscellaneous

USSR

UDC 621.923:669.14

INVESTIGATION OF THE BEHAVIOR OF GEKSANIT-R DURING THE MICROCUTTING OF TITANIUM AND STEEL

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 76 pp 123-127 manuscript received 8 Jan 76

SAMSONOV, G. V. (deceased), PILYANKEVICH, A. N., ADAMOVSKIY, A. A., BOCHKO, A. V., DZHAMAROV, S. S., and BALAN, T. R., Kiev

[Abstract] A study was made of the wear resistance of a new superhard abrasive material--Geksanit-R--on the microcutting of steel and titanium under conditions simulating the work of an abrasive grain in a grinding disk. It is found that the principal form of the wear of Geksanit-R during the grinding of titanium is adhesive, and during the grinding of steel is abrasive; Geksanit-R is effective for grinding steel, and is ineffective for grinding titanium. Figures 3; references 12: 11 Soviet and 1 Western.

USSR

UDC 533.64

INFLUENCE OF THE GEOMETRICAL PARAMETERS OF SINGLE CRYSTALS ON STRENGTH OF A PHOSPHATE-BINDER ULTRALIGHTWEIGHT REFRACTORY

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 76 pp 113-115 manuscript received 6 Apr 76

POKATOV, V. V., BALASHKINA, G. P., and MOROZOV, A. G., Saratov

[Abstract] Consideration is given to the results of mechanical tests on the compression of specimens of a phosphate-binder ultralightweight refractory, reinforced by mullite single crystals. The relationship of the strength of the specimens during compression to the geometrical parameters (diameter and length) of the mullite single crystal is derived. A description is given of the mathematical method of multiple correlation analysis for evaluating the relationship between the length and diameter of the reinforcing mullite single crystals and the breaking point for compression of the specimens of the phosphate-binder ultralightweight refractory reinforced by these crystals. Tables 1; references 9: all Soviet.

USSR

UDC 669.017:620.18

THE ACTION OF AN ELECTRICAL PULSE DISCHARGE ON METALS IN AN AIR MEDIUM

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 76  
pp 3-7 manuscript received 4 Feb 76

UGLOV, A. A., and SKOTNIKOV, S. A., Moscow

[Abstract] Experimental data are presented on the action of electrical pulse discharges (duration approximately 200 microseconds) in an air medium on metals with various physical properties. A discussion of these data is conducted. Quantitative conceptions of the action mechanism are developed, which include processes of explosive evaporation and the screening of part of the pulse, which leads to a lowering of the specific flux on the metal surface. Tables 2; references 9: all Soviet.

USSR

UDC 536.4

QUANTITATIVE ANALYSIS OF THE EVAPORATION KINETICS OF METAL FILMS WHICH ABSORB LASER EMISSION

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 6, Nov-Dec 76  
pp 8-15 manuscript received 15 Jan 76

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

[Abstract] The evaporation kinetics of metal films is dealt with on the basis of a solution of the thermal-conductivity problem in a region with a moving boundary. The metal film has been applied on a transparent substrate, and account is taken of the energy of vapor formation, heat removal into the substrate, and the decrease of the heat-source intensity caused by the increase of film transparency during the evaporation process. Figures 2; references 14: 11 Soviet and 3 Western.

USSR

UDC 541.18;620.179.3;620.18

THE EFFECT OF ACTIVE LIQUID MEDIA ON THE STRUCTURALLY STRESSED STATE OF METALS DURING FATIGUE

Kiev FIZIKO-KHIMICHESKAYA MEKHANIKA MATERIALOV in Russian Vol 12, No 6, Nov-Dec 76 pp 53-56

SHEVELYA, V. V., and IL'INSKIY, I. I., Kiev Institute of Civil Aviation Engineers

[Abstract] X-ray analysis was used to study the alteration of microstresses in a thin surface layer of certain metals produced by the action of both adsorption and corrosive media (fatigue in air, experienced by the metals Armco iron, steel 45, copper M-3 and aluminum AMU). It was established that the formation of microstresses and the crushing of blocks of a mosaic on the surface of a cyclically deformed metal are controlled not only by the presence of an active liquid medium, but also by the magnitude of stress amplitude. Figures 3; references 7: all Soviet.

USSR

UDC 548.73

THE EFFECT OF THE ANISOTROPY OF CRYSTALS ON THE STRUCTURE OF X-RAY LINES IN THE CASE OF A POLYCRYSTAL UNDER STRESS

Moscow FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 5, Nov 76 pp 954-964

AKSENOV, G. I., and NATANZON, A. YA., Kuybyshev Polytechnic Institute imeni V. V. Kuybyshev, and Kuybyshev Aviation Institute imeni Acad. S. P. Korolev

[Abstract] The authors derive mathematical expressions for a volumetric stressed state in polycrystalline objects of various crystallographic systems; these make possible the investigation of the effect of the anisotropy of the elastic properties of crystals on the structure of x-ray lines. In the Reuss approximation, with use of electronic computers, a calculation is made of the scattering of lines produced by stresses of the first type, in the case of linear and plane stressed states. The results of numerical analysis assist in the selection of parameters (indexes of the reflecting plane; angles fixing the direction of relative deformation) which will correspond to the optimal conditions (that is, maximal displacement of the line with minimal scattering) for x-ray photography.

USSR

UDC 669.85/86.018

THE POSSIBILITY OF OBTAINING THE COMPOUND  $V_3Ga$  BY THE HYDROEXTRUSION METHOD

Moscow FIZIKA METALLOV I METALLOVEDENIYA in Russian Vol 42, No 5, Nov 76  
pp 1112-1114

KONYAYEV, YU. S., BERZON, E. M., VELLER, M. V., and TARUTIN, O. B.,  
Institute of High-Pressure Physics, Academy of Sciences USSR

[Abstract] The compound  $V_3Ga$  is of interest as a superconductor with high critical parameters; however, the production of articles from this material is very difficult owing to its extreme brittleness.

In this experiment the authors were able to deform a vanadium-gallium alloy of stoichiometric composition without destruction, and achieve a reduction of 30-40%, using hydroextrusion with counter-pressure, with only a single passage at room temperature.

This elimination of prolonged heat treatment in favor of extrusion eliminates any danger of contamination of the material--an important factor in obtaining superconductors with high critical parameters. Figures 3; references 11: 5 Soviet and 6 non-Soviet.

USSR

UDC 539.1 + 539.2

QUADRUPOLE INTERACTION IN A TITANIUM-NIOBIUM-HYDROGEN SYSTEM

Moscow FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 5, Nov 76  
pp 1109-1112

GIL'MANOV, A. N., KASHAYEV, R. S., and SAYKIN, K. S., Kazan' Physicotechnical  
Institute, Academy of Sciences USSR

[Abstract] The question of the structure of hydrides of the transition metals and of their alloys is regarded with divergent opinions, especially in connection with the paucity of information on the physical and electron structure of hydrides of titanium-niobium alloys, which are of great interest in the field of superconductivity.

Powder samples of several different proportional makeups of Ti and niobium-hydrogen mixtures were studied. It is concluded that the role of protons in increasing  $C_z$  up to 26 MHz in a Ti-Nb-H system may consist in variation in electrical field gradients at the point of position of the niobium nucleus, this resulting from variation of the electron structure.

USSR

UDC 669.5'715

THE EFFECT OF COMPOSITION ON INTRAGRAIN SLIPPING IN SUPERPLASTIC ALLOYS OF A ZINC-ALUMINUM SYSTEM

Moscow FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 42, No 4, Oct 76  
pp 848-853

KAYBYSHEV, O. A., KAZACHKOV, I. V., and RODIONOV, B. V., Ufa Aviation  
Institute imeni S. Ordzhonikidze

[Abstract] A study is made of the effect of the phase composition of a zinc-aluminum system on the variation in the textures of rolled metal during the process of superplastic deformation. It is shown that with an increase in the content of aluminum in the beta-phase, there is a gradual transition from the predominantly basal type of slipping in a zinc--2% aluminum mix to slipping along the basal planes in a loosely packed direction in a zinc--50% aluminum mix; this takes place at a low rate of deformation. With increase in the deformation rate, however, there is an accompanying increase in the number of slipping systems in action. The deformation characteristics of the alpha-phase also depend on the phase composition of the alloy. It is assumed that in the presence of small-grain structure, such variation of the active slipping systems is produced by variation in the conditions of the birth of dislocations on the interphasal-intraphasal boundaries. Figures 3; references 9: 5 Soviet and 4 Western.

USSR

UDC 669.018.58:669.859

TICONAL (ALLOYED) WITH SAMARIUM

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 12,  
1976 pp 22-24

BEZUGLOV, A. A., Novocherkassk Permanent Magnet Plant

[Abstract] Given are data on the positive effect of additives of samarium (0.1%) on the magnetic properties of the Ticonal alloy, with additional alloying with 0.8% Si. C-shaped curves are obtained showing the isothermic shift of the alpha-transformation into the alpha-plus-gamma-transformation. It is established that samarium increases the stability of the alpha-solid solution and compresses the temperature of the second transformation mentioned. Figures 4; references 4: all Soviet.

USSR

UDC 669.018.5:620.183:539.26

THE NATURE OF THE X-PHASE IN ALLOYS OF THE YuNDKT TYPE

Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 12, 1976 pp 16-21

LESHCHINSKAYA, R. P., and GORBUNOV, V. A.

[Abstract] The method of metallographic and X-ray analysis are used here to study the nature of the X-phase (overheating phase) in YuNDKT alloys. This phase is really the high-temperature gamma-phase when cooled to room temperature.

The authors determine the type and parameters of the lattice of the phase, which is tentatively termed the "gamma-p phase"; its crystal structure is that of a lattice with the parameter 3.61 Å. The experimental data collected in the study, and in an earlier work by the first author do not support the suggestions of K. I. Vlaskina regarding the structure and properties of the YuNDK42T8 alloy in the temperature range adjoining the solidus line of the new phase, which is essentially different from the gamma-phase of the medium-temperature phase. Figures 4; references 4: all Soviet.

USSR

UDC 620.179.14

QUALITY CONTROL OF SURFACE HARDENING OF PRODUCTS OF TYPE 45 STEEL

Sverdlovsk DEFECTOSKOPIYA in Russian No 6, Nov-Dec 76 pp 36-39 manuscript received 15 Jan 76

ACHIL'DIYEVA, E. S., VALIYEV, M. M., KAGANOV, Z. G., and KUSIMOV, S. T., Ufa Aviation Institute

[Abstract] A study is made of the possibility of using a type KF-1 coercimeter to test the depth and hardness of the surface layer of crankshafts manufactured of type 45 steel and treated by induction hardening. It is shown that it is possible to test the hardness and depth of hardening of crankshaft necks separately by using two coercimeter ferroprobes of different sizes. Experiments in the manufacturing plant confirm this possibility. The error in determination of hardness is not over 1 HRC; the error in determination of depth of hardened layer is not over 0.5 mm. References 6: all Soviet.

USSR

EXPERIENCE IN JET-STATIC THINNING OF Ti AND Mo FOILS FOR ELECTRON MICROSCOPY

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 42, No 10, 1976 pp 1209-1211

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[Abstract] The authors share their experience in the method of thinning of Ti and Mo foil for electron microscopy. The first stage of jet thinning is performed by the method of successive thinning of both sides of the object, with maintenance of the flow rate of the electrolyte by the use of a simple bubbler device; the second stage, thinning in the static bath, is performed using free fall of a stream of cooled electrolyte. An attempt was made to achieve the maximum chemical stability of the body of the bath, with low heat conductivity, minimum condensation on inspection windows and optimal electrolyte volume. The authors have used the method to thin  $\beta$ -Ti alloy foils in the system Ti-Cr-V-Fe-Mo, as well as commercially pure Mo foil. Success in the preparation of good foils depends on: a) the level and ratio of current and voltage; b) the concentration of electrolyte and relationship of its active components; c) temperature; d) the speed of the stream of electrolyte and dimensions of the jet. References 3: all Soviet.

USSR

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DEVIATIONS FROM SIEVERTS LAW IN THE AREA OF HIGH PRESSURES

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, CHERNAYA METALLURGIYA in Russian No 12, 1976 pp 92-96 manuscript received 3 May 76

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[Abstract] The author studied the solubility of hydrogen in iron at 700-1500°C and pressures up to 300 atm. Specimens of pure iron (impurities less than 0.003%) were used. Over 100 atm and 800°C, systematic negative deviation from Sieverts law was observed. The curves indicate saturation. The results produced are explained alternatively: by conditions of adsorption-kinetic equilibrium at the gas-metal interface; by phase conversion of lattice gas to lattice liquid hydrogen; by contact of spheres of interaction of hydrogen atoms in the solid solution. References 9: 7 Soviet and 2 Western.

USSR

UDC 669.018.4:621.793.7

THE STABILITY OF REFRACTORY OXYGEN-FREE COMPOUNDS IN LOW-TEMPERATURE PLASMA

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, CHERNAYA METALLURGIYA in Russian No 11, 1976 pp 56-60

AKHMATOV, V. I., KOSTIKOV, V. I., MELEKHIN, V. F., STEPANYUK, V. S., and SHESTERIN, YU. A., Moscow Institute of Steel and Alloys

[Abstract] A study is made of the behavior of carbides, borides and nitrides of refractory materials during the process of applying plasma coatings made from these substances. The stability of oxygen-free refractory compounds in low-temperature plasma is very largely determined by the content of oxygen in the atmosphere of the spray, the intensity with which the charge in the plasma jet is heated, and the character of the thermal dissociation of the compounds. Practical recommendations for the technology of a plasma bath with coatings of these substances are given. References 4, all Russian.

USSR

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THE HEAT OF SOLUTION OF ALUMINUM IN IRON-NICKEL-ALUMINUM BATHS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY, CHERNAYA METALLURGIYA in Russian No 11, 1976 pp 51-55

OSTROVSKIY, O. I., MYASNIKOV, V. V., PLOSHKIN, V. V., STOMAKHIN, A. YA., and GRIGORYAN, V. A., Moscow Institute of Steel and Alloys

[Abstract] Most data dealing with the heats of formation of solutions on an iron or nickel base at steel production temperatures (approx. 1600°C) relate to binary systems; data on three-component baths are extremely limited. The study is aimed at correcting this deficiency, using an Fe-Ni-Al metal bath and improved high-temperature calorimeter, with verification of the possibility of calculating the heats of formation from data on the boundary systems. The method devised previously (1976) by the authors is used.

The experimental data obtained are in agreement with those arrived at by calculation, using a model of subregular solutions, which takes into account the concentration relationship of the coordination number of the bath. Figures 2; references 4: 3 Russian and 1 Western.

## East European Abstracts

### CZECHOSLOVAKIA

#### MACHINABILITY OF THE 17 247 STEEL

Prague STROJIRENSKA VYROBA in Czech Vol 24, No 6, Jun 76 pp 401-409

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[Abstract] Increased construction of atomic energy power stations results in high demand for special materials--mainly austenitic stainless steels and alloys with high-temperature corrosion resistance. Many austenitic steels are difficult to machine, and their utilization is limited by the problems of their specific mechanical characteristics. Steel 17 247 has the following approximate composition: C 0.08% max.; Mn 2.0% max., Si 1.0% max.; P 0.04% max.; S 0.03% max.; Cr 17 to 19.5%; Ni 9 to 12%; Ti 5x C% min. Elongation of the steel is 37%. It is difficult to weld, but its corrosion resistance is high. This steel is similar to Swedish steel No 2333, and Soviet No OKh18N12T. Under established production conditions the 17 247 steel can be successfully machined. Cutting tools should be made of sintered uranium carbide U2; otherwise, machining costs for the material are too high. Surface hardening of the steel improves its machining of polished surfaces. Uranium carbide type SK H10 showed the best properties as a machining material for austenitic stainless steels. Figures 15; tables 4.

### CZECHOSLOVAKIA

#### RECENT ADVANCES IN COLD FORGING OF ALUMINUM PARTS IN CLOSED DIES

Prague STROJIRENSKA VYROBA in Czech Vol 24, No 5, May 76 pp 325-332

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[Abstract] Czechoslovak Standard aluminum alloys CSN 42 4002, CSN 42 4003, CSN 42 4004, and CSN 42 4005 are very easily cold forged, and therefore may be used for the manufacture of hollow, thin walled parts of complex shapes. Such parts are used in radiotechnology, packaging, and other branches of mechanical engineering industries. The alloys are of the following types: Al-Cu-Mg; Al-Mn 1; Al-Zn4-Mg2-Cu, and Al-Cu4-Bi-Pb. Large-scale series of items may be produced by cold forging. Figures 15; references 1 Czech.

CZECHOSLOVAKIA

INVESTIGATION OF THE USE OF RAW ARGON IN STEEL REFINING

Prague HUTNIK in Czech Vol 26, No 4, Apr 76 pp 135-138

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[Abstract] The author describes raw argon prepared in an N10T gaseous oxygen producing plant, which supplies oxygen of 99.5% purity and has a capacity of 10,000 m<sup>3</sup>/hr. The argon section consists of an argon column with a condenser, and a heat exchange section in the regenerators. The condenser provides reflux for the column. Argon is removed from the oxygen column at a tray where its concentration is highest. At an output of 25 m<sup>3</sup>/hr of A its oxygen content is 0.4 to 0.6%; at 150 m<sup>3</sup>/hr oxygen increases to 3%. The nitrogen content at 25 m<sup>3</sup>/hr is 1%, at 150 m<sup>3</sup>/hr 7%. At 50 m<sup>3</sup>/hr, oxygen content is 1%, nitrogen 6%. The contents of oxygen and nitrogen in refined steel depend on the amount of raw argon introduced, and on partial pressures of O<sub>2</sub> and N<sub>2</sub> in it, on the residence time of the raw argon in the steel melt, and on reaction kinetics between the three gases in liquid steels. Experimental results indicate that argon with oxygen contents of up to 1% may be used for refining structural grade steels. Figures 9; references 4: all Czech.

CSO: 1842

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