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USSR Report

MATERIALS SCIENCE AND METALLURGY

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ANALYSIS AND TESTING

UDC 669.018.531.28

PARAMETERS OF ATOMIC ORDERING AND MECHANICAL PROPERTIES OF IRON-COBALT ALLOYS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 282, No 3, May 85 (manuscript received 29 May 84) pp 590-594

GLAZYRINA, M. I., GLEZER, A. M. and MOLOTILOV, B. V., Central Scientific Research Institute for Ferrous Metallurgy imeni I.P. Bardin, Moscow

[Abstract] Atomic ordering of the B2 type has a profound effect on the mechanical properties of Fe-Co alloys, which are widely used for their magnetic properties. The present article provides a brief summary of the dependency of the mechanical properties of these alloys on atomic order parameters in order to clarify the nature of the durability and plasticity. Four variant alloys contained Ni, V, Mn or Cr, in concentrations from 0.4 to 6% by atomic weight; thus the atomic ratios of the basic components remained the same in all variants. Structural parameters, measured by illuminating electron microscope, X-ray structural analysis, neutronography, differential scan calorimetry and magnetometry, showed that with the growth of atomic ordering energy, the magnetic component declined somewhat. The energy of the antiphase boundary was found to be the structural component which determined most mechanical properties. A third component had a distinct impact on this value. The greater the energy of the antiphase boundary, the less important the special configuration of the dislocational nucleus and the less activation energy required. References 6: 3 Russian, 3 Western.
[184-12131]

UDC 669.017

THE PROBLEM OF THE INFLUENCE OF TEXTURE ON THE HYPERPLASTICITY EFFECT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 282, No 3, May 85 (manuscript received 28 May 84) pp 594-598

KAYBYSHEV, O. A., KAZACHKOV, I. V. and ZAPIROV, N. G.

[Abstract] Studies of hyperplasticity have shown that the crystallographic structure, along with other structural factors, has a profound impact on an

alloy's mechanical properties. For example, results of comparative studies of alloys VT6 and zinc with 22% Al have shown that texture is related to reduction of viscous stress, increased plasticity and more rapid deformation. The present article reports on study of the impact of crystalline texture on hyperplasticity in MA15, a magnesium-base alloy with 3.1% Zn, 1.1% Cd, 0.95% La and 0.65% Zn. Mechanical tests showed that the properties of the untextured alloy were isotropic both during normal deformation and under hyperplastic flow conditions. When the alloy had a pronounced axial structure, anisotropy was observed which decreased as deformation increased. Subsequent analysis of texture showed that the axial structure changed only slightly with elongation of up to 200%. Intragranular creep was regarded as the cause of granular-boundary shifts. Intragranular dislocational creep was an important factor in gradual reshaping. Anisotropy of pore formation processes determined the differences in longitudinal and transverse textures. References 12: 4 Russian, 8 Western.
[184-12131]

UDC 536.421.5

PLASTIC DEFORMATION OF DIAMOND POWDER UNDER HIGH PRESSURE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 282, No 3, May 85 (manuscript received 4 Jul 84) pp 601-604

FEDOSEYEV, D. V., SOKOLINA, G. A. and YAKOVLEV, Ye. N., Institute of Physical Chemistry, USSR Academy of Sciences, Institute of High Pressure Physics, USSR Academy of Sciences, Moscow

[Abstract] Plastic deformation of diamond powder at high pressure and temperature was studied to determine the possibility of using this mechanism to describe the compaction of diamond powder at high pressure into industrial diamonds. Changes in porosity and thermal and electrical conductivity were studied, since they indicate changes in intergranular boundaries and the latter shows graphite formation. Since the specimens had no less than 1% porosity, they had little durability and readily lost temper. Diamond crystals of various sizes were annealed in graphite vessels in the thermodynamic range of diamonds. Subsequent analysis with a scanning electron microscope showed that deformation of some granules and pores took place after 5 seconds of heating. Mathematical analysis based on the Mackenzie-Shuttleworth model and the Bingham medium theory of plastic flow, along with experimental data, showed that the electrical conductivity of polycrystals annealed in this way was several orders higher than that of polycrystals annealed without covering. Thus, the thickness of graphite layers on the diamond crystals did not exceed a few Å. The use of the plastic deformation mechanism to describe the compaction of diamond powder was confirmed. References 4: all Russian.
[184-12131]

STUDY OF MECHANICAL BEHAVIOR OF ALUMINUM FOLLOWING SUPERPLASTIC DEFORMATION

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85
(manuscript received 31 Jul 84) pp 1215-1223

MYSHLYAYEV, M.M. and SENKOV, O.N., Institute of Solid-State Physics, USSR
Academy of Sciences, Chernogolovka.

[Abstract] Results are presented from studies of the mechanical properties of aluminum following preliminary superplastic deformation. Tests were performed at room temperature on 99.92% pure aluminum containing the following impurities: Cu- $8 \cdot 10^{-3}$ mass percent, Mg- 10^{-2} , Si- $5 \cdot 10^{-2}$, Fe- 10^{-3} , Zn- $5 \cdot 10^{-3}$, Ti- $2 \cdot 10^{-3}$, other impurities not over $4 \cdot 10^{-3}$. An increase in plasticity and strength of the alloy at 20°C was observed after preliminary superplastic deformation, related to the influence of the initial state on the character of local deformation of specimens. The preliminary superplastic state of aluminum, differing from ordinary homogeneous mechanical properties and structure, facilitates more uniform subsequent deformation of the specimen at room temperature, thus increasing plasticity. References 7: 6 Russian, 1 Western.
[231-6508]

UDC: 536.33

ANALYSIS OF HEAT EXCHANGE IN LIGHT SCATTERING MATERIALS HEATED BY RADIATION

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 85
(manuscript received 14 Feb 83) pp 35-40

TOVSTONOG, V.A., Moscow

[Abstract] A study is made of unsteady heat exchange in a flat layer of strongly scattering material heated by a flux of radiation. The heat exchange in the semitransparent light-scattering material is described by a system of equations containing the equation of nonsteady heat conductivity and the equation for transfer of radiation with the appropriate boundary conditions. Ignoring the natural radiation of the medium in comparison to the external radiation flux and considering time as a parameter of the radiation field characteristics, a system of equations is developed and solved. An analytic solution to the equation for radiation transfer is thus produced for a scattering medium which is illuminated by both diffuse and collimated radiation fluxes, and estimates are given of the accuracy of the solution. Heat exchange by radiation and by heating of the scattering materials is analyzed. It is shown that at short radiation pulse lengths (about 1 millisecond) the temperature field is determined primarily by the radiation field, reducing the requirement for accuracy of the computation of heat conductivity and heat exchange. Heating of scattering semitransparent materials by collimated and diffuse radiation fluxes differs, which must be considered in the interpretation of experimental data and synthesis of mathematical models. References 7: all Russian.
[216-6508]

UDC: 669.24'295'3:620.181

INFLUENCE OF COPPER ON STRUCTURAL TRANSFORMATION IN TiNi ALONG THE TiNi-TiCu AND TiNi-Cu SECTIONS OF THE Ti-Ni-Cu TRINARY SYSTEM

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85
(manuscript received 13 Jul 84) pp 1226-1228

CHERNOV, D.B., MONASEVICH, L.A., BASHANOVA, N.N. and PASKAL, Yu.I., Siberian Physical-Technical Institute imeni V.D. Kuznetsov.

[Abstract] Comparison of the results of studies of titanium nickelide containing copper (4-5 at. %) on two cross-sections (TiNi-CuTi and TiNi-Cu) confirms that the influence of alloying elements on the temperature at which memory appears depends significantly on the method of the alloying of the titanium nickelide. The work was performed on alloys obtained by electric arc melting with multiple remelting in a water-cooled copper mold. Introduction of copper by replacement of nickel has little influence on the critical points of transformation. The characteristic feature of these alloys is expansion of the hysteresis loop of the reverse transformation of the initial phase with B2 structure and monoclinic B19' martensite. Alloying with copper on the TiNi-Cu cross-section facilitates the formation of the rhombohedral R phase. The type and kinetics of martensite conversion in titanium nickelide alloys thus depends strongly on the cross-section of the trinary system along which alloying with copper is performed. References 7: all Russian.

[231-6508]

UDC: 669.15'74-194:539.4.015

IMPACT FATIGUE OF Fe-Mn ALLOYS WITH VARIOUS TYPES OF MARTENSITIC STRUCTURE

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85
(manuscript received in final form 17 Oct 84) pp 1230-1232

LEONOVA, N.K., GEORGIYEVA, I.Ya. and LVOV, Yu. B.

[Abstract] A study is presented of the mechanical properties of carbonless manganese alloys with various mechanisms of martensite formation under static and impact-cycle loading. Metallographic studies of the morphology of the martensite indicated that in the alloy 03G12 there is a "massive" alpha-martensite, consisting of "packets" of groups of martensitic plates of identical orientation separated by low-angle boundaries, a structure which is characteristic of the massive martensite of many iron alloys. The impact toughness of 03G12 is significantly superior to 03G13. The strength characteristics are the same. The type of martensite structure thus significantly influences the properties of Fe-Mn alloys under dynamic loading. The impact toughness, impact-fatigue strength and resistance to fatigue cracking in martensite formed directly from the gamma-phase are higher than when it is formed through an intermediate epsilon phase. References 6: 4 Russian, 2 Western.

[231-6508]

ESTIMATE OF LOCAL PERMEABILITY OF POROUS POWDER MATERIALS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 85 (manuscript received 28 Mar 84) pp 55-57

VITYAZ, P.A., KAPTSEVICH, V.M., PILINEVICH, L.P., SOROKINA, A.N. and SHELEG, V.K., Belorussian Scientific-Production Association of Powder Metallurgy.

[Abstract] A method is suggested for determining the local permeability of porous powder materials by means of a device patented in the Soviet Union by the authors. The method is as follows: a measurement head is pressed lightly against a porous plate, the local permeability of which is to be determined. An elastic rim around the tube in the measurement plate is compressed by the light contact force. A flow of gas passes through the measurement head under pressure applied from the other side of the plate. The gas flow passing through the measurement head passes through a rheometer which determines its flow rate. The flow rate and known area of the measurement head are used to determine porosity. The method can be recommended for estimation of the structural homogeneity of porous permeable materials. References 7: all Russian.
[229-6508]

WETTING AND CONTACT INTERACTION IN RARE EARTH ELEMENT OXIDE-TIN-TITANIUM MELT SYSTEMS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 85 (manuscript received 21 Dec 83) pp 73-78

NAYDICH, Yu.V., ZHURAVLEV, V.S., FRUMINA, N.I., LASHNEVA, V.V. and VERKHOVODOV, P.A., Institute of Material Science Problems, Ukrainian Academy of Sciences.

[Abstract] Results are presented from an experimental study of the influence of various factors on wettability and contact interaction in yttrium group rare earth metal oxides plus tin melt systems. The influence of the thermodynamic stability of the oxide substrate on the contact wetting angle was analyzed by comparison of the wettability of the rare earth metal oxides and aluminum oxide. Wetting was studied by the standing drop method in a vacuum of 2 mPa at 1423 K. The oxides were found to be better wet by the rare earth element oxides than by aluminum oxide. The interphase interaction of tin-titanium melts with rare earth element oxides does not cause the formation of layers of TiO in the contact zone as are usually observed upon wetting of titanium-containing melts of the oxides of silicon, magnesium and aluminum. References 13: 10 Russian, 3 Western.
[229-6508]

CREEP AND RUPTURE OF AGING ALLOYS

Kiev PROBLEMY PROCHNOSTI in Russian No 6, Jun 85 (manuscript received 10 Sep 84)
pp 11-14

ARUTYNYAN, R.A. and CHIZHIK, A.A., Leningrad University

[Abstract] The purpose of this work was to develop equations relating to the theory of creep of aging materials and to formulate additional strength criteria. Use of the concept of damageability of materials causes the value of the time to failure to approximate the experimental value, although it does not fully solve the problem of predicting long-term service life. Consideration of the aging of the material allows an approach to be made to actual prediction of long-term strength of the material. References 10: all Russian.
[239-6508]

INTERRELATIONSHIP OF STABLE CREEP DEFORMATION RATE AND TIME TO FAILURE OF PEARLITIC AND AUSTENITIC STEELS

Kiev PROBLEMY PROCHNOSTI in Russian No 6, Jun 85 (manuscript received 10 May 84)
pp 14-17

GIGINYAK, F.F., MOZHAROVSKAYA, T.N., TIMOFEYEV, B.T. and ULIN, V.P.,
Institute of Strength Problems, Ukrainian Academy of Sciences.

[Abstract] Results are presented from a study of the interrelationship between the minimum rate of creep deformation and time to failure upon long-term static active loading, in the form of a modified Hoff criterion. Creep testing of pearlitic and austenitic steels was performed using solid cylindrical specimens 10 mm in diameter and 32 mm gauge section length. The experimental studies indicated the relationship between minimum deformation rate as a basic characteristic for calculations and the time to failure, and showed that the Hoff criterion is not fulfilled for all materials under all test conditions. A modified form of the condition is presented which is more universal and can be extended to a broader class of materials. References 5: 4 Russian, 1 Western.
[230-6508]

ESTIMATE OF RELAXATION STRENGTH AND FATIGUE STRENGTH OF ALLOYS UNDER VARIOUS
FORCE AND TEMPERATURE CONDITIONS

Kiev PROBLEMY PROCHNOSTI in Russian No 6, Jun 85 (manuscript received 6 Aug 84)
pp 18-21

SAVKIN, A.N., LUKYANOV, O.P., KONDRATYEV, O.V. and KHROMUSHKIN, K.D.,
Volgograd Polytechnical Institute.

[Abstract] An estimate is presented of the influence of various force and temperature effects on the relaxation strength and fatigue strength of a number of types of titanium alloys under cyclical loading. Cyclical stress relaxation tests were performed on a hydraulic pulsation machine which was modernized for the purpose. The force parameters of cyclical stress were found to affect the relaxation strength of titanium alloy significantly at normal temperatures. The cyclical relaxation limit depends on the ratio of the mean cycle stress to the static relaxation limit. Increasing the test temperature reduces the relaxation strength of the material which is manifested to various degrees for various titanium alloys. Surface-plastic deformation of the material increases its relaxation strength and fatigue strength, particularly the latter. References 10: all Russian.
[230-6508]

UDC: 669.715'721:620.172.251.1:620.172.2:620.171.3:620.178.15:539.3

MECHANICAL CHARACTERISTICS OF AMg6M ALLOY OVER A BROAD RANGE OF TEMPERATURES
AND DEFORMATION RATES

Kiev PROBLEMY PROCHNOSTI in Russian No 6, Jun 85 (manuscript received 10 May 84)
pp 38-44

KRASHCHENKO, V.P., RUDNITSKIY, N.P., DVOYEGLAZOV, G.A. and YERMOLAYEV, G.V.,
Institute of Strength Problems, Ukrainian Academy of Sciences.

[Abstract] A study was made of the mechanical properties of an aluminum-magnesium alloy over a broad range of temperatures and deformation rates. The change in hardness and dynamic elasticity modulus as a function of temperature was also studied. The AMg6M specimens used were heat treated by annealing at 593 K for one hour and cooling in air. Tests were performed at 80 and 850 K, loading rates varied from $1.2 \cdot 10^{-6}$ to $3.3 \cdot 10^{-1} \text{ s}^{-1}$. References 26: all Russian.
[230-6508]

INFLUENCE OF HIGH-DENSITY ELECTRIC CURRENT ON PLASTIC DEFORMATION OF ALUMINUM

Kiev PROBLEMY PROCHNOSTI in Russian No 6, Jun 85 (manuscript received 14 Aug 84)
pp 44-47

KLIMOV, K.M., BURKHANOV, Yu. S. and NOVIKOV, I.I., Metallurgy Institute, USSR
Academy of Sciences

[Abstract] A study is made of the influence of high density electrical current on processes of contact interaction during upsetting of metal strips. Smooth cylindrical rolls were used as the working tools, the experimental installation being based on a two-high mill with 84 mm diameter rolls. Strips of aluminum were compressed between the rolls with fixed compression of 25, 30, 35 or 40%. As the current was passed through, the elastically compressed rolls instantaneously moved closer together by a certain quantity which depended on the force, current and condition of the contact surface. It was found that the actual contact area was not over 3 to 5% of the geometric contact area prior to application of the current. Therefore, significant heating of microscopic projections of the surface occurred upon passage of the current without significant heating of the metal in the volume of the deformation focus. The small projections of the surface were sometimes melted due to heat release as the current passed through, reducing the force of friction practically to zero without significantly softening the deformed metal. References 4: all Russian.
[230-6508]

INFLUENCE OF PHASE COMPOSITION ON VIBRATION STRENGTH OF STAINLESS CHROME-NICKEL STEELS

Kiev PROBLEMY PROCHNOSTI in Russian No 6, Jun 85 (manuscript received 3 Mar 82)
pp 47-51

KONDRATOV, V.M., RUDAKOV, A.A., KOROSTELEV, V.M. and KOCHKIN, L.I., Kirov,
Sverdlovsk.

[Abstract] A study was made of the influence of the phase composition of chrome-nickel steels on their vibration resistance, viability and capability for resisting fatigue cracking, and also on their damping properties. Studies were performed on stainless chrome-nickel steels type Kh12N8 alloyed with various amounts of carbon in order to produce structures with various ratios of austenite to martensite after initial heat treatment. A method is suggested for plotting the line of the beginning of the formation of a macroscopic crack based on the increase in low-amplitude energy dissipation as a result of cyclical loading, allowing determination of an important parameter of structural strength--viability. The vibration strength of stainless chrome-nickel steels depends significantly on phase composition. The least vibration strength is that of the steel with martensite structure due to the low capability of

energy absorption in irreversible processes upon cyclic deformation. Steel in the two-phase state, the austenite of which is metastable upon deformation, has high vibration strength due to a favorable combination of fatigue and damping properties. Chrome-nickel steel with unstable austenite in its structure, although it has the highest damping capability, occupies an intermediate position in terms of vibration strength due to the low endurance limit. References 12: all Russian.
[230-6508]

UDC: 669.15.24.28-194:620.196.2

MECHANICAL PROPERTIES OF IRON-MANGANESE HIGH- AND COMMERCIAL-PURITY ALLOYS

Kiev PROBLEMY PROCHNOSTI in Russian No 6, Jun 85 (manuscript received 14 Oct 84)
pp 51-58

VOLYNOVA, T.F., MNASIN, V.M. and SIDOROVA, I.B., Central Scientific Research Institute of Ferrous Metallurgy.

[Abstract] Continuing previous works on the study of Fe-Mn alloys, the present work studies the mechanical properties in the range of concentration of 4 to 54% Mn as a function of purity of the alloy and type of crystalline lattice. Two groups of iron-manganese alloys of high and commercial purity were studied. The high-purity alloys were obtained in a vacuum furnace, the commercial-grade alloys in an open induction furnace. The phase composition of the alloys in the initial state and on fracture surfaces was determined by an x-ray structural method. In alloys containing 4 to 9% Mn, strength was characteristically high, ductility low. In alloys containing 9% Mn the structure qualitatively varied, with epsilon martensite appearing along with the alpha martensite previously present. In the two-phase area, as the content of manganese increased over 17.5%, strength characteristics increased unexpectedly, in spite of the increase in gamma phase and decrease in epsilon phase, probably as a result of the development of martensitic conversion upon deformation and of the great capability for deformation hardening of the matrix austenite. In alloys containing over 29% Mn, the mechanical properties are determined by the properties of the stable Fe-Mn austenite. Single-phase gamma alloys are less strong than epsilon and alpha martensite alloys. The purity of the alloy was found to have a significant influence on mechanical properties and the nature of change of these properties with variation in composition. An increase in the content of interstitial impurities in commercial alloys is accompanied by a change in the nature of fracture and an increase in the transition temperature from brittle to tough fracture. References 5: all Russian.
[230-6508]

SHIFTED HYSTERESIS LOOPS IN AMORPHOUS $\text{Fe}_5\text{Co}_{70}\text{Si}_{15}\text{B}_{10}$ RIBBONS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 2, Feb 85
(manuscript received 29 Jun 84) pp 332-338

POTAPOV, A.P., GLAZER, A.A. and STARTSEVA, I. Ye., Institute of Metal Physics,
Urals Scientific Center, USSR Academy of Sciences

[Abstract] Amorphous ribbons of $\text{Fe}_5\text{Co}_{70}\text{Si}_{15}\text{B}_{10}$ produced by rapid hardening have zero magnetostriction, and after proper processing have excellent magnetic properties. The present article presents a systematic report on the magnetic parameters of amorphous materials with shifted hysteresis loops in order to determine the physical reason for the shift, as well as to assess the shift's effects on dynamic magnetic properties. Metalloid content in the tested alloys varied slightly. Toroidal samples with an outer diameter of 12 mm were assessed with a microvibrometer to determine static hysteresis, and electromagnetic loss was determined on the basis of the dynamic loop surface at 20-80 kHe. The formation of shifted hysteresis loops is diagrammed and discussed, including ways to eliminate the phenomenon. The mechanism involved showed no stabilization of structure, suggesting that in a soft magnetic matrix, some zones of enhanced coercive force appear that control magnetism during annealing. Tore variations were found to have a direct effect on loop shift, which in its turn affected high-frequency properties. As temperature was increased, the shift increased, while coercive force declined. Shift in hysteresis loops was also affected by the appearance of microcrystalline zones with high coercive force after annealing. Figures 7; references 3: 2 Russian, 1 Western.
[187-12131]

MESSBAUER STUDY OF ALLOYS BASED ON GAMMA-PHASE OF Ti-Al SYSTEM

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 2, Feb 85
(manuscript received 15 May 84) pp 413-415

ZELENKOV, I. A. and PASTUSHENKO, S. N., Kiev Institute for Civil Aviation
Engineers

[Abstract] The high heat resistance and durability of intermetallic TiAl combined with its low weight make it a very attractive alloy for aircraft use. The present article reports on nuclear gamma-resonance study of impurity ^{57}Fe atoms in such an alloy with additional vanadium at 5 and 10% by atomic weight. The alloys were made in a vacuum arc furnace from pure Al, titanium iodide and electrolytic vanadium. The Fe atoms were added during homogenization. Messbauer absorbers were then added during a pulverizing procedure. Diffractometer and spectrometer analyses, which had an error of no more than 0.02 mm/sec, showed that no change occurred in the electron density of the ^{57}Fe atoms during alloying of TiAl with vanadium. The appearance of doublets was attributed to heterogeneity in the alloy, rather than to tetragonal crystalline distortions. Figure 1; references 9 in Russian.
[187-12131]

ULTRASONIC TESTING OF CONTINUITY OF AUSTENITE SURFACING

Sverdlovsk DEFEKTOSKOPIYA in Russian No 6, Jun 85 (manuscript received 16 Apr 84)
pp 9-14

KRETOV, Ye.F., YERMOLOV, I.N. and NEKHONOV, A.V., 'Izhorpskiy Zavod' Production Association imeni A.A. Zhdanov, Leningrad; 'Tsniitmas' Scientific-Production Association, Moscow.

[Abstract] Problems relating to ultrasonic testing of the continuity of an austenite anticorrosion coating itself, rather than simple testing of the adhesion of the anti-corrosion surfacing to the base metal, are discussed. Two pairs of specimens with austenite surfacing on a base of type 22 K steel were prepared. Signal amplitudes were measured from artificial reflectors produced by drilling apertures in the surfacing coatings. The noise level in the surfacing, level of reflection from the contact zone, alpha-phase and propagation velocity of longitudinal waves in the surfacing material were measured. A layer of 1 to 2 mm of the surfacing was then removed mechanically and all measurements repeated. The results of testing of ten defectoscopes of type DUK-66PM indicated that in 90% of cases the deviation of mean amplitude did not exceed 1 dB, indicating the possibility of using these devices for defectoscopic testing of the coatings. Figures 10, references 4 Russian.
[227-6508]

RECOGNITION OF PORE CHAIN DEFECTS FROM REFLECTED SIGNAL SPECTRA

Sverdlovsk DEFEKTOSKOPIYA in Russian No 6, Jun 85 (manuscript received 17 Apr 84)
pp 30-37

STASEYEV, V.G., Central Scientific Research Institute of Heavy Machine Building, Moscow.

[Abstract] The problem of recognizing defects such as accumulation of pores based on the characteristics of reflection spectra is a pressing one. Theoretical studies were performed in the Kirchhoff approximation, using the second integral equation of Huygens for pressure to calculate the reflection fields. It was found that the amplitude-frequency characteristics of pore chains have certain characteristics allowing them to be distinguished from other types of defects. The reflection spectra from the pore chains thus provide information on the dimensions and orientation of the defects. The appearance of side maxima in the reflection spectra serves as a distinguishing characteristic for pore chain type defects. Experimental studies were performed on specimens with induced and natural defects. The results produced were positive in general, confirming the effectiveness of the criterion suggested for recognizing pore chain defects. Figures 11, references 5 Russian.
[227-6508]

STUDY OF RELATIONSHIP OF ACOUSTICAL EMISSION TO FORMATION OF SLIPPING BANDS
IN PLASTIC DEFORMATION OF AUSTENITIC STEEL

Sverdlovsk DEFEKTOSKOPIYA in Russian No 6, Jun 85 (manuscript received 27 Jul 83;
in final form 13 Sep 84) pp 38-42

DROBOT, Yu.B. and KORCHEVSKIY, V.V., 'Dal'standart' Scientific-Production
Association, Khabarovsk.

[Abstract] A study is presented of the relationship of acoustical emission to the formation of slipping bands during extension of polycrystals. Deformation was performed by extending flat specimens 4 mm thick of type 12Kh18N10T steel, the gauge section being half as thick as the remainder of the specimen. Specimens were hardened from 1100°C in water before testing, yielding a mean grain diameter of 0.006 to 0.013 mm. The surfaces were electrically polished before extension. Acoustical emission was recorded during manual deformation at 1.8 mm/min. Continuous acoustical emissions were recorded beginning at a residual deformation of 1 to 2%. The formation of slipping bands was found to be the process of functioning of the sources of acoustical emission by a one-time irreversible mechanism. An analytic expression is produced to describe the change in acoustical emission sources upon performance of an individual act of radiation of elastic oscillations as a function of the residual deformation. The energy of the signals of continuous acoustical emissions was found to be directly proportional to the number of slipping bands formed. Figure 1, references 10 Russian.
[227-6508]

EXOEMISSION DEFECTOSCOPY AND STRUCTURE MEASUREMENT OF AMORPHOUS ALLOYS

Sverdlovsk DEFEKTOSKOPIYA in Russian No 6, Jun 85 (manuscript received 27 Feb 84;
in final form 23 Jul 84) pp 75-78

BOYDENKO, V.S., POTAPOV, A.P., PREOBRAZHENSKIY, M.N. and ALEKSEYEV, V.P.,
Yaroslavl State University; Institute of Metal Physics, Urals Science
Center, USSR Academy of Sciences

[Abstract] Studies are performed of photothermostimulated and thermostimulated exoelectron emission of ferromagnetic alloys based on iron and cobalt obtained by centrifugation in the form of strips 20 microns thick. Emission curves of amorphous specimens of Fe₈₁Si₁₇B₁₂ were obtained. Photothermostimulated exoelectron emission was found to be sensitive to all processes observed and can be used without preliminary electron excitation. The maximum of photothermostimulated emission observed at 1200°C is clearest for the alloy in the crystalline state and may be related to the greater defect content of the surface and adsorption processes in this state. Exoelectron emission is sensitive both to structural relaxation processes occurring upon heating of the amorphous alloy and its crystallization. Figures 3, references 11: 8 Russian, 3 Western.
[227-6508]

PROCESS OF CRACK FORMATION DURING RETARDED STEEL FAILURE UNDER CONDITIONS OF HYDROGEN SATURATION

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 5, May 85, (manuscript received 10 Jan 84; in final form 18 Apr 84) pp 996-1004

GRIBANOVA, L. N., SARRAK, V. I. and FILIPPOV, Institute of Metal Studies and Metal Physics, Central Scientific Research Institute for Ferrous Metallurgy imeni I. P. Bardin

[Abstract] Retarded failure of steel in the presence of hydrogen takes place under stresses considerably below the viscosity of the metal and develops in three stages: "incubation" of cracks, stable spread and rapid failure. Previous models of hydrogen embrittlement did not take into account microplastic deformation. Electrolytic factors in gradual failure are given particular attention in the present study, which subjected 40Kh and 40KhF steel specimens to tempering at 850°C, followed by tempering at 470°C for 1.5 hours, prior to saturation with hydrogen and deformation. Changes in physical and mechanical properties are discussed in terms of stress and deformation, relaxational effect, internal friction and dynamic resilience. The incubation period and early formation of cracks, and plasticity prior to the development of brittle changes, are also discussed. Results indicate that the increase in steel's tendency to gradual failure and irreversible loss of plasticity stems from increases in the amount of local microstress during deformation while saturated with hydrogen. Microcracks, then more serious flaws follow, as the hydrogen interacts with minor flaws to cause larger failures. Figures 4; references 13: 7 Russian, 6 Western. [239-12131]

UDC: 535.21:621.373.826

EFFECT OF QUASISTEADY MILLISECOND NEODYMIUM LASER RADIATION PULSES ON METALS

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 6, Jun 85 (manuscript received 4 Jul 84) pp 1211-1219

MIN'KO, L.Ya., LOPAREV, A.N., Deceased, NASONOV, V.I. and KOVALEV, A.M., Institute of Physics, Belorussian Academy of Sciences, Minsk.

[Abstract] A study is made of the dynamics of formation of laser erosion plasma flames, the reflection and scattering of laser radiation. The brightness temperatures of target surface and flame are determined when a quasisteady millisecond neodymium laser pulse acts on duralumin at moderate power densities (1-9 MW/cm²). The GOS-1001 laser used generates quasisteady pulses with energy E of about 900 J, length about 1.5 ms. The radiation was focused by a 19 cm lens on a spot 3.5 mm in diameter. Under the experimental conditions the evaporative mode of interaction predominates without significant surface shielding. At 0.5 to 1 MW/cm² only melting of the duralumin surface occurs, with no crater or flame formed. At 1.9 to 7.8 MW/cm², the flame formed contains drops of the liquid

metal and partially absorbs and scatters the laser radiation. At this interval of q , the pressure and temperature are not great, the coefficient of absorption of the plasma being not over 0.1 cm^{-1} . The coefficient of absorption and surface temperature of the target, as well as the distance to the compression jump at the maximum of the laser pulse, increase monotonically with an increase in q to 7.8 MW/cm^2 . From 7.8 to 8.6 MW/cm^2 , the absorption coefficient increases from 0.1 to 1 cm^{-1} , leading to a rapid rise in temperature and pressure and a decrease in the coefficient of reflection. The erosion plasma is formed practically simultaneously with the beginning of evaporation. Figures 6, references 27: 25 Russian, 2 Western.
[218-6508]

BIAMPEROMETRIC METHOD FOR DETERMINING NITROGEN CONTENT IN NIOBIUM, TITANIUM AND THEIR ALLOYS WITH IRON

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 51, No 6, Jun 85 pp 21-22

AGAFONOV, P. F., ZUYEVA, V. L. and KOZLOVA, N. V., Chelyabinsk Scientific Research Metallurgical Institute

[Abstract] The Kjeldahl method for determining nitrogen content, with its high use of distillation equipment, is replaced by an electrometric method that was previously used for measuring the nitrogen contents of chromium, vanadium, manganese and alloys of them with iron within a range of 0.1 to 10% by weight. In niobium and titanium and alloys with iron tested in the present study, the range was 0.03 to 0.50% nitrogen. The nitrides of niobium and titanium were found to dissolve incompletely in boiling perchloric acid. Oxidation of various ions with variable valence is discussed. Since the lower limit for nitrogen concentrations was 0.03%, careful attention to the amount of ammonium salts in the reagents used was necessary. The ammeter had 2 platinum electrodes and was used at 250 millivolts. The method tested yielded better results than the Kjeldahl method without using elaborate distilling procedures, so that simplicity and speed of testing were enhanced. References 3: all Russian.
[241-12131]

UDC 543.425

ATOMIC ABSORPTION DETERMINATION OF BASIC COMPONENTS OF FERROTITANIUM

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 51, No 6, Jun 85 (manuscript received 27 Mar 84) pp 24-27

BURYLIN, M. Yu. and TEMERDASHEV, Z. A., Kuban State University, Krasnodar

[Abstract] The present article reports on study of use of atomic absorption spectroscopy to determine basic components of ferrotitanium. Previous attempts to use this method were hampered by calibration error when absorption values were greater than 0.3, but an increment method and preliminary study of disturbances caused by various components when other components were being measured, led to improved results. Atomic absorption measurement of high concentrations

of iron and titanium was tested on F16 ferrotitanium with $33.04 \pm 0.06\%$ Ti. A Zeiss AAS-IN spectrometer was used in the tests. Since the iron content of the standard specimen was not given, it was also measured. The effect of manganese was eliminated by introducing a hydrochloride of hydroxylamine. The method tested produced much quicker and more accurate results than procedures used previously. Figures 2, references 6: 5 Russian, 1 Western.
[241-12131]

UDC 669.14:620.171:539.42

FRACTOGRAPHIC METHOD OF DETERMINING EFFECTIVE GRANULE SIZE IN LOW CARBON AND LIGHTLY ALLOYED STEELS

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 51, No 6, Jun 85 (manuscript received 19 Jul 84) pp 38-42

GORITSKIY, V. M. and KHROMOV, D.P., Central Scientific Research Institute for Steel Construction Design imeni Mel'nikov, Moscow

[Abstract] The dimensions of ferrite granules and martensite or bainite ingots are key factors in determining physiochemical properties of steel such as resistance to brittle failure, but measurements are often hampered by etching of specimens or other structural ambiguities, or weld seam impurities. The present article reports on use of a quantitative fractographic method which measured facets of trans-crystalline creep as an indicator of elementary micro-fissures of brittle failure. The "Neofot" microscope and the Tesla BS-540 electron microscope were used for studying steel structures, while fractographic studies were made with scanning and illuminating electron microscopes. The results of the study indicated that the fractographic method for determining the effective dimensions of granules could be used effectively in studying lightly alloyed and low-carbon steels with mixed or indefinite structures, in a temperature range down to as low as -196°C . Data on various steels are presented in tables. Figures 3, references 9: 4 Russian, 5 Western.
[241-12131]

UDC: 539.26+669.017.3

INSTABILITY OF CRYSTALLINE LATTICE PRIOR TO STRUCTURAL PHASE CONVERSIONS

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 5, May 85, pp 118-126

KOZLOV, E.V., MEYSNER, L.L., KLOPOTOV, A.A. and TAYLASHEV, A.S., Tomsk Construction Engineering Institute.

[Abstract] Based on data from the literature and studies performed by the authors, an analysis is made of the picture of developing instability of the crystalline lattice of metal alloys near structural phase transitions. The

analysis is limited to pure metals and single-phase alloys with close-packed body-centered cubic and face-centered cubic structures in ordered and disordered states. Results of electron microscope studies of states developing the day before face-centered cubic to body-centered cubic, reverse and other phase conversions are not described. The materials covered indicate that pretransition phenomena observed prior to a structural phase transition are interface transitions usually of second or higher order and are observed both before low-temperature martensitic conversion and in other temperature intervals. These transitions are related to harmonic softening of the crystalline lattice which may be isotropic or anisotropic. The direction of softening of the lattice agrees with the direction of the anticipated restructuring. References 50: 41 Russian, 9 Western.
[228-6508]

MARTENSITIC CONVERSIONS AND THE SHAPE MEMORY EFFECT IN ALLOYS

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 5, May 85, pp 3-4

DUDAREV, Ye.F., Doctor of Physical-Mathematical Sciences.

[Abstract] This note introduces this special theme issue, including experimental and theoretical articles on the most important problems of crystal geometry and kinetics of martensitic conversions, the evolution of structure and properties in pretransition states. Regularities and mechanisms of manifestation of martensitic inelasticity and the possibility of the practical application of alloys with shape memory and superelasticity in technology and medicine are discussed. Each of the articles in the issue is briefly discussed. More detailed discussions of all of them are presented in the individual abstracts that follow.
[228-6508]

UDC: 669.295.24.539.370

PRETRANSITION PHENOMENA AND MARTENSITIC CONVERSIONS IN TITANIUM NICKELIDE-BASED ALLOYS

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 5, May 85, pp 5-20

PUSHIN, V.G., KONDRATYEV, V.V. and KHACHIN, V.N., Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences; Siberian Physical-Technical Institute imeni V.D. Kuznetsov, Tomsk State University.

[Abstract] A combined systematic study is presented of the structure and properties of alloys based on titanium nickelide. Using the model of static displacement waves, a thermodynamic analysis of the stability of intermediate shear structures and their relationship with the intermediate and final martensitic phases is presented. As a result of the analysis of structural data and

theoretical conclusions, the sequence of structural transformations in these alloys is established. Studies were performed by transmission electron microscopy and microdiffraction of electrons in situ, as well as X-ray diffraction studies. The unique physical and mechanical properties of titanium nickelide alloys are controlled by the status of the structure and structural transformations dependent on temperature, chemical composition, processing or usage conditions. The present study covers the fine structure, physical properties and their interrelationships for a broad range of Ni-Ti, Ni-Ti-Fe and Ni-Ti-Cu alloys undergoing thermoelastic martensitic conversion in order to establish the specifics of changes in the stability of the crystalline lattice and structural state. The results indicate that, in these alloys, as the stability of the crystalline lattice decreases there is a sequence of genetically related structural conversions, beginning with an increase in the initial high-temperature B2 near-order phase of atomic displacements and continuing in the microdomain structure characterized by intermediate shear structures of martensite. Strengthening of the correlation of periodic short-wave atomic displacements, in addition to homogeneous deformations, may cause a shear martensite restructuring in the initial phase. The premartensite localized displacement structures are centers at which martensite crystals are seeded. References 40: 14 Russian, 6 Western. [228-6508]

UDC: 539.319:539.219.2

SHAPE MEMORY EFFECTS. PROBLEMS AND PROSPECTS

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 5, May 85, pp 21-40

LIKHACHEV, V.A., Leningrad State University imeni A.A. Zhdanov.

[Abstract] A discussion is presented of certain key aspects relating to metals and alloys with reversible martensitic conversion without attempting to completely cover the problem as a whole, based on the results of studies of recent years involving the author. First, the fundamental regularities of the structural and mechanical behavior of materials as related to reversible martensitic conversions are discussed. The nature of the effect of conversion plasticity is analyzed. Phenomena of structural heredity which occur upon martensitic conversion and the nature of the shape memory effect are discussed. Examples of the practical utilization of shape memory are noted. References 77: all Russian. [228-6508]

QUASIEQUILIBRIUM DESCRIPTION OF MARTENSITIC STATES

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 5, May 85, pp 41-53

PASKAL, Yu.I., Siberian Physical-Technical Institute imeni V.D. Kuznetsov, Tomsk University.

[Abstract] Martensitic conversion is an essentially nonequilibrium process. However, in most cases the martensite or austenite-martensite state is retained indefinitely in the temperature area where it is formed. The question arises of the thermodynamic status of these states. They are frequently called metastable, but this is not quite accurate. In the classical understanding a metastable phase is macroscopically homogeneous, and its state is defined by the minimum of equilibrium thermodynamic potential. Martensite states are macroscopically heterogeneous, and their description requires nonequilibrium generalization of the thermodynamic potential. The quasiequilibrium interpretation of martensite states helps to classify specific experimental situations and clarify the thermodynamic content of simple experimental data such as the temperature hysteresis loop or superelasticity hysteresis loop. Although many experimental situations cannot yet be described, the experimental plan here outlined can serve as an effective intermediate stage between the experimental result and its physical explanation. References 20: 17 Russian, 3 Western. [228-6508]

DISSIPATIVE PROPERTIES OF MATERIALS WITH THERMOELASTIC MARTENSITIC CONVERSION

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 5, May 85, pp 54-67

KOSILOV, A.T., Voronezh Polytechnical Institute.

[Abstract] Studies of internal friction under isothermal conditions indicate rapid attenuation of the process of the restructuring of a lattice after heating or cooling of a specimen stops. As soon as the rate of change of temperature becomes zero, initial friction very rapidly drops to the background level. Two theories have been suggested to explain internal friction in the process of the martensite conversion: the theory of amplitude-independent internal friction, based on the model of thermally-activated formation of seeds of the new phase; and the phenomenological theory, based on the experimentally observed linear variation of inelastic deformation as a function of applied external stress. Analysis of the variation of internal friction of materials as a function of amplitude upon thermoelastic martensitic transformation requires consideration of both the directed motion of the interface under the influence of monotonically increasing thermodynamic stimulus in the direction of increasing volume of the new phase, and the process of reverse displacement of boundaries under the

influence of the external periodic stress field. This approach is taken in the present work. Known results from previous studies of internal friction in polycrystalline alloys with thermoelastic martensitic conversion are analyzed, as well as the results of special studies using Cu-Al-Ni single crystals. It is found that, whereas losses determined by irreversible processes decrease with increasing load, the amplitude variation of the background component of internal friction as a function of type of transformation may be complex and nonmonotonic with a loss maximum at certain amplitudes. References 20: 14 Russian, 6 Western.
[228-6508]

COATINGS

UDC: 669.018.543.14

ELECTRON MICROSCOPE STUDY OF BANDS OF DEFORMATION WITH NONHOMOGENEOUS PLASTIC FLOW OF AMORPHOUS ALLOYS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 283, No 1, Jul 85 (manuscript received 19 Jun 84) pp 106-109

GLEZER, A.M., MOLOTILOV, B.V. and UTEVSKAYA, O.L., Institute of Precision Alloys, Central Scientific Research Institute of Ferrous Metallurgy imeni I.P. Bardin, Moscow.

[Abstract] Basic results are briefly presented of an electron microscope study of the fine structure of deformation bands formed upon nonhomogeneous plastic flow of amorphous iron-based metal-metalloid type alloys. The thickness of deformation bands in $\text{Fe}_{65.5}\text{Ni}_{17}\text{P}_{17.5}$ was measured after preliminary isothermal annealing from 50 to 250°C for one hour. 25 to 30 cases were studied for each state. Deformation bands were created by the use of a microhardness indenter with a load at 0.3-0.5 N on thin foil 0.1 micrometer thick. The results obtained can be successfully described within the framework of the atomic model of nonhomogeneous plastic flow of a amorphous alloys based on the concept of excess free volume as the basic elementary plastic deformation carrier. Figures 2, references 5: 3 Russian, 2 Western.
[223-6508]

UDC: 022.346.3

STRUCTURE AND COMPOSITION OF COATINGS OF TITANIUM DIBORIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 85 (manuscript received 23 May 84) pp 41-46

PLATONOV, G.L., SAVEL'YEV, B.A., TOROPCHENOV, V.S., ANIKIN, V.N. and ANIKEYEV, A.I., All-Union Scientific Research Institute of Hard Alloys.

[Abstract] Results are presented from metallographic and x-ray analysis of the structure and phase composition of composite coatings consisting of titanium diboride, as well as laboratory studies of the cutting properties of multifaceted interchangeable plates with these coatings. The specimens for the study were multifaceted plates of tetragonal shape made of the alloys VK100M and

TT10K8B. The results indicate diffusion of boron during precipitation of titanium diboride from the gas medium and possibly from the growing layer in the intermediate layer. The high mobility and chemical activity of the boron atoms from the vapor phase are indicated by experiments on precipitation of boron and titanium diboride from gaseous media directly onto a hard layer of VK100M over a broad range of temperatures. The tungsten and cobalt borides formed result in reduced physical properties when titanium diboride is directly deposited onto the hard alloy. When applied to layers of titanium carbide or nitride, these reactions do not occur. References 6: 3 Russian, 3 Western. [229-6508]

UDC: 621.762

ADHESION OF PYROLYTIC CHROMIUM COATINGS TO STEELS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 85 (manuscript received 12 Sep 84) pp 46-51

KOTKIS, A.M., SHIRYAYEV, A.M. and SHCHUROV, A.F., Gorkiy State University

[Abstract] An attempt is made to determine the structural specifics of pyrolytic chromium coatings obtained by thermal decomposition of organometallic compounds in the vapor phase, determining the mechanism of their cohesion and adhesion fracture under tensile stress. Coatings were obtained by thermal decomposition of bis-ethylbenzene diethylbenzene chromium at 400-500°C. The case of application of coatings onto the internal surfaces of tubular parts was studied. Cohesion fracture of coatings occurs due to the development of cracks of normal tensile type perpendicular to the substrate as well as shear cracks developing at the boundaries of layers in the coatings formed due to nonuniform distribution of carbon-containing impurities through the thickness of the coating. Adhesion fracture of coatings occurs as a result of stable growth of shear cracks developing at the coating-substrate interface and initiated by normal tensile cracks. The mechanism of coating-substrate fracture may vary as a function of the relationship between toughness of fracture of the coating and toughness of slipping of layer interfaces. References 8: 6 Russian, 2 Western. [229-6508]

STUDY OF OXIDE COMPOUNDS OF ALUMINUM AND TANTALUM PRODUCED BY ANODIZATION

Minsk VESTSI AKADEMII NAVUK BSSR; SERIYA FIZIKA-MATEMATYCHNYKH NAVUK in Russian No 2, Mar-Apr 85 (manuscript received 7 Jun 83) pp 94-99

SOKOL, V.A., VOROBYEVA, A.I. and LITVINOVICH, G.V., Minsk Radio Engineering Institute

[Abstract] Anode oxide coatings of aluminum, tantalum and their compounds are widely used as dielectric condensers, but most of the research on them has concentrated on their resistor function. The present article reports on the study of infrared spectra as a ready means for determining the properties of Al-Ta alloys for use as dielectric condensers. Coatings were obtained by ion-plasma spray techniques in an argon medium at 3 Pa pressure, a rate of 0.12-0.16 nm/sec, and 453 K temperature, or (for aluminum alone) electron arc evaporation at residual pressure of 1×10^{-3} Pa, rate of 4.5-5.0 nm/sec and 393 K. Infrared absorption bands of 590-650, 780-835, 900-960, 1150, 1500-1600 and $475-500 \text{ cm}^{-1}$ are discussed. Additional electron microscopic and spectral-luminescent analyses were also made. The latter confirmed the basically amorphous structure of the coatings, with crystalline modifications occurring only after high-temperature annealing at high pressure. The amorphous oxide formed contained water, electrolytic byproducts and structured forms of Al and Ta oxides. Primary boehmite and $\gamma\text{-Al}_2\text{O}_3$ were also present. References 15: 6 Russian, 9 Western.

[180-12131]

LIGHT-COLORED FLUORIDE-FREE TITANIUM ENAMELS FOR STEEL

Moscow STEKLO I KERAMIKA in Russian No 6, Jun 85 pp 15-16

ANTONOVA, L. D., engineer, USHAKOV, D. F., doctor of technical sciences and ZAKHAROV, M.S., engineer, Leningrad Technological Institute imeni Lensovet, Special Project and Designing Bureau, Local Industry Administration, Leningrad City Council Executive Committee

[Abstract] Production of light-colored enamels for consumer goods requires advances in technology for producing titanium dyes that will overcome the color instabilities that arise during heating. The present article reports on studies aimed at producing thermally stable titanium enamels for such items as steel vessels. Working with the Kishinev Elektromashina plant, the authors' institutions produced fluoride-free enamels with the following mass content composition: 4-8% P_2O_5 , 37-42% SiO_2 , 8-11% TiO_2 , 0.5-2.5% ZrO_2 , 6-11% Al_2O_3 , 11-15% B_2O_3 , 0.75-2.25% MgO , 0.5-1.5% CaO , 14-18% Na_2O and 0.01-0.4% Co_2O_3 . Other formulas were also used, along with both traditional and innovative pigments. Of the oxides tested, only Cr_2O_3 was found suitable for producing colors

that would withstand annealing without fading. It was best for yellow-green to blue-green tones, while for blue-gray shades the addition of 3% CoHPO_4 to the mixture was recommended. Other substances tested for color fastness included potassium permanganate, ammonium bichromate, blue vitriol and cobalt nitrate. Of these, only the ammonium bichromate produced the desired effect, yielding a yellow color with insignificant amounts of dye. No red or brown tones were produced by the tests, but the colors produced (the above plus orange) did not reduce the enamel's qualities and in other regards as well met GOST standards. [233-12131]

UDC: 669-494:669.71+669.784

NICKEL COATINGS IN CARBON-ALUMINUM COMPOSITE

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 85
(manuscript received 27 Sep 84) pp 123-127

CHERNYSHOVA, T.A., ARSENTYEVA, M.P. and SHEBO, P.

[Abstract] Information on the morphologic stability of nickel coatings on carbon fibers used in composites is quite contradictory. A study is presented in this work of the effectiveness of using nickel coatings on carbon fibers in the production of carbon-aluminum composite materials. It was found that heat treating of carbon fibers with nickel coatings changed the morphology of the coating. Morphologic instability of nickel coatings on carbon fibers was found to be a significant obstacle to the production of nickel-coated fibers by liquid-phase methods. Nickel coatings less than $1\ \mu\text{m}$ thick on carbon fibers do not perform their functions, either technological or protective, due to the morphologic instability when heated. The use of nickel coatings more than $1\ \mu$ thick is not desirable due to the embrittlement of the matrix and decrease in the specific strength of the composite which result. References 15: 13 Russian, 2 Western. [216-6508]

COMPOSITE MATERIALS

UDC: 539.4

THE STRESS STATE OF A FIBER COMPOSITE MATERIAL WITH CURVED STRUCTURES WITH LOW CONCENTRATION OF FIBERS

Kiev PRIKLADNAYA MEKhanika in Russian Vol 21, No 6, Jun 85 (manuscript received 18 Jun 84) pp 37-44

AKBAROV, S.D. and GUZ', A.N., Institute of Mathematics and Mechanics, AzSSR Academy of Sciences, Baku; Institute of Mechanics, Ukrainian Academy of Sciences, Kiev.

[Abstract] A study is made of an infinite elastic body reinforced with a single curved fiber. The materials of the fiber and matrix are assumed to be homogeneous and isotropic. The case in which the midline of the fiber is a flat line in a plane is studied. Cross-sections of the fiber which are perpendicular to the midline of the fiber are assumed to be circles. When the curvatures in the structure of the fiber composite are extremely slight, self-balancing perpendicular and shear stresses acting on the interface between the matrix and the fiber may be several times greater than the balanced stress in the matrix. The values of self-balancing perpendicular and shear stresses depend nonmonotonically on the parameter of wave formation of the curve shape. Self-balancing stresses at the interface, defined on the basis of a piecewise-homogeneous body model, must be considered in predicting the strength of fiber composite materials. References 13: 12 Russian, 1 Western.
[217-6508]

UDC: 539.3

NUMERICAL STUDY OF STRESS-STRAIN STATE OF HETEROGENEOUS FLEXIBLE ENVELOPES OF ROTATION OF COMPOSITE MATERIALS

Kiev PRIKLADNAYA MEKhanika in Russian Vol 21, No 6, Jun 85 (manuscript received 20 Feb 84) pp 67-73

GRIGORENKO, Ya.M., VASILENKO, A.T. and KRYKOV, N.N., Institute of Mechanics, Ukrainian Academy of Sciences, Kiev.

[Abstract] A study is made of thin multilayer envelopes of rotation which have been assembled of anisotropic layers that vary in thickness in the

meridional direction. The material of each layer in the envelope is heterogeneous. The nonlinear boundary value problem is solved numerically using an approach based on a combination of the methods of linearization and discrete orthogonalization. The data presented indicate the need to compute the stress-strain state of composite material envelopes with allowance for large displacements. References 12: all Russian.
[217-6508]

UDC: 621.762;620.187

STRUCTURE AND PROPERTIES OF POWDERS OF CERTAIN COMPOSITE MATERIALS BASED ON WURZITE-LIKE BORON NITRIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 85 (manuscript received 25 Oct 84) pp 81-85

VOLKOGON, V.M., PADERNO, V.N. and MARTYNNENKO, A.N., Institute of Material Science Problems, Ukrainian Academy of Sciences.

[Abstract] Methods of scanning electron microscopy, microscopic x-ray spectral and x-ray phase analysis are used to study the structure of composite materials based on wurzite-like boron nitride containing titanium carbide, zinc oxide or aluminum oxide as additives. The morphology, shape and dimensions of particles of the initial powders were studied. The x-ray phase analysis showed that the powders produced from the composites are multiphase systems containing boron nitride of both wurzite and sphalerite modifications in addition to traces of phases based on the additives introduced. When titanium carbide, zinc or aluminum oxide is introduced to a granulated mixture of wurzite-like boron nitride, low-strength cakes are produced which are easily broken along the boundaries of the BN granules by mechanical force, providing particles with the desired size. References 6: all Russian.
[229-6508]

FERROUS METALS

NEW DRILLING RIG REQUIRES EXPENSIVE REMODELING

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 16 Jul 85 p 2

[Article by Ye. Sorokin, supervisor of the Mining Equipment Repair and Operation Department of the Norilsk Metallurgical Mining Combine im. A. P. Zavenyagin and V. Serebryanny, correspondent of the newspaper GORNYAK under the rubric "New Technology: Level and Efficiency": "When Advice Was Ignored"]

[Text] The shops and buildings of the Norilsk Metallurgical Mining Combine and the city of Norilsk stand on half a million reinforced concrete piles. Pile construction on such a large scale does not exist anywhere else in our country nor anywhere in the world.

Pile construction on permafrost, an invention of northerners, was preceded by a great deal of work to improve the "BS-1" churn drilling rig. Mining engineers were not satisfied with the borehole rate and passability when moving from place to place. The mechanics of the combine decided to change the undercarriage of the rig and to suspend a more productive three-ton gear in place of the designed 1,200 kilogram gear.

The replacement required complete modernization of the mechanism. According to the mechanics, only one fifth of the rig remained after it was remodeled. In return, the rig made boreholes almost twice as fast and the borehole diameter was increased several fold. The Norilsk workers even changed the brand name--they added the letter "M" to the name that means modernized.

In the mining technology repair shop, where over three decades a thousand rigs have been remodeled, a special section was organized. The state price for each rig is 19,500 rubles, and the cost of modernization is an additional 12,500 rubles. Now it seems incredible that ten million rubles were spent for something that did not have to be done. All of this could have been done, in the first place, at the plant located in Blagoveshchensk. The manufacture of mechanisms of improved construction is not for northerners only--after all, such rigs operate all over Siberia.

The Norilsk workers tried to write all about this to Blagoveshchensk addressed to the Amurskiy Metallist Plant and to designers in Sverdlovsk addressed to NIPigormash [Scientific Research, Planning and Design Institute of Mining and Concentrating Machinery], but they received no replies. And, so they abandoned this little project. The expenditures for modernization paid for themselves in the first year of operation and, for this reason, the workers became accustomed to it as a necessity. This wasn't the first time that northerners had to adapt "southern" technology to their specific conditions.

A few years back, the combine received a notice: "BS-1" rigs will no longer be manufactured in the country. In place of these, the Amurskiy Metallist Plant will manufacture the "BS-2". Its testing was planned for 1982. The combine specialists raised a fuss: invite us to these tests, the experience of the Norilsk workers cannot be discounted. After all, in all these years the advantage of Norilsk constructed rigs has been acknowledged in practice many a time. Specialists from BAM [Baikal-Amur Trunk Line]--first from the Eastern section and then from the Western one--came for the experience of the northerners. They were given blueprints, some units and consultants. And the modernized mechanisms worked well.

In Norilsk there are administrations of the all-union trusts and associations of "Gidropetsstroy", "Gidropetsfundamentstroy" and "Soyuzshakhtoosusheniye" whose specialists use the churn drilling rig at different ends of the country and consider rigs of our construction to be the best. They only lease rigs with the letter "M" from our combine.

The Norilsk workers thought if they could participate in the tests then, maybe, the drillers of Siberia will finally get an improved rig, and the northerners will no longer have to spend all their money on remodeling series equipment. They sent letters and telegrams to the designers in Sverdlovsk, but received no reply. The testers decided to manage without any advice.

And so, the first "BS-2" rigs arrived in Norilsk. Drillers of S. Amin's and A. Nagornyy's brigades from the Soyuzshakhtoosusheniye trust were called upon to test them in operation at the construction of the second section of a cement plant. Each driller had close to twenty years of experience and both of them are top management specialists.

"When we saw the rig in blueprints, we liked it very much," they said. "Each assembly has its own individual drive, this is convenient. There are elements of hydraulics and automation, a friction-drive winch with a three-ton weight lifting capacity, electric jacks, and other innovations that attracted us."

However, when the rig arrived, our machinists immediately saw that it was not conscientiously assembled. Instead of continuous welding, there was a dotted line of tack welding. For three months a crew worked on altering the newest mechanism. Soon, other deficiencies

appeared, structural ones. For example, the weight of the rig had been increased by thirteen tons, but the carriage remained as before, that is, the reliability fell sharply. The pair of carriages in the back had to be replaced by an excavator one. And, the chains had to be replaced as well--the plant ones broke during the very first attempt to move the rig by itself. They raised the gear--its weight does not hold: the hydraulic brake piston does not work properly. They had to remodel the rig.

The drillers introduced about twenty changes, large and small, into the new rig, but the main difficulty they were unable to change. The new rig is made in such a way that the gear rate cannot be changed during the drilling process. This is a large and difficult to correct error on the part of the designers. The gear cannot operate productively in rocky or flooded soils.

The "BS-2" remained in the brigade a year. Only 600 meters of borehole had been drilled with a two-shift working operation.

"Earlier we had six rigs in the brigade," said Sergey Aminov, "and with five old rigs it was somehow possible to work with one new machine. Now, the number of old construction rigs has decreased, and the brigade has refused to accept such new marvels."

The opinion of the combine specialists is even more categorical. The chief mechanic of the Fundamenstroy administration, V. Kurin, said that, despite the enormous weight, high price--57,000 rubles--and excessive consumption of electric power, the new rig has the same certificate productivity as the old one. The question is: what purpose did all this trouble serve?

The builders of LEP-220 and the gas workers refused the "BS-2" as soon as they saw its weight in the certificate: a tractor simply cannot take such a huge and cumbersome thing into the tundra on a sledge, and in the spring the mammoth rig will sink along the route. The new rig will not be able to operate without a special rock fill.

Remodeling the rig with our own efforts will cost about 30,000 rubles and, as a result, the drillers will have for this money only one unit instead of three. This is something for the economists, the mechanics and builders to think about. The chief mechanic of the combine has the following available data: of the 100 "BS-1M" rigs now at the combine, almost each of them has operated more than seven years; their certificate serviceability has expired. Spare parts for them are no longer made. However, the new rigs, even those that have not been used yet, require additional basic structural work. The construction program at the combine is threatened by failure in the coming five-year plan.

Since 1980, letters from Norilsk have been going out to Sverdlovsk and Blagoveshchensk. This year alone, several telegrams and a letter were sent addressed to the Chief Engineer of the Amurskiy Metallist Plant, B. Belov. On the first of March, the last telegram was sent to Deputy Director of NIPIgormash for the scientific section, Yu.

Korkin, and to Plant Deputy Director, Ye Ovchinnikov, with the request that the designer and representative of the enterprise, manufacturing the rigs, be sent out to the combine--let them look at their wondrous creation at the place of its operation.

So what happened? In the folder marked "BS-2" there is only "outgoing" mail: the combine has not received a single reply in all these years!

A basically new drilling machine, developed by the scientists at the Kharkov Aviation Institute and the designers of VNIlgormash, was recently tested in Norilsk. It was manufactured at the same Amurskiy Metallist Plant. This new machine increases labor productivity by 16-fold! Unfortunately, it cannot be used everywhere and, for this reason, cannot fully replace the traditional rigs. As before, the need for them still remains. The only thing is that the "B-2" rig does not satisfy this need.

12525

CSO: 1842/235

UDC: 620.179.14

STUDY OF EFFECTIVENESS OF MAGNETOGRAPHIC TESTING OF LONGITUDINAL SEAM
QUALITY IN ELECTRICALLY WELDED PIPE

Sverdlovsk DEFEKTOSKOPIYA in Russian No 6, Jun 85 (manuscript received
11 Jun 84) pp 49-61

SHLEYENKOV, A.S., SHUR, M.L., SHCHERBININ, V.Ye., and KOP'YEV, M.A.,
Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences.

[Abstract] A study is made of factors resulting in the appearance of the welded joint field on a magnetic tape during magnetographic testing of the longitudinal seam in electrically welded pipe. Factors decreasing the sensitivity of the magnetographic method are noted. The selectivity of the method for surface defects can be increased by adding extra induction to the magnetizing field, which allows estimation of the width of a defect in the seam. With transverse magnetization of pipe by means of an electromagnet, after the magnetizing current is turned off there is spontaneous remagnetization of the tube section enclosed between its ends, leading to the appearance of a reverse field from a defect large enough to erase the recording of the initial defect field on the tape. The sensitivity of the method to surface defects can be increased by removing the tape when the magnetic field is at zero, eliminating the reduction in level of recording due to the reverse defect field. Longitudinal seams in electrically welded pipe can be tested for residual magnetism, since the reverse defect fields are sufficiently intense to be recorded on the magnetic tape. Figures 22, references 5 Russian.

[227-6508]

FORMATION OF DENDRITIC CARBONITRIDE CRYSTALS (Ti,Nb)(C,N) IN MICROALLOYED STEEL

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 282, No 5, Jun 85
(manuscript received 7 Sep 84) pp 1121-1123

ARKHAROV, V.I., Academician, Ukrainian Academy of Sciences, DOLZHENKOV, F.Ye., NOVIK, V.I. and GLAZUNOVA, V.A., Donetsk Scientific Research Institute of Ferrous Metallurgy

[Abstract] Electron microscope analysis of type 09G2FB cast steel revealed dendritic carbonitride 'star' crystals. The continuous-cast metal had the following chemical composition, in percent: 0.11 C; 1.57 Mn; 0.25 Si; 0.07 V; 0.03Nb; 0.03 Ti; 0.03 Al; 0.005 S; 0.016 P. Local x-ray spectral analysis revealed P and Nb in the crystals. The carbonitride stars were observed in foils and by means of carbon replicas on etched microsections and on the fracture surfaces of impact test specimens. The branches of the carbonitride dendrites are oriented in three mutually perpendicular directions. The dendritic crystals are morphologically distinct from known carbonitride segregations of other forms observed in cast and hot-rolled microalloyed steel. The formation of the segregations is probably related to specifics of the industrial technology for production and continuous casting of steel. Figures 2, references 4: 3 Russian, 1 Western.
[224-6508]

UDC 669.15'26'24'295-194:620.181

STUDY OF PHASE TRANSFORMATIONS IN AUSTENITE STEEL Khl8N10T UNDER PRESSURE

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 5, May 85
(manuscript received 11 Apr 84) pp 957-963

YESHCHENKO, R.N., DEMCHUK, K.M., MARTEM'YANOV, A. N. and CHARIKOVA, N. I., Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences

[Abstract] Dislocation mechanisms in martensite transformations have received considerable attention in recent years. The present article reports on study of the role of structural defects that occur in compaction of metal particles and the emergence of alpha- and epsilon-phases. The steel studied, Khl8N10T, contained by weight 10% Ni, 18.8% Cr, 0.051% C and 0.4% Ti. Sample rods tempered at 1000°C for 1 hour, in an austenitic state, were subjected to pressure of 8.0 GPa, and then deformed at room temperature and at -196°C. Then features of the resulting thermally stable steel were assessed. Results showed that at 3.5-5.0 GPa a gamma-epsilon phase transformation occurred, while at 5.0-8.0 GPa, simultaneous gamma-epsilon and gamma-alpha transformations were noted. Formation of the epsilon-phase was accompanied by significant drop in the number of compaction defects in the austenite steel. Alpha-martensite treated under pressure was not as dispersed

as that formed by deformation. Formation of the alpha-phase was apparently initiated by uncompensated tensile stress under pressure. Figures 6; references 19: 11 Russian, 8 Western.
[239-12131]

UDC 669.15'71'782:669.112.227.342

FORMATION PATTERNS OF DEFORMATION ALPHA MARTENSITE IN TWO-PHASE (GAMMA + EPSILON) STEELS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 5, May 85 (manuscript received 27 Dec 83, in final form 31 Aug 84) pp 968-97

NEMIROVSKIY, Yu. R., NEMIROVSKIY, M. R., KHADYYEV, M. S. and FILIPPOV, M.A., Urals Polytechnical Institute imeni S. M. Kirov

[Abstract] Patterns of martensite structures during deformation have been studied in Fe-Cr-Ni and Fe-Mn-Cr steels that are characterized by low austenite compaction defect energy. The present article reports on a systematic study based on information gathered from unstable austenite steels where crystallographic analysis was not hampered by the presence of epsilon-phase layers. Cylindrical specimens with Fe-29% Mn and Fe-20% Mn-1% Si were studied after elongation by 15-20%. The formation of alpha-crystals relative to external load was studied only in experimental situations where no significant divergences from a position perpendicular to the electron flux were observed. Analysis showed that earlier findings on unstable austenitic alloys with deformation gamma-epsilon, alpha- transformations were found, also hold true for gamma + epsilon structures in alloys of the G20 type. Three types of alpha-crystals, with markedly different rates of formation, and the role of energy factors in their formation, are discussed. The authors consider the decisive factor to be minimization of local plastic deformation, opposite to the direction of external load, while less common "anomalous" alpha-crystals provide the possibility of shift processes initiated by external loads at contact points of epsilon-phase layers without significant local deformation. Figures 2; references 7: 3 Russian, 4 Western.
[239-12131]

FEATURES OF CHANGES IN CRYSTALLINE MATRIX OF STEELS WITH ANOMALOUSLY HIGH TETRAGONAL FORMATION OF MARTENSITE AT LOW TEMPERATURES

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 5, May 85
(manuscript received 13 Apr 84, in final form, 31 Aug 84) pp 975-986

PROKOSHIN, S. D. and MAREYEVA, Ye. Yu., Moscow Institute of Steels and Alloys

[Abstract] Introduction of a carbon atom into alpha-iron is known to result in tetragonal distortion, which changes as a linear function of the concentration of carbon in the solid solution. The present article reports on the decrease in tetragonal structure in freshly formed martensite in Fe-Ni, Fe-Ni-C and Fe-Al-C alloys at temperatures from -180°C to room temperature. Mechanisms of partial transfer of carbon atoms from octahedron to tetrahedron structures and of "incorrect" doubling along surfaces are questioned due to energy problems and inconsistency, respectively. The authors propose that the mechanism involved is based on rupture of the coherent bond of the solid state as a function of the degree of proximity, dimensions and position. This hypothesis is tested using alloys with varying contents of iron, carbon, nickel, and aluminum. Results indicated that in the carbon-free N32 alloy, freshly formed martensite has a tetragonal structure at -180°C , while Fe-Ni-C and Fe-Al-C alloys have anomalously high tetragonal structures. With heating to room temperature, that structure decreases, apparently due to the loss of the coherent bond mentioned above and the development of ordering structures as austenite forms. In 130N12 steel, the tetragonal structure increased during the same heating process, while in 100N18 no change was noted due to competition between structural processes. Graphite formation was also observed in Fe-Ni-C and Fe-Al-C steels with anomalously high tetragonal structure. Figures 3; references 36: 25 Russian, 11 Western. [239-12131]

LEAF SYSTEMS OF THE INTERNATIONAL ELECTROTECHNICAL COMMISSION FOR MONITORING MEAN MAGNETIC LOSSES OF ELEKTROTECHNICAL STEEL

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 51, No 6, Jun 85,
(manuscript received 27 Sep 84) pp 91-94

CHISTYAKOV, V. K., KOBOBEYNIKOVA, I. Ye., KOROBA, O.B., MINTS, B. B. and KOSTRILEVA, N. S., Verkh-Isetskiy Metallurgical Plant, Sverdlovsk

[Abstract] The transition from traditional methods of evaluating cold-rolled electrotechnical steels in an Epstein apparatus to leaf or foil measurements will provide data on mean magnetic loss (MML) and magnetic induction (MI) without additional annealing and hardening, with no loss of accuracy. The present article reports on two types of such devices that can measure

magnetic values on either one or both sides of a metal leaf simultaneously. Mathematical calculations of test results are presented for symmetrical and asymmetrical metal specimens. The study showed the advantages of the leaf devices over devices with a single magnetic lead to be improved measurement of MML and less correction for magnetic induction variation (by a factor of two). Figures 3.

[241-12131]

UDC: 539.4

INFLUENCE OF TEMPERATURE AND LOADING TIME ON STRENGTH AND RUPTURE OF IRON AND TYPES St.3 AND 12Kh18N10T STEEL DURING SPALLING

Kiev PROBLEMY PROCHNOSTI in Russian No 6, Jun 85 (manuscript received 27 Jan 83) pp 28-34

GOLUBYEV, V. K., NOVIKOV, S.A., SOBOLEYEV, Yu.S. and YUKINA, N.A., Moscow

[Abstract] This work, a continuation of earlier works by the same authors, analyzes a broad range of processes for armco iron and St.3 and 12Kh18N10T steels over the temperature range from -196 to 800°C. Critical load levels corresponding to the development of spalling microscopic damage sites are determined. The development of these sites, referred to as 'strength,' is found to vary at different loading intensities, depending on the duration of loading. Metallographic and fractographic studies of fractures were performed. References 16: 10 Russian, 6 Western.

[230-6508]

UDC: 669.15'24:548.313.3:538.13

ATOMIC AND MAGNETIC SUPERSTRUCTURE OF RESIDUAL AUSTENITE IN Ni-66.8 AT.% Fe WITH INCOMPLETE GAMMA TO ALPHA CONVERSION

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85 (manuscript received 16 Jul 84) pp 1165-1176

DUBININ, S.F., TEPLUKHOV, S.G., YEVTUKH, A.A., KOLYADIN, V.P., SKOROBOGATOV, V.P. and SIDOROV, S.K., Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences.

[Abstract] This article, the eighth in a series on neutronographic study of the atomic and magnetic structures of austenitic Fe-Ni alloys over a broad range of compositions and temperatures, presents an investigation of the superstructure of the austenite crystal in Ni-66.8%Fe cooled below the temperature at which the martensite conversion begins. Analysis of complex diffraction pictures measured with and without magnetic fields over a broad temperature range reveals antiferromagnetic reflexes and peaks of purely structural origin

resulting from modulated displacement of atoms from nodes in the initial face-centered cubic lattice. Long-range antiferromagnetic order coexists with ferromagnetic order in the crystal of residual austenite. The results of the work, in combination with the previous studies in the series, indicate that the antiferromagnetic and nuclear superstructure depend on composition of the residual austenite. The magnetic structure of the austenite plays a decisive role in terms of the nature of atomic displacements in the crystal and their variation as a function of composition. References 13: 8 Russian, 5 Western. [231-6508]

UDC: 669.15'26'74-194:669.788:620.178.13

INFLUENCE OF HYDROGEN ON SHORT-CYCLE DURABILITY OF TYPE 06Kh17G17 STEEL

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85 (manuscript received 19 Jul 83; in final form 11 Jul 84) pp 1224-1226

BARANNIKOVA, G.A., GOL'TSOV, V.A., SAMOYLENKO, Z.A. and ROMANIV, A.N., Donetsk Polytechnical Institute; Donetsk Physical-Technical Institute, Ukrainian Academy of Sciences.

[Abstract] An X-ray study was performed of the structural changes in 06Kh17G17 steel occurring upon short-cycle loading. Milled specimens of rolled sheets of the austenite chrome-manganese steel 2mm thick, cut in the direction of rolling, were subjected to flat pure flexure with a constant amplitude of total deformation of 1.6% in a pulsating cycle at 20 cycles per minute. Tests were performed in technically pure hydrogen and high purity hydrogen at 10^5 Pa, and also in a vacuum of $1.3 \cdot 10^{-2}$ Pa at 20 to 600°C. Hydrogen was found to change the selectivity of crack propagation under the test conditions. This factor apparently is in effect throughout the entire temperature range studied.

References 5: all Russian.

[231-6508]

UDC: 669.14.018.294.2:666.046.516:539.537

INFLUENCE OF MICROALLOYING ON IMPACT TOUGHNESS OF RAIL STEEL

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85 (manuscript received 16 Oct 84) pp 1228-1230

DOBUZHSKAYA, A.B., KOLOSOVA, E.L., SYREYSHCHIKOVA, V.I., VELIKANOV, A.V. and SHCHERBAKOVA, L.P., Urals Scientific Research Institute of Ferrous Metals; All-Union Scientific Research Institute of Railroad Transport

[Abstract] In order to determine the reason for the drop in impact toughness of rail steels deoxidized with calcium- and magnesium-containing hardeners containing vanadium, titanium and zirconium, a study was made of the influence

of addition of small quantities of vanadium, titanium and zirconium on the structure of hardened and tempered high-carbon rail steels. The steels studied were made in industrial open hearth furnaces. Ingots were rolled into rails and then the rails were heat-treated by isothermal annealing at 600°C for two hours, hardening in oil from 840 to 850°C with a holding time of one hour, and tempering at 450°C for two hours. Results of the studies showed that the austenite grain and pearlite colony size in the steels did not change with the addition of zirconium, vanadium or titanium. Microalloying with vanadium of titanium was found to increase the temperature at which pearlite transformation occurred upon hardening in oil due to the seeding effect of undissolved vanadium carbon nitrides and titanium nitrides. The decrease in impact toughness of hardened and tempered steel containing these additives results from thickening of Fe_3C plates and the presence of dispersed $\text{V}(\text{C},\text{N})$ and TiN particles. Microalloying with zirconium did not influence the structure of the steel. References 10: 9 Russian, 1 Western.
[231-6508]

UDC: 536.3.543.87

STUDY OF PROGRESS OF HEATING AND OXIDATION OF 12Kh18N10T STEEL AT HIGH TEMPERATURES

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA FIZICHESKIKH I TEKHNIЧЕСKIKH NAUK in Russian No 3, May-Jun 85 (manuscript received 27 Jun 84) pp 89-94

MELNIKOV, V.K. (Deceased), KOVALEV, V.N., ZAKE, M.V. and LIYEPINYA, V.E., Physics Institute of the LaSSR Academy of Sciences

[Abstract] An experimental study is presented of the kinetics of oxidation, thermal surface radiation and electron transfer when type 12Kh18N10T steel is heated in high-temperature argon containing 4% oxygen. Studies were performed with unsteady heating and steel specimens in the range from room temperature to 1400 K. The specimens were thin sheets of 12Kh18N10T foil measuring 10 x 12 x 0.05 mm. Three series of experiments were performed with gas flow temperatures of 2410, 2810 and 3200 K. Oxidation produced a complex oxide containing such compounds as magnetite Fe_3O_4 , chromite FeCr_2O_4 with a spinel-type structure and simple oxides FeO and NiO , apparently as $(\text{Fe},\text{Ni})\text{O}$ solutions. Comparison of the kinetics of the change in the values measured with the kinetics in change of sheet temperature and oxide film thickness indicate that the basic changes in the kinetics of charge transfer from plasma to steel surface occur in the initial stage of heating in the area of thin oxide films. This indicates that the compact oxide film formed on the surface of the steel has good protective properties for both chemical and electrical interactions between the argon plasma and oxygen and the surface of the steel. References 9: 8 Russian, 1 Western.
[220-6508]

CONSTRUCTION PROBLEMS AT ZARINSK BY-PRODUCT COKE PLANT

Moscow PRAVDA in Russian 2 Jul 85 p 2

[Article by V. Sapov, PRAVDA reporter, under the rubric "Put The Year's Priority Projects into Operation," "Out of Coke Batteries"]

[Text] The Altay, the largest Siberian granary, is now known as a supplier of "bread" for ferrous metallurgy. And they "bake" it at the by-product coke plant in the new city of Zarinsk. Here, on the banks of the Chumysh river, three batteries are already in operation, each producing a million tons of the valuable product a year. By the end of the current-Five-Year-Plan, one more "millionaire" is scheduled to be put in operation. Construction of the third phase of the enterprise with two more batteries is planned. Our story tells how the things are at this All-Union shock project.

I remember taking out the first coke "pie" in the fall of 1981. This event became a real holiday for both construction workers and chemists. Later two more victories were won. World practice does not know of putting installations in operation at such a high speed (a battery a year). And here is Zarinskites' new initiative: to put the fourth battery into operation ahead of schedule, by August 25. This will allow them to produce at least 200,000 tons of coke above the plan.

"The goal is absolutely within our reach," says A. Kotovich, director of the by-product coke plant. "I think the builders will not let us down either. Incidentally, the oven firing is already under way."

The sections of the Altaykoksokhimstroy trust are very busy. The integrated brigades of A. Abramov of SU (construction administration)-46 and P. Grachyov of SU-38, and the finishing team of A. Larina of SU-56 are working hard. The installers are working faster too.

The construction workers of Zarinsk have been coming out with valuable initiatives time and again, and now they are employing many new methods. A lot of collecting work on contract. All this helps to increase labor productivity.

One of the novelties is the work center method of construction management. Its essence is that a priority project is divided into subcomplexes, each with its own volume of work. For instance, the fourth oven has five such subcomplexes. Each subcomplex has its own person in charge. The targets are given to them. What is the result? First of all, each project is now under better control. For instance, the trust manager used to spend an inordinate amount of time at daily staff meetings, so there was hardly any time left for working with people. It also happened that things were overlooked at a given unit, and the entire project broke down. Now things are different. Staff meetings take place twice a week. Every project is under control. Planning discipline has improved. Working commissions have been now formed for every project. In determining the technical readiness, these commissions take into account even the smallest imperfections.

The brigade contract is also gathering strength in Zarinsk. For instance, due to it the Sibantekhmontazh trust completed the four years' plan a month ahead of schedule. The Altay SMU (construction and installation administration) of the Altaykoksokhimstroy trust, where conversion to the new form of work organization permitted labor productivity to be raised by 59 percent, has achieved notable success.

However, sometimes all efforts come to naught because the equipment delivery schedule is not met, as well as because of the poor quality of the equipment. Almost half of the steel linings for the batteries were shipped with defects. Electrical motors have defective shafts. Two boilers were damaged in transit. And these are not isolated cases.

Even more noticeable is the lack of coordination of the fifth battery, which is scheduled to be put into operation in 1988. The documentation issued for today by the Kharkov Giprokoks institute is obviously not sufficient for the incomplete projects. That is not to mention preparation of the forms for the structures beforehand. The battery is one of a kind: it will be erected on piles. Its capacity is one third higher than that of models already in operation. It means that different rigging will be necessary.

The problem of financing the fifth battery is being resolved very slowly. Out of 100 million rubles, the Ministry of Ferrous Metallurgy has allocated for 1985 only... 3.6 million, whereas 25 million at a minimum are needed. It may happen that next year the allocation will be so high that there will be no way to put the entire sum to use. This is the fear at Glavaltastroy.

"We had such difficulties increasing the production volumes at the Zarinsk site," says I. Kopeliovich, chief of this main administration, "and now we are racking our brains trying to keep our people busy, and we are losing our subcontractors. Here are the figures: in 1983 the Altaykoksokhimstroy trust performed 63.5 million rubles worth of work, in 1984 48.5 million, and in 1985 the plan given it is for only 38 million."

When the first battery was commissioned, no money was spared for social, cultural and everyday services: for instance, 100,000 square meters of housing space alone was put in service in one year. But then these services

were given much less attention. Unlike the construction workers, the plant workers have neither a Palace of Culture nor a dispensary. There are not even enough dining facilities.

The town, the plant, the people are interrelated concepts. Nowadays everybody knows how Norilsk or Strezhevoy were built. Here is the standard for both the town-planners and the clients. Of course, the scope in Zarinsk is different. But regardless of the scope, Zarinsk is also entitled to a balanced building process. And the more complete it is, the stronger are the ties between the townspeople and the plant, the more Altay coke will the country get.

12770

CSO: 1842/234

NON-METALLIC MATERIALS

UDC: 548.33

DYNAMIC RECRYSTALLIZATION OF THE SPHALERITE MODIFICATION OF BORON NITRIDE AT HIGH PRESSURES AND TEMPERATURES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 283, No 1, Jul 85 (manuscript received 7 Sep 84) pp 119-121

KURDYMOV, A.V., OLEYNIK, G.S., PILYANKEVICH, A.N., DZHAMAROV, S.S. and FRANTSEVICH, I.A., Academician, Ukrainian Academy of Sciences, Institute of Material Science Problems, Ukrainian Academy of Sciences, Kiev.

[Abstract] A study is made of the regularities of behavior observed in the process of hot deformation of BN_{spg} crystals formed by a crystal orientation mechanism. Studies were performed by transmission electron microscopy through thin polycrystalline foils obtained by sintering wurzite boron nitride BN_w at high pressures and temperatures. Primary recrystallization of crystals with high chemical bond energy and a large fraction of directed bonds results from their significant deformation, carried out under high hydrostatic pressure and high temperatures. Recrystallization of these crystals, as in the case of metal materials, occurs by the formation of recrystallization seeds in the deformed area, i.e., the mechanism of true seed formation. These data indicate applicability of the concepts of seeding of recrystallization centers and their growth in metal materials for the description of processes of recrystallization in strongly deformed ion-covalent crystals. Figures 6 Russian. [223-6508]

UDC 678.01:536.5:543.51

THERMOGRAVI-MASS-SPECTROMETRIC DEVICE FOR STUDYING DESTRUCTION OF COMPOSITE POLYMER MATERIALS DURING HIGH-SPEED HEATING

Moscow ZAVODSKAYA LABORATORIYA in Russian Vol 51, No 6, Jun 85 (manuscript received 16 May 84) pp 53-56

SKLEMIN, N.K., GRISHIN, V.V. and KHMEL'NITSKIY, R.A.

[Abstract] Evaluation of thermal features and kinetic parameters of volatile products of thermolysis is often crucial in assessing polymer composites. The

present article reports on a thermogravi-mass-spectrometric device that permits modelling of high-temperature high-speed thermal destruction processes that yield data on weight-change kinetics and volatile products of thermolysis. The device permits comprehensive study of several parameters. Programmed linear heating of the test specimens was done with an infra-red lamp. Vacuum and high-speed factors of the tests are summarized. Accuracy was verified using synthetic mixtures of varying concentrations of saturated hydrocarbons with nitrogen. Ethylene-propylene resins and carbon plastics of phenyl-formaldehyde mixtures were studied by pyrolysis in an inert medium at heating rates of 1.7, 17 and 60 degrees/min. The results indicated that the device made it possible to determine the rate of destruction and thermal features of polymer composites during high-speed heating, along with data on composition and dynamics of emission of volatile products, and kinetics of thermal destruction and depolymerization of various volatile materials. Figures 4; references 6: all Russian.
[241-12131]

UDC: 669.245'295.018.6

USE OF ALLOYS WITH SHAPE MEMORY IN MEDICINE

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 5, May 85, pp 127-132

GYUNTER, V.E., KOTENKO, V.V., POLENICHKIN, V.K. and ITIN, V.I., Siberian Physical-Technical Institute imeni V.D. Kuznetsov, Tomsk State University.

[Abstract] The discovery of shape memory in metals resulted in the creation of a fundamentally new area of medicine, related to the development and investigation of alloys, structures and devices with shape memory and the creation of basically new and unique methods of treatment using them. In addition to the usual requirements of metals for use in medical apparatus, such as corrosion resistance and tissue compatibility, alloys with shape memory must also meet the requirements of high strength and ductility, elasticity and rigidity, flexibility, wear resistance and toughness. TiNi alloys have all of these properties, making them among the most promising for this area of use. Metal structures with shape memory can be deformed before insertion into bones and other body parts, then heated sufficiently to regain their original shape, thus fixing bone fragments in place firmly without the use of screws and other fasteners. The use of porous and nonporous alloys with shape memory as implantable structures represents a new stage in the development of medicine. Alloys with shape memory can not only improve traditional methods of treatment but open fundamentally new possibilities for the use of metal implantates in medicine. References 8: all Russian.
[228-6508]

MARTENSITIC INELASTICITY OF ALLOYS

Tomsk IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 5, May 85, pp 88-103

KHACHIN, V.N., Siberian Physical-Technical Institute imeni V.D. Kuznetsov, Tomsk State University

[Abstract] Martensitic inelasticity represents a third basic form of deformation behavior of alloys (after elasticity and plasticity). This review discusses the inelastic behavior of alloys upon thermoelastic martensitic conversion. The specifics of the manifestation of martensitic inelasticity result from the specifics of the development of thermoelastic martensitic conversion, simultaneously a structural phase transition and a geometrically reversible deformation process. B2 titanium-based compounds with inelastic properties are among the most interesting in the physical and practical aspects. Studies of these substances have established and classified the basic regularities of the inelastic behavior of alloys upon martensitic conversion. The basic regularities of the development of martensitic conversion have been determined, as have the structural mechanisms of inelastic deformation in various alloys, including the B2 titanium-based compounds, the most promising for practical use. In these, martensitic conversion results from loss of thermodynamic stability of the B2 lattice in one of two or successively (simultaneously) both of the major shear systems. A series of alloys has been created with clear manifestation of inelastic properties. Technologies have been developed for manufacture of B2 compounds of titanium with nickel, cobalt, iron, copper and palladium. Problems for future study include the creation of high strength, workable structural alloys with inelastic properties higher than those used today, development of alloys with new physical and mechanical properties, and improvement of existing and creation of new technological processes for production of alloys and semifinished goods with strictly defined chemical and phase composition that allow the broad introduction of this class of materials to the economy. References 61: 25 Russian, 36 Western. [228-6508]

UDC: 669.745.018:539.4.42:620.18

SHAPE MEMORY EFFECT IN ANTIFERROMAGNETIC ALLOYS OF GAMMA MANGANESE

Tomsk IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 5, May 85, pp 104-117

VINTAYKIN, Ye.Z., UDOVENKO, V.A., LITVIN, D.F., MAKUSHEV, S.Yu. and DMITRIYEV, V.B., Institute of Metal Science and Metal Physics, Central Scientific Institute of Ferrous Metallurgy.

[Abstract] A description is presented of the specifics of the shape memory effect and its relationship with structural conversions in antiferromagnetic

manganese-based alloys. The initial solid solutions of stabilized gamma manganese undergo low-temperature martensitic type phase conversion from face-centered cubic to tetragonal. The conversion is magnetic in nature, related to the antiferromagnetic ordering of magnetic moments of the manganese atoms. The crystallography and nature of antiferromagnetic conversions in manganese-based alloys cause a number of specifics in the manifestation of the shape memory effect. These include greater manifestation of the reverse shape change even with slight degrees of shaping deformation; a broad temperature range of shape change; the practically nonhysteresis nature of reverse shape change in polycrystalline material; and the existence of an alternating reversible change of shape. References 27: 12 Russian, 15 Western.
[228-6508]

UDC: 669.15.24.295:669.017.3

TITANIUM NICKELIDE CRYSTALLINE STRUCTURE AND PHASE TRANSFORMATION

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 5, May 85, pp 68-87

LOTKOV, A.I. and GRISHKOV, V.N., Siberian Physical-Technical Institute imeni V.D. Kuznetsov, Tomsk State University

[Abstract] A review is presented of experimental studies of the crystalline structure, phase transformations and influence on them of composition and heat treatment in binary TiNi alloys of near equiatomic composition. Studies performed by direct structural methods were primarily used. The change in the structural state of the high-temperature phase and its influence on the sequence and temperature of martensitic conversions, the basis of the effect of shape memory, were given primary attention. Studies of the dynamics of the crystalline lattice, electron structure and its changes upon martensitic conversions and the influence of alloying on martensitic conversions were intentionally omitted from the study. It is noted that the high-temperature phase of TiNi has B2 structure with ordered CsCl-type placement of atoms. There have been almost no studies of the change in degree of long-range order in TiNi as a function of temperature and concentration. The conversion from B to $\rightarrow B19'$ to $B2 \rightarrow R \rightarrow B19'$ is quite significant for the effect of superelasticity in TiNi alloys. A high concentration of structural vacancies is not unusual for B2-structure intermetallides. This may have a significant influence on phase conversions. References 57: 17 Russian, 40 Western.
[228-6508]

SOME SPECIFICS OF THE PROCESS OF GRINDING AND PRESSING BORON CARBIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 85 (manuscript received 2 Jul 84) pp 29-33

STRUK, L.I., FEDORUS, V.B., MAKARENKO, G.N. and PRILUTSKIY, E.V., Institute of Material Science Problems, Ukrainian Academy of Sciences.

[Abstract] A comparative study is presented of the kinetics of the grinding of boron carbide in a magnetic eddy apparatus and a planetary activator. Technical boron carbide powder containing 75.1%B_{tot}, 24.6% C_{tot}, 0.13B_{free} and 0.3% Fe was used, with specific surface 0.46 m²/g. The studies showed that the experimental variation of specific surface of the powder as a function of grinding times can be described by a Khodakov equation: $\ln (S_0 - S) / (S_m - S) = Kt$, where S_0 and S_m are the specific surfaces of the initial and finished materials; S is the specific surface corresponding to time t ; K is the grinding rate constant. The effectiveness of the grinding of boron carbide in a planetary activator is an order of magnitude higher than in the magnetic apparatus. However, the process is accompanied by greater milling of the iron in the planetary activator. The process of compacting boron carbide powders produced by both methods can be described by a logarithmic variation of relative volume as a function of pressing pressure. References 7: all Russian. [229-6508]

UDC: 667.09473:621.762

DETERMINATION OF BORON CARBIDE IMPURITY IN WURZITE-LIKE BORON NITRIDE

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 85 (manuscript received 28 Mar 84) pp 65-69

PECHENTKOVSKAYA, L.Ye. and NAZARCHUK, T.N., Institute of Material Science Problems, Ukrainian Academy of Sciences.

[Abstract] The purpose of this work was to develop a chemical method for determining the phase B₄C in wurzite-like boron nitride. Boron nitride and carbide are chemically inert. The search for a method involved selection of a selective solvent for a boron-carbide-based phase from among the most corrosive media and strongest oxidizers. Concentrated sulfuric acid and potassium bichromate were considered most promising, and the interaction of boron nitride and carbide with their corrosive mixture was studied. Treatment of wurzite-like boron nitride with this mixture results in reduction of hexavalent chromium to trivalent chromium only under the influence of the B₄C phase. An equation is presented for computing the relationship between the quantity of boron carbide oxidized and the quantity of chromium reduced, allowing the method to be used for determination of B₄C. References 6: all Russian. [229-6508]

NON-FERROUS METALS AND ALLOYS; BRAZES AND SOLDERS

HONORS AND NEW GOALS FOR METALLURGICAL COMBINE IN NORILSK

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 13 Jul 85 p 2

[Article by TASS special correspondents M. Gorbacheva and R. Gallyamov: "For Labor Stalwartness"]

[Text] NORILSK (Krasnoyarsk Kray), 12. (TASS special correspondents M. Gorbacheva and R. Gallyamov). Production of the Norilsk Metallurgical Mining Combine im. A. P. Zavenyagin is very important in accelerating the scientific technical progress of the country's national economy. This powerful complex for the production of non-ferrous metals was developed under the severe conditions of Zapolyar [Arctic Circle].

This enterprise has been found worthy of the Order of the October Revolution for its great services in the development of nonferrous metallurgy, overall assimilation of the natural resources in the Far North, and successful fulfillment of the goals of the 11th five-year plan. Today, a ceremonial meeting was held in Norilsk that was dedicated to the 50th anniversary from the day the combine was founded and presentation of the award.

An honorary presidium to the Politburo of the CPSU Central Committee was chosen with enthusiasm.

V. I. Dolgikh, secretary of the CPSU Central Committee and candidate for membership to the Politburo of the CPSU Central Committee, addressed the meeting at which he was warmly welcomed by the attendees.

In the name of the CPSU Central Committee, the Presidium of the USSR Supreme Soviet and the USSR Council of Ministers, V. I. Dolgikh cordially congratulated the combine workers on receiving the motherland's high award and wished the enterprise collective success in its work, good health and good luck.

The speaker said that the Communist Party and all Soviet people were preparing for the next 27th CPSU Congress in an atmosphere of solidarity and unity.

The most important stages in this work were the April (1985) CPSU Central Committee Plenum and the June conference on problems of accelerating scientific technical progress; they defined the concept of accelerating the socioeconomic development of the country and impressively showed the innovative approach of our party and its Central Committee to solving urgent problems, and consistency in pursuing the Leninist political course.

At the Plenum and Conference, M. S. Gorbachev set forth the cardinal problems of technically reequipping the national economy, accelerating the development and assimilation of progressive technology, raising the quality of production, and improving the administrative system for these purposes. The clear and well detailed program of actions for the party, state, agricultural, trade union and Komsomol organizations received public support and approval.

The CPSU Central Committee and the Soviet government are devoting a great deal of attention to the Norilsk Metallurgical Mining Combine, which plays an important role in the development of the country's economy, in accelerating scientific technical progress. V. I. Dolgikh stressed that the Norilsk collective, famous for its remarkable traditions and rich experience, is always in the vanguard of drives for successful solution of the problems set by the party. The 50-year course of establishing and developing the combine is a convincing testimonial to this.

The development of the mineral resources in the Norilsk region is inseparably tied to implementation of the Lenin plan for industrialization of the country, that has required the establishment of a large base for the production of nickel and other nonferrous metals.

In practice, the feasibility and economic expediency of constructing a huge production complex have been proven and the ways and technical means of solving the most complicated problems, primarily building under permafrost conditions, have been found in Norilsk--the outpost for the development of rich mineral ore resources of the Far North regions.

Increase of production at the combine is accompanied by consistent solution of social problems. During the 11-th five-year plan alone, capital investments were directed to housing and civilian construction that were 1.5-fold more than in the preceding 5-year plan. Much attention is being devoted to the improvement of working conditions. About 140 million rubles were spent for these purposes in 1981-1984. The number of workers engaged in manual labor has been reduced by one fifth.

The Norilsk Metallurgical Mining Combine is deservedly considered the leading enterprise of the country, a powerful base of nonferrous metallurgy. The increase of production capacities and work on improvement of their utilization have enabled in the last ten years a

significant increase in the output of nickel--1.5-fold, copper--45 percent and cobalt--65 percent. The capital expenditures for expansion and reconstruction of the combine are rapidly paying for themselves.

The achieved successes are primarily the result of the creative labor of the workers, engineering-technical workers and employees and the extensive organizational and political operations of the party, state, trade union and Komsomol organizations of Norilsk.

V. I. Dolgikh stressed that the combine is rich in everything--unique ore deposits, and huge production capacities, and modern technology, and a remarkable city, and glorious work traditions, but the greatest of its riches, the most valuable of its possessions, is its personnel of miners, ore concentrators, metallurgists, builders, electric power workers and workers of other trades.

In carrying out the decisions of the April (1985) CPSU Central Committee Plenum on acceleration of the country's economic development, an important position was assigned to nonferrous metallurgy which is at the point of solving the problems of accelerating scientific technical progress. The industry must provide for the sharply increasing needs of machine building, instrument manufacture and ferrous metallurgy with the needed amount of nonferrous and alloying metals, rare metals, alloys, new construction materials, hard alloy and other production.

The experience of the Norilsk Metallurgical Mining Combine demonstrates the creative application of scientific and technological achievements--the main lever for providing dynamic and effective development of production. Here, high-speed methods of tunneling shafts and level working in mines and progressive systems of mining and processing ores have been introduced.

However, one cannot rest on one's laurels. The enterprise collective must introduce faster economical systems of ore concentration and processing, advanced metallurgical technology, automated control systems of technological processes, and means of mechanizing labor intensive processes.

Devoting more attention to problems of labor productivity improvement in Zapolyar [Arctic Circle] has a special importance. Here, significantly more funds are needed, than in other regions of the country, for providing people with social and daily life amenities and their wages. For this reason, only minimal essential manpower should be used.

In this modern stage of development, when the production of fuel and other raw products is becoming increasingly more expensive, the policy of conserving resources is of paramount importance. For the Norilsk Combine, this primarily means rational overall use of raw

products, improvement of metal extraction, introduction of technology to cut waste, lowering of material consumption standards, and intensification of more economical conditions.

The orator said that the important tasks were to change the investment policy, to emphasize technological reequipment of enterprises instead of new construction, to significantly improve the efficiency of capital investments and to provide a high pay back rate.

This is particularly important for Krasnoyarsk Kray and the Norilsk region. The state is directing huge financial and material resources for their development. This should be done in such a way that full value is received.

The Krasnoyarsk party organization and managers of enterprises and construction jobs together with planning bodies, ministries and departments must work out and implement a system of measures for eliminating present deficiencies, accelerating the introduction of projects being built into operation, developing their capacities faster, and solving in detail the problems of further development of production forces in the kray.

Intensive and progressive development of the national economy, and improvement of productivity and quality of labor--this is an indispensable condition for further growth of the well-being of people. All our efforts for accelerating the development of economy are directed, in the end, at having the potentiality to assign more money to social needs and improve all aspects of the Soviet people's life.

V. I. Dolgikh, having dwelled on questions regarding the international situation, said that the Soviet Union will be doing, as before, all it can to strengthen peace and strongly repulse the forces of militarism and aggression. We are obligated to do this by the sacred memory of the countless victims, and by the heroic feat of the Soviet people and its Armed Forces that made the main contribution to crushing fascism. The 40th Anniversary of the Great Victory, which was marked by all progressive mankind, reminded us with particular force that--one has to fight against war tirelessly before it begins.

Then, V. I. Dolgikh read the Order of the Presidium of the USSR Supreme Soviet and attached the decoration to the combine banner while the audience cheered.

He gave out the Order of Lenin and gold "Hammer and Sickle" medals to combine workers awarded the Hero of Socialist Labor title. He also gave out Orders of Lenin, October Revolution and Labor Glory of the first degree.

The following addressed the meeting: Hero of Socialist Labor Director of the Metallurgical Mining Combine im. A. P. Zavenyagin, B. I.

Kolesnikov, honorary guest of Norilsk and one of the first builders of the combine. I. M. Perfilov, USSR Minister of Nonferrous Metallurgy P. F. Lomako, brigadier in charge of tunneling personnel of the Norilsk mining-construction trust of the 'Noril'skstroy' Production Association, Lenin prize winner and holder of all the Labor Glory Orders N. S. Kulesh, converter of the Nadezhdinsk Metallurgical Plant and Hero of Socialist Labor A. D. Grigor'yev, converter at a copper plant V. V. Myachinov, and First Secretary of the CPSU Krasnoyarsk Kray Committee P. S. Fedirko. They expressed their heartfelt thanks to the Communist Party and the Soviet state for their high opinion of the metallurgists' labor and swore that they will apply all their efforts, knowledge and skills to fulfill the 1985 plans and the five-year plan as a whole and will greet the 27th CPSU Congress with new labor achievements.

Participants of the ceremonial meeting received the welcoming letter of the CPSU Central Committee, Presidium of the USSR Supreme Soviet and the USSR Council of Ministers with great enthusiasm.

12525

CSO: 1842/235

UDC: 536.535.34

RADIATION OF TITANIUM UPON UNSTEADY HEATING BY MEANS OF A HIGH-TEMPERATURE
STREAM OF ARGON CONTAINING NITROGEN

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA FIZICHESKIKH I
TEKHNICHESKIKH NAUK in Russian No 3, May-Jun 85 (manuscript received
27 Jun 84) pp 38-88

MELNIKOV, V.K. (Deceased), ZAKE, M.V. and KOVALEV, V.N., Physics Institute
of the LaSSR Academy of Sciences

[Abstract] A study is presented of the radiative capacity of the surface of titanium when heated by a stream of argon-containing nitrogen. Studies were performed on a high-temperature installation in which titanium was heated by a plasma flow containing 4% nitrogen. As the titanium specimens were heated, the directed integral radiation of the surface and temperature of the specimens were measured. The temperature of the argon stream varied between 2680 and 3280 K, heating the metal to 1640 K at 230-320 K/s. X-ray phase analysis indicated that heating of the titanium specimen in an argon plasma with nitrogen was accompanied by the formation of titanium nitride. When the phase transition temperature was reached, the surface color changed to yellow, indicating the formation of a thin film of the nitride. The chemical kinetics of nitriding were determined by two heating areas: the unsteady area determined by the rate of heating of the metal, and the steady area which has a logarithmic rather than a parabolic curve. Kinetic constants were obtained, allowing computation of the rate of nitriding of compact titanium at high temperatures. References 10:
all Russian.

[220-6508]

CONCENTRATIONAL VARIATION OF THERMOELECTRIC PROPERTIES OF Cu-Ni ALLOYS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85
(manuscript received 4 May 83; in final form 7 Sep 84) pp 1085-1090

LUKHVICH, A.A. and KAROLIK, A.S., Institute of Applied Physics, Belorussian Academy of Sciences.

[Abstract] An attempt is made to provide a qualitative explanation of the variation of absolute thermoEMF and thermoEMF induced by hydrostatic compression in a melt of transition metals with noble metals throughout the entire range of concentration. Copper and nickel, being neighboring elements in the periodic table, have full mutual solubility and form an FCC alloy throughout the entire concentration range. Lattice parameters change only 2.5% upon transition from pure Ni to pure Cu. The Mott approximation is used as a basis for development of the explanation. The largest contribution to concentration variation of thermoelectric properties is that of electron state density at the Fermi level. References 21: 4 Russian, 17 Western.
[231-6508]

STRUCTURE AND ELECTRICAL PROPERTIES OF NIOBIUM BOMBARDED WITH HELIUM IONS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85
(manuscript received 5 Oct 83; in final form 29 Jun 84) pp 1107-1113

VOLKOV, M.P., SOKURSKIY, Yu.N., TSYPKIN, S.I., CHUYEV, V.I. and SHISHOV, V.N., Physical-Technical Institute imeni A.F. Ioffe, USSR Academy of Sciences.

[Abstract] A study is presented of the structure and certain electrical characteristics of niobium foils implanted with helium. The data obtained are of independent interest for solid-state radiation physics. The structure, residual resistivity and upper critical field are determined for Nb specimens which have various initial ratios of resistances at cryogenic and room temperatures and implanted with helium ions at various concentrations. Annealing of a nonirradiated specimen increases residual resistivity by $5 \cdot 10^{-9}$ ohm·m. Annealing of bombarded specimens causes most of the embedded atoms to gather in bubbles and results in absorption of residual gases. The effect of microheterogeneity of specimens on resistivity and critical field and their relationship is studied. References 6: 5 Russian, 1 Western.
[231-6508].

UDC: 669.859.5:538.248

PHASE COMPOSITION OF HOMOGENIZED $\text{Sm}(\text{Co}, \text{Fe}, \text{Cu}, \text{Zr})_z$ ALLOYS AND ITS INFLUENCE ON MAGNETIC HARDNESS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85
(manuscript received 13 Jul 84) pp 1114-1121

IVANOVA, G.V., POPOV, A.G., MAGAT, L.M., MAYKOV, V. G., PUZANOVA, T.Z.,
SHUR, Ya.S. and NIKOLAYEVA, N.V., Institute of Metal Physics, Urals Scientific
Center, USSR Academy of Sciences.

[Abstract] A study is made of the role of the high-temperature state in the formation of magnetic hardness in alloys. The phase compositions of a number of Sm-Co-Fe-Cu-Zr alloys at 1100-1200°C were compared with the hysteresis characteristics obtained after treatment leading to magnetic hardening. The influence of replacement of a portion of the samarium with praseodymium in $\text{Sm}(\text{Co}, \text{Fe}, \text{Cu}, \text{Zr})_{7.4}$ was also studied. Depending on the value of z , $\text{Sm}(\text{Co}, \text{Fe}, \text{Cu}, \text{Zr})_z$ alloys (with z between 6.84 and 8.35) after homogenization at 1150-1165°C contained various quantities of phases similar in composition to SmM_7 and $\text{SmM}_{7.8}$ and small quantities of $(\text{Co}, \text{Fe})_3(\text{Sm}, \text{Zr})$. $\text{SmM}_{7.8}$ is a solid $\text{HSm}_2\text{Co}_{17}$ -based solution, slightly enriched in iron. High coercive force can be obtained in alloys containing one or both of these phases in the initial state. At 1200°C a multiphase structure is formed which is unfavorable for the production of high coercive force. Replacing a portion of the samarium with praseodymium decreases this temperature. In such alloys high coercive force can be obtained by reducing the homogenization annealing temperature. References 14: 4 Russian, 10 Western.

[231-6508]

UDC: 669.15'24'25:620.181

STRUCTURAL TRANSFORMATIONS AND THEIR INFLUENCE ON MAGNETIC AND THERMAL PROPERTIES OF Co-Fe-Ni ALLOYS CONTAINING Ti AND Al

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85
(manuscript received 25 Jul 84) pp 1122-1128

VLASOVA, Ye.N. and MATORIN, V.I., Central Scientific Research Institute of
Ferrous Metallurgy imeni I.P. Bardin.

[Abstract] A study is presented of the nature of phase transformations in Ni-Fe-Co ellinvar alloys containing titanium and aluminum, their kinetics, morphology and the influence of structural defects, as well as the relationship of structural changes to changes in thermal and magnetic properties in these alloys. X-ray structural analysis is used for the alloys, in which two main reactions are observed: formation of an ordered gamma-prime phase and a phase with BCC structure with subsequent type B2 ordering. The first process is accompanied by an increase in lattice period of the matrix and a decrease in saturation

magnetization of the alloy. The second process is a diffusion process and is greatly activated by deformation defects. Long-term tempering leads to the third, B2 order reaction. Gamma-gamma-prime and gamma-alpha conversion processes occur simultaneously in overlapping temperature intervals. Differential thermal analysis shows that, upon continuous heating of cold deformed alloys, the gamma to gamma-prime conversion process leads the process of segregation of the alpha phase and occurs in two stages. The boundary of the range of the existence of the gamma-prime phase is 840°C. References 4: all Russian.
[231-6508]

UDC: 669.15'25'781'782:541.65

INFLUENCE OF CRYSTALLIZATION OF AMORPHOUS $\text{Fe}_5\text{Co}_{70}\text{Si}_{15}\text{B}_{10}$ ALLOY ON OPTICAL PROPERTIES

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85
(manuscript received 30 Oct 84) pp 1146-1150

KNYAZEV, Yu.V., BARAKOVSKIKH, A.B., BOLOTIN, G.A. and POTAPOV, A.P., Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences.

[Abstract] In order to study the process of crystallization of the amorphous ferromagnetic alloy $\text{Fe}_5\text{Co}_{70}\text{Si}_{15}\text{B}_{10}$, a method of optical spectroscopy was used allowing the restructuring of electron energy spectra to be observed upon structural phase transformations. Low-temperature annealing activates processes of diffusion with atoms migrating over short distances, helping to form a certain degree of order. Subsequent annealing at 410°C converts the alloy to a cubic single-phase small-crystalline solid solution of the initial composition with small alpha-Co segregations. Crystallization annealing at 510°C leads to dissolution of the solid solution and formation of a number of compounds in the alloy. The crystal grain becomes larger by an order of magnitude. The contribution of low-energy quantum transitions to optical conductivity is significant throughout almost the entire long-wave band. During amorphization of the alloy, the optical constants change significantly, as do the plasma and relaxation frequencies of conductivity electrons. The increase in the square of the plasma frequency upon amorphization of the alloy corresponds to an increase in the concentration of conductivity electrons by an equal value. This tendency appears at the same time as there is an increase in relaxation frequency due to the increase in the scattering intensity of electrons on crystalline structure heterogeneities. The change in optical conductivity structure is related to restructuring of the electron energy spectrum upon structural phase conversions. References 13: 8 Russian, 5 Western.
[231-6508]

PREPARATION

PROPERTIES OF AUSTENITIC STAINLESS STEEL POWDERS PRODUCED BY VARIOUS METHODS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 85 (manuscript received 16 Apr 84) pp 1-5

RADOMYSELSKIY, I.D., NAPARA-VOLGINA, S.G. and VENGLOVSKAYA, Ye.V., Institute of Material Science Problems, Ukrainian Academy of Sciences.

[Abstract] Results are presented from a comparative study of the properties of Austenitic stainless steel powders produced under industrial or laboratory conditions by atomization, calcium hydride reduction and diffusion saturation. A detailed chemical analysis of the powders was undertaken, their technological and physical properties were determined and their microstructure was investigated. It was found that stainless steel powders obtained by different methods have good properties and can be used for the manufacture of various products by powder metallurgy methods. Powders produced by atomization and diffusion saturation are recommended primarily for the production of low-porosity or practically pore-free products for structural use. Calcium hydride powders, due to their great moldability, can also be used to produce porous products for various purposes of stainless steels. Their insufficient homogeneity has a negative influence of the corrosion resistance of products made of this powder, which places certain limitations on their use. References 6: all Russian. [229-6508]

UDC: 621.762:621.793:661.655:536.48

STRUCTURE OF COMPOSITE BORIDE COATINGS FORMED UNDER LOW TEMPERATURE ANNEALING CONDITIONS

Kiev POROSHKOVAYA METALLURGIYA in Russian No 6, Jun 85 (manuscript received 13 Nov 84) pp 51-55

BONDAR, V.T., FEDORCHENKO, I.M., GUSLIYENKO, Yu.A., KHRIYENKO, A.F., KRYLOVA, N.A. and TIKHONOVICH, T.N., Institute of Material Science Problems, Ukrainian Academy of Sciences.

[Abstract] Methods of transmission electron microscopy and local X-ray spectral analysis are used to study the changes occurring in the structure of Ni-B coatings upon heating in order to determine the temperature at which nickel

borides are formed and the mechanism of the process. In the process of coprecipitation of nickel with boron, crystal structural disruptions occur resulting from the formation of cloud-like dislocation masses and twinning of nickel. The temperature threshold for experimentally recorded formation of nickel boride when amorphous boron is used is 400°C. The process of formation of the boride is accompanied by dislocation restructuring of nickel grains from cloud-like masses to a cellular structure. During formation of borides, the morphology of the boron-containing phase changes from branched to circular. The growth of Ni_3B grains in boride rosettes is accompanied by the formation of a boride skeleton in the coating structure. References 3: all Russian.
[229-6508]

TREATMENT

UDC 621.639.61

PLASMA APPLICATION OF COPPER IN A PROTECTIVE VACUUM

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR: SERIYA
TEKHNICHESKIKH NAUK in Russian No 4, Issue 1, Mar 85 (manuscript received
9 Feb 84) pp 30-37

KUDINOV, V.V., KILTOCHNIKOV, M. Ye., NAUMKIN, A.O. and PEKSHEV, P.Yu.,
Institute of Metallurgy imeni A.A. Baykov, Moscow

[Abstract] While early research showed the need for a protective atmosphere for ultrasonic or sonic plasma current application of various coatings, later research has been incomplete or contradictory. The present article reports on a laboratory device for applying copper coatings in a vacuum. The device is shown in a picture and described. Its vertical cylinder has water cooling and can be used with either vibration or plate-type sprayers. It permitted sonic and ultrasonic plasma currents of up to $M=2$. Steel No 3 and quartz, glass and aluminum oxide dielectrics were coated, then heated for further thermal activation by plasma flow, electric heat or a combination of these, or by a supplementary charge. Coating in normal atmosphere was done as a control. Results showed that very rapid and accurate coating could be done in the vacuum device with little energy consumption. The effect on the applied material of being in the plasma current, and comparative properties of the coatings obtained in the test and control processes, showed that the plasma current yielded similar coatings at much greater speed and less energy consumption. Figures 6; 2 tables; references 7: 3 Russian, 4 Western.
[177-12131]

QUALITY CONTROL OF PLASMA COATINGS

Novosibirsk IZVESTIYA SIBIRSKOGO OTDELENIYA AKADEMII NAUK SSSR: SERIYA
TEKHNICHESKIKH NAUK in Russian No 4, Issue 1, Mar 85 (manuscript received
25 Oct 83) pp 38-46

PUZRYAKOV, A.F. and KOSOLAPOV, A. N., Scientific Research Institute for
Problems of Machinebuilding, Moscow

[Abstract] Plasma application of decorative and protective coatings is a promising technique, but careful research and solution of the problems of mass production must precede wide implementation. The authors discuss such factors as determining parameters for coatings, selecting technical means of production and monitoring their effectiveness. A mathematical model and theoretical diagram of technical equipment are presented and explained. While internal contour parameters require relatively simple regulation, a number of parameters of external contour cannot be regulated directly. Other topics discussed include stabilization of the plasma current either by a laminar current procedure or by use of a controlled atmosphere, heating of applied particles, activation of the substrate by thermal means, cooling of the coated item, features of coating application in a controlled atmosphere, and thermomechanical treatment of the coating. Effective quality control requires theoretical improvement and effective implementation of automated procedures for surface preparation, application and subsequent cooling. Figures 3; 1 table; references 24: 12 Russian, 12 Western.

[177-12131]

UDC: 539.4

DECREASE IN CONTACT FRICTION FORCE WITH ELECTROSTIMULATED DEFORMATION OF METALS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 283, No 1, Jul 85
(manuscript received 2 Aug 84) pp 116-118

KLIMOV, K.M., BURKHANOV, Yu.S. and NOVIKOV, I.I., Corresponding Member,
USSR Academy of Sciences, Institute of Metallurgy imeni A.A. Baykov, USSR
Academy of Sciences, Moscow.

[Abstract] Elastically compressed rolls in a rolling mill were used to create initial plastic deformation with 20 to 40% compression of aluminum of the type used in electric cables. Alternating current at 50 Hz was passed through the deformation focus for 0.2 s using the rolls as the conductors. Electromagnetic sensors automatically recorded the change in deformation force and gap between rolls as well as the temperature in the contact zone between the tool and strip. Current density varied from 50 to 250 A/mm². As the current density increased, the contact pressure and friction decreased linearly, the friction practically dropped to zero, the perpendicular stress dropped to a certain

minimum. The behavior of friction in the contact zone when high density electric current is present results from the fact that the relative area of actual contact is approximately equal to the ratio of perpendicular stress to the modulus of elasticity, so that the actual contact area does not exceed 3 to 5% of the geometric contact area. As electric current passes through, the microscopic projections of the surface actually in contact with the rolls can be significantly heated without greatly heating the full volume of metal in the deformation focus, eventually causing melting of the microscopic projections and greatly decreasing the force of friction in the surface zone without significant thermal softening of the metal being deformed. Figures 2, reference 1 Russian.
[223-6508]

UDC: 621.373.826:536.423

SPECIFICS OF EVAPORATION OF MAGNESIUM AND LEAD BY QUASI-STEADY LASER RADIATION

Moscow KVANTOVAYA ELEKTRONIKA in Russian Vol 12, No 6, Jun 85 (manuscript received 4 Jul 84) pp 1282-1285

GOLOVIN, A.F. and PETRUKHIN, A.I., Institute of Earth Physics imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow.

[Abstract] Lead and magnesium were used to perform experimental studies of the parameters of a steady vapor jet produced by the action of a continuous laser beam with a wavelength of 1.06 microns and a flux density of less than 10 MW/cm^2 . The quasi-continuous neodymium glass laser had a pulse length at the 10% level of about 650 microseconds. At about 0.6 MW/cm^2 on the lead target, pulsations in reaction pressure were observed. In a separate series of experiments, interferograms of the steady state lead jet were produced at an instant the maximum intensity of neodymium laser radiation. Large differences were observed in the radial distributions of q and n , the latter decreasing rapidly toward the edge of the irradiated spot, probably as a result of lateral unloading of the vapor jet. This indicates that the surface of transition through the speed of sound does not coincide with the boundary of the condensed phase. Further increases in power do not result in an increase of n . The stopping of the increase in index of refraction can be explained by the appearance of a significant concentration of electrons in the vapor jet. The equilibrium degree of ionization was found to be 10^{-7} - 10^{-6} for lead, 10^{-12} - 10^{-11} for magnesium. The physical processes leading to the high degree of ionization at relatively low temperatures (not over 2600 K for lead, 1600 K for magnesium) are not clear. Figures 4, references 7 Russian.
[218-6508]

HEADING OF TITANIUM ALLOY DRILLING PIPE

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 5, May 85, pp 19-20

MILGEVSKIY, V. Ya.

[Abstract] Previous attempts to head titanium drilling pipe on horizontal forging machines and hydraulic presses have not been successful: cracks, folds and other defects have formed. These difficulties can be overcome by greatly reducing the time of heating of the area of the pipe to be deformed and preventing partial cooling of the metal in the process of formation of the thicker ends. This is done by heading titanium pipe without a die in a continuous process. If the inductor moves down the pipe at 40 to 80 mm/min, heating and formation of the thickened end occur in 0.16-0.33 minute, during which time the gas-saturated layer formed is so thin that it does not significantly influence metal flow. Pipes 114 and 140 mm in diameter, 10 mm thick made of alloys VT14 and 3V were headed in an experimental NIIPtmash-50 machine, capable of producing thicker areas up to 1,000 mm in length, thickness up to double the normal wall thickness. Quality testing of the pipes showed them to be satisfactory. References 4: all Russian.

[221-6508]

HYDROGEN PLASTICIZING EFFECT UPON ISOTHERMAL UPSETTING OF VT9 TITANIUM ALLOY

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 5, May 85, pp 28-30

NOSOV, V.K., YELAGINA, L.A., BELOVA, S.B. and ANDREYEVA, L.V.

[Abstract] Hydrogen plasticizing is manifested as an increase in plasticity and decrease in deformation force, based on the principle of reversible alloying of titanium alloys with hydrogen as an effective beta stabilizer. This work studies the influence of hydrogen on plastic deformation resistance of alpha+beta titanium alloy type VT9 at 700-950°C. Studies were performed on specimens 13 mm in diameter and 18 mm long containing 0.003% hydrogen. In some cases thermal diffusion was used to introduce 0.2 and 0.36% hydrogen. Tests of specimens with varying hydrogen content were performed on an MTS machine at 700, 800, 850, 900 and 950°C, traverse speeds 10, 50 and 100 mm/min. The influence of hydrogen on deformation resistance was found to vary. At temperatures in the two-phase alpha+beta region, an increasing hydrogen content leads to a drop in specific upsetting force under all conditions. In the single-phase beta region, an increasing hydrogen content causes an increase in specific force required. At 700-850°C the specific upsetting force of VT9 containing 0.2 and 0.36% hydrogen is comparable to the deformation resistance of the pseudo-beta alloys. Introduction of hydrogen can reduce the temperature of isothermal deformation by 100-150°C and improve the force conditions of operation of stamps. References 7: 6 Russian, 1 Western.

[221-6508]

EQUIPMENT FOR PRESSING BLANKS OF METAL MELTS

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 5, May 85,
pp 34-35

TOMASHEVSKIY, S.K., KRUTSKIY, V.I. and TURBIN, S.K.

[Abstract] The Voronezh Special Design Bureau of Forging and Pressing Machines and Automatic Production Lines has developed technical documentation, and the Dnepropetrovsk Production Association for Manufacture of Heavy Presses has manufactured a double-action hydraulic press, the Model K20809, with a force of 12.5/6.3 MN for pressing blanks of metal melts. This process is known as "liquid metal stamping" or "pressing of metal during crystallization." Combining the processes of pressing and crystallization produces blanks of efficient shape with good mechanical properties due to the compact metal structure. The melt is poured into the lower half of a stamp through an aperture in the upper half outside the stamping zone of the press of an extending stage. The stage then moves the stamp containing the liquid metal into the pressing zone and the shape is pressed, after which it is removed, with the bottom half of the stamp extending once more on the stage, the bottom half is cleaned out, the stage is returned a second time into the press and the top half is replaced, after which it is extended once more to be refilled. The specifications of the press are presented in tabular form. The stage measures 1300 x 1100 mm, the press is 9750 mm wide, 8450 mm deep, 6800 mm high, and the mass of the press is 150,000 kg.

[221-6508]

UDC 620.197:669.245

HEAT DURABILITY OF ZHS6K ALLOY WITH HEAT-RESISTANT CHROMIUM-BASED COATING

Moscow ENERGOMASHINOSTROYENIYE in Russian No 5, May 85 pp 35-37

KLYPINA, A.M., candidate of technical sciences, MELAMED, M. M., candidate of physicomathematical sciences, CHISTYAKOVA, L.D., engineer, ASTAFYEV, A.A., doctor of technical sciences and professor, GRISHIN, V.I. and LEVIN, A. Ye., candidates of technical sciences and UDALTSOVA, G.B., engineer

[Abstract] Guide vanes of powerful gas turbines that operate at 750°C in an aggressive medium containing sulfur, vanadium or sodium require special steels. The present article reports on a study of ZHS6K alloy with corrosion resistance increased by diffusion chrome plating. Specimens were tested at 800°C with allowance for the uneven gas flow, wherein certain parts were subjected to even higher temperatures. Diffusion chrome plating was done at 1100°C for 20 hours, or at 1190°C for 2 hours, resulting in layers of 120 or 80 μm, respectively. Analysis of results showed that chrome plating reduced the long-term durability of the alloy by 12-15%, but this was not regarded as

dangerous for vane reliability, since a reserve durability factor of 2 was retained even at 800°C. Diffusion processes between the chromium coating and the base metal led to changes and resorption of layers. The projected service life of the vanes was 11,000-12,000 hours. References 2: all Russian.
[237-12131]

UDC: 669.3:539.4.016.3

HARDENING OF COPPER STRIP AFTER RAPID CONTINUOUS HEATING

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 59, No 6, Jun 85
(manuscript received 12 Jun 84) pp 1201-1206

VEZHBINSKIY S., Institute of Principles of Metallurgy imeni A. Krupkovskiy,
Polish Academy of Sciences, Cracow.

[Abstract] Increasing the speed of continuous heating displaces the interval of primary recrystallization in a copper strip into higher temperature areas and thus increases the rate of formation and growth of recrystallization grains. Increasing the heating rate also increases the number of defects not destroyed in the recovery stage. This article studies the influence of temperature and a rapid continuous heating rate on coefficients in equations describing various areas of the hardening curves for polycrystalline copper specimens. The purpose of this study was to establish the influence of the degree of preliminary deformation and the rate of continuous heating on two coefficients in the equations describing segments of the hardening curves, as well as the change in true uniform elongation and ultimate tensile strength of specimens cut at various angles to the direction of rolling. It is found that selection of the preliminary degree of deformation and heating rate can be used to control the structure and properties of the metal. References 13: 8 Russian, 3 Eastern European, 2 Western.
[231-6508]

UDC: 621.983.3:65.011.56

AUTOMATED PLANNING OF TECHNOLOGY FOR DRAWING OF SHEET MATERIALS

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 6, Jun 85, pp 9-10

ZHARKOV, V.A. and TETERIN, G.P.

[Abstract] The automated planning of technological processes for single- or multiple-operation drawing of cylindrical and box section parts from sheet materials includes the following stages: input of initial data; computation of the parameters of the technological process; selection of press equipment; determination of the technological scheme of the stamp; computation of technical and economic parameters; and drafting of technological documents. The

initial data used are operational and standard reference information. Automated planning of the technological processes involved in drawing requires the filling-out of a relatively simple initial information card, which is sent to the computer center. Computer programs then write the initial technical documentation for part stamping. This system has been put in use at the Volgograd and Vladimir tractor plants and elsewhere, yielding an annual economic effect of over 100,000 rubles by saving metal and planning time and cost and by reducing the number of stamping operations required. References 8: all Russian.
[219-6508]

UDC: 621.73 621.73.073

INFLUENCE OF STAMP TEMPERATURE ON CRACK DEVELOPMENT DURING UPSETTING OF BLANKS OF MA14 ALLOY

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 6, Jun 85 pp 23-24

GUSEV, A.V., BURDINA, G.P. and ALIMOVA, V.V.

[Abstract] During upsetting of MA14 blanks with 80.5% deformation, cracks appeared on the side surfaces. A study was made of the effect of stamp temperature on crack formation. Blanks 30 mm in diameter and 45 mm high were upset on a laboratory hydraulic press at 300, 350, 400 and 450°C blank temperatures, with stamp temperatures of 200, 250, 300, 350, 450 and 500°C. Blanks were tested under compression until the first crack visible to the naked eye appeared on the side surface. The macrostructure of the blanks was studied along the deformation axis. The results indicated that the rate of cooling of blanks was greater, the lower the temperature of the stamp. Cracks were not observed when both blanks and stamps were heated to 330-400°C. References 2: all Russian.
[219-6508]

UDC: 536.421:539.211

CALCULATION OF MELTING OF METALS BY CONCENTRATED ENERGY STREAM

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 85 (manuscript received 23 Jan 85) pp 3-8

UGLOV, A.A., SMUROV, I.Yu. and GUSKOV, A.G., Moscow

[Abstract] A study is made of the melting of a semi-infinite solid by a heat source at the surface. The absorbed energy flux density on the free surface is considered homogeneous and constant. It is also assumed that the liquid phase is immobile and the only mechanism of propagation of energy in the liquid phase is heat conductivity. Approximate analytic equations are obtained which

describe the temperature fields, coordinates and rate of movement of the melting front. Melting is found to differ significantly from the process of ablation of metals. There are significant temperature gradients in the liquid phase, and the temperature of the surface of the liquid reaches the boiling point rather quickly. Determination of the temperature field in the melt bath is significant for analysis of a number of physio-chemical processes which occur when a concentrated energy flux acts upon metals. The melt temperature gradients obtained provide an upper estimate of the actual quantities, since they do not consider processes leading to mixing of the liquid phase or, consequently, equalization of its temperature. References 3: all Russian.
[216-6508]

UDC: 621.9.048.7

PULSATING EVAPORATION OF MATERIALS IN A POWERFUL OPTICAL RADIATION FIELD

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 85
(manuscript received 16 May 83) pp 9-12

GAVRIKOV, V.K., Kharkov.

[Abstract] Thermal destruction of materials by powerful light beams is accompanied by significant pulsations in flame size, temperature of the spot struck by the radiation, speed of destruction and depth of the crater formed. This article estimates the frequency of pulsations under such conditions, resulting from the finite time interval between evaporation and recondensation of evaporated material. The study is restricted to the case in which the primary contribution to self-shielding of the material is attenuation of the incoming light flux on condensate particles. References 11: all Russian.
[216-6508]

UDC: 669.14.018.252

HARDENING OF SURFACES OF PLANE-PARALLEL DISTANCE MEASUREMENT STANDARDS BY LASER RADIATION

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 85
(manuscript received 15 Feb 83) pp 13-16

KREMNEV, L.S., VLADIMIROVA, O.V., SAGADEYEVA, T.G., BUSURINA, I.A., KHOLODOV, Ye.V. and MITAUER, S. Ya., Moscow.

[Abstract] Normal laser hardening of the surfaces of annealed steels produces a hardened layer which is frequently less thick than the normal machining allowance for production of high precision measurement standards. Studies were therefore performed to determine the possibility of increasing the depth of the laser-hardened layer in type ShKh15 steel. Plates were hardened with

a CO₂ continuous laser with a power rating of 1 kW after the surfaces were blackened to improve energy absorption and increase the depth of the hardened layer. Energy density was $4.5 \cdot 10^3 \text{ W/cm}^2$, scanning speed 0.54 cm/min. It was found that the depth of the hardened layer depended significantly on the initial structure of the specimen. The deepest layer, 0.5 mm, was formed in specimens with initial troostite structure. Initial annealed structure specimens had hardened layers 0.05 mm or less in thickness, or no hardened layer at all. In suitable specimens, the surface hardness of the laser-hardened layer was greater than that produced by traditional hardening methods. References 3: all Russian.

[216-6508]

UDC: 536.422:535.211

EVAPORATION OF PARTICLES IN A VACUUM UPON EXPOSURE TO LASER RADIATION

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 85
(manuscript received 24 Sep 84) pp 17-20

POPOVA, L.V. and SUTUGIN, A.G., Moscow

[Abstract] When metals are cut in a vacuum by a laser beam, aerosol particles develop which may form a cloud around the surface and prevent further cutting. This work was intended to determine the evaporation time and temperature of spherical aerosol particles in a vacuum under the influence of the laser radiation itself as a function of the material, particle dimensions, energy flux and wavelength. Isolated particles were studied, ignoring the interactions with other particles and the products of breakdown of each particle itself. Equations were derived for computation of the temperature and evaporation time of graphite and aluminum particles under the influence of continuous laser radiation. Calculations were performed on an M-220-M computer. The curves obtained can be used with extrapolation to find the temperature and evaporation time of particles for different flux values. The curves were found to approach saturation with increasing flux, at a temperature of about 5,000 K for graphite. Evaporation time approaches zero with increasing flux. References 4: all Russian.

[216-6508]

UDC: 535.211:536.21

ABSORPTIVE CAPACITY OF FLAME FORMED UPON INTERACTION OF CONTINUOUS CO₂ LASER RADIATION WITH Kh18N10T STEEL

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 85
(manuscript received 25 Sep 81) pp 21-24

LYASHENKO, Ye.I., SHUMRIKOV, V.V., KOSYREV, F.K., MORYASHCHEV, S.F.,
and FROMM, V.A., Dnepropetrovsk, Moscow.

[Abstract] Experimental results are presented from a study of the absorption coefficient for He-Ne laser radiation with a wavelength of 632.8 nm by a flame which is formed upon interaction of continuous CO₂ laser radiation, power 5 kW, with Kh18N10T steel. A diagram of the experimental installation is presented. The experiments were performed in two stages: exposure of film by laser radiation which had passed through a nine-stage attenuator, and exposure of film by laser radiation which had passed through the flame produced in the experiment. The studies showed that absorption resulted from the presence of the plasma and condensed phase in the laser flame. The contribution of the condensed phase to absorption decreases with increasing distance from the target, while the significance of plasma particles increases. References 7: 5 Russian, 2 Western.
[216-6508]

UDC: 539.377:536.12

OPTIMAL CONTROL OF LASER MIRROR OPTICAL SURFACE'S TEMPERATURE MOVEMENTS

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 85
(manuscript received 2 Feb 84) pp 25-30

VIGAK, V.M., KOLESOV, V.S. and YASINSKIY, A.V., Moscow, L'vov.

[Abstract] An attempt is made to find the optimal conditions for cooling of a mirror to minimize thermal movements in the optical surface through the use of internal heat sinks. The mirror model used was an isotropic, freely supported circular plate; the cooling system was modeled by heat sinks distributed at a known density in a plane parallel to the optical surface of the mirror. An analytical solution is obtained to the problem. The necessary condition for controllability of the temperature movements of the plate by means of internal heat sinks was defined. If the condition of controllability is not met, optimal control can be constructed in the form of a minimizing sequence. References 6: all Russian.
[216-6508]

CUTTING OF STAINLESS STEEL BY SOLAR ENERGY

Moscow FIZIKA I KHIMIYA OBRABOTKI MATERIALOV in Russian No 3, May-Jun 85
(manuscript received 24 May 83) pp 31-34

KASICH-PILIPENKO, I. Ye., MARKHASEV, B.I. and PASICHNYY, V.V., Kiev.

[Abstract] Experiments on cutting of Kh18N10T chrome-nickel steel were performed on a type SGU-5 installation with a two meter diameter parabolic mirror concentrator. The installation is equipped with automatic sun-tracking systems and a system to regulate the radiant flux power in the focal zone, plus a vacuum system to control the environment in the cutting chamber. The studies were performed primarily in air, with vacuum experiments being used only as a control. Kh18N10T specimens 0.5 and 2.0 mm thick were cut to determine the energy contribution of heat released upon burning of the components of the stainless steel in air to the total energy of the cutting process, and to study the structure of the transformed steel to evaluate the cutting process as a preparatory operation for welding. Structural and chemical analyses showed that cut specimens were suitable for welding without additional processing. The use of concentrated solar energy for cutting is recommended for regions with shortages of traditional energy sources, e.g., deserts. References 4: all Russian.
[216-6508]

WELDING, BRAZING AND SOLDERING

UDC: 620.179.14

SPECIFICS OF PHASE COMPOSITION OF STAINLESS AUSTENITIC STEELS AND POSSIBILITY OF EDDY-CURRENT SORTING OF PIPE MADE OF THESE STEELS BY GRADES

Sverdlovsk DEFEKTOSKOPIYA in Russian No 6, Jun 85 (manuscript received 12 Mar 84; in final form 20 Nov 84) pp 68-71

MIKHEYEV, M.N., BELENKOVA, M.M., KOGAN, L.Kh., VITKALOVA, R.N., ROYTMAN, V.I., ANOPRIYENKO, S.S. and KOKHMAN, L.V., Institute of Metal Physics, Urals Scientific Center, USSR Academy of Sciences.

[Abstract] Studies were performed of a combination of mechanical, magnetic and electrical characteristics of certain grades of chrome-nickel and chrome-nickel-molybdenum austenitic steels used for the production of hot rolled pipe. Magnetic analysis revealed the presence of a martensite phase in the structure of chrome-nickel stainless steel. The possibility is demonstrated of nondestructive testing of austenitic steels to determine their type. An eddy-current method was used with a surface transducer with an armored core providing for local measurements and high sensitivity to changes in electromagnetic characteristics. For finished pipes, testing can be performed at the ends of the pipes with thicknesses at least 9 mm or on the pipe surface after removal of oxide scale. Figures 2, references 7 Russian.
[227-6508]

UDC 621.791.75.04

WELDING CORROSION-RESISTANT MARTENSITE-TYPE STEELS

Moscow ENERGOMASHINOSTROYENIYE in Russian No 5, May 85 pp 29-32

RYMKEVICH, A.I., candidate of technical sciences

[Abstract] The use of martensite-class steels, with high durability, and corrosion, cavity and hydroabrasive resistance, is promising for machine parts that work under heavy loads at high temperatures and in corrosive media. The Scientific Production Association of the Central Scientific Research Institute for Machinebuilding Technology tested 10Kh12NDL, 06Kh12N3D and 06Kh14N5DM steels

(as well as others) with good mechanical properties to determine their performance under the above conditions. A basic difficulty in using chromium steels has been that of welding them, since either preheating to 200-400°C or use of austenite additives is required. While foreign steels used in this way have reduced carbon content, this reduces their stability. Research showed that nickel had a pronounced impact on mechanical properties, since added nickel contents were associated with reduced ferrite and increased residual austenite in the metal. Improved plasticity in the martensite came with minimal amounts of carbon and nitrogen and vacuum-induction smelting processes. For automatic and electroslog welding, a flux of $\text{CaF}_2\text{-CaO-Al}_2\text{O}_3$ was used; for manual welding a special rod based on Sv01Kh12B2-VI wire coated with less than 25% marble was used. The procedures tested made it possible to reduce the preheating temperature to 80-120°C and to replace heat treatment after welding with thermal relaxation at 150-250°C. The results showed that the best steel for such parts was 06Kh12N3D, welded with low-carbon Ni-Mo-V steel electrodes. Both homogeneous and mixed-metal welds (with the special welding rod) met all standards required for the target machine parts; the metals have been used to make turbine, valve and pump components. References 9: 8 Russian, 1 Slovak. [237-12131]

UDC 621.791.052:624.014.27:539.4.001.24

EVALUATION OF DURABILITY OF WELDED PIPE ASSEMBLIES DURING PERIODIC LOADING OF COMPONENTS BY LONGITUDINAL FORCES

Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 85 (manuscript received 17 Jul 84) pp 11-17

GARF, E. F., candidate of technical sciences and LITVINENKO, A. Ye., engineer, Institute of Electric Welding imeni Ye. O. Paton, UkSSR Academy of Sciences

[Abstract] Use of pipe assemblies whose welded joints are subject to both static and periodic loading is common in many structures, such as cranes and communication towers, mining equipment and off-shore platforms. The present article reports on an approach for assessing fatigue resistance in such assemblies that would provide a calculation method for such evaluation of pipe welds. Complexities of tension and deformation, as well as variations in pipe wall thicknesses, impede the calculations. On the basis of the calculations, the authors developed a classification of locations of fatigue cracks in relation to design and the combination of periodic loads. Data on varying stress and fatigue factors and their consequences are presented. Results indicated that failure of pipe assemblies under periodic loading took place at zones of thermal deterioration during welding. Diagonal stresses were also found to be important in calculating resistance to fatigue failure, and longitudinal forces were realized in the diagonal direction. The mechanical properties of the specific material tested apparently had little to do with fatigue resistance. References 14: 7 Russian, 7 Western. [236-12131]

STUDY OF LAMINATE AND ZONAL SEGREGATION OF SULFUR IN WELDS ON CARBON STEELS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 85 (manuscript received 3 Jan 84, in final form 27 Jun 84) pp 20-22

POKHODNYA, I.K., academician, UkSSR Academy of Sciences, BULAT, A.V., candidate of technical sciences, PONOMAREV, S. S., engineer and YAVDOSHCIN, I. R., candidate of technical sciences, Institute of Electrical Welding imeni O. Ye. Paton, UkSSR Academy of Sciences

[Abstract] Welds on carbon steels have laminate and zonal segregation as well as dendrite segregation of sulfur. Metallographic and autoradiographic studies have previously shown the development of these factors, but their relationships had not been identified. The present article reports on a quantitative study of chemical irregularities depending on the carbon and manganese contents of welds, as well as the connections between dendrite, laminate and zonal segregation of sulfur. The research was conducted using electron microscopy and micro-X-ray spectral analysis of cross-sections of metal deposited on steel bases in an argon medium. The carbon, manganese and silicon contents of weld seams was carefully controlled. Results showed that increased carbon in the weld hampered zonal and enhanced laminate segregation of sulfur; carbon promoted and manganese hampered dendrite segregation. Redistribution of sulfur was the same for laminate as for dendrite segregation, and laminate segregation was dependent on dendrite segregation. References 8: all Russian.
[236-12131]

CLASSIFICATION OF HEAT-RESISTANT NICKEL ALLOYS ACCORDING TO RESISTANCE TO CRACKING DURING HEAT TREATMENT OF WELD JOINTS

Kiev AVTOMATICHESKAYA SVARKA in Russian No 5, May 85 (manuscript received 16 Jun 84) pp 23-25

SOROKIN, L. I., candidate of technical sciences and TUPIKIN, V.I., engineer, Moscow

[Abstract] Welded articles of dispersion-hardening nickel alloys tend to crack during heat treatment. Most research has attributed this to residual welding stress, volume stress and thermal stress. Alloys containing aluminum are particularly susceptible to this phenomenon. The present article reports on deeper study of the effects of aluminum and titanium on this cracking in order to provide more precise classification of heat-resistant alloys. The research was done on metals of the type Kh20N80TYu with varying contents of aluminum and titanium. A ring specimen with a check weld 30 mm in diameter was checked for cracks by visual and X-ray illumination. Results showed that,

regardless of the material state, alloying with aluminum increased the likelihood of cracking more than did alloying with titanium, by a factor of 1.4. Cracks formed in the alloy if more than 12% of γ -phase metal was present. The same results were obtained with commercial alloys, whether deformed or cast alloys were tested. Three groups of alloys with increasing amounts of γ -phase metal were identified. For the group with the most γ -phase metal, more than 45%, high-temperature annealing above 950-1000°C dissolved a significant portion of the γ -phase metal and promoted heat resistance. References 8: 5 Russian, 3 Western.
[236-12131]

CSO: 1842

END