69698

S/126/60/009/03/021/033
E193/E483

On the Effect of Preliminary Straining at 300°K on the Mechanical Properties of Technical Iron at 77°K

The relationship between the ductility of the test pieces at 77°K and the degree of pre-straining at 300°K is illustrated in Fig 4, where elongation (δ, %) and reduction of area (ψ, %) are plotted against σ_o (kg/mm^2) on the left-hand side diagram and against δ_o (%) on the right-hand side diagram; the experimental points denoted by open circles relate to δ, crosses relate to ψ, and the triangle indicates δ of test piece Nr 1, which had not been subjected to preliminary straining; numbers ascribed to each point denote the number of the test piece. Fig 5 shows how the yield point σ_s, kg/mm^2, (open circles) and the true tensile strength σ_b, kg/mm^2 (full circles) at 77°K varied with the degree of pre-straining at 300°K, given in terms of σ_o (left-hand graph) or δ_o (right-hand graph), the triangle indicating the true tensile strength of test piece Nr 1. A characteristic feature of test pieces which, at 77°K, failed in a ductile manner (test pieces Nr 2 to 6) was twin formation and the appearance of slip bands. It was revealed by

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S/126/60/009/03/021/033
E193/E483

On the Effect of Preliminary Straining at 300°K on the Mechanical Properties of Technical Iron at 77°K

metallographic examination of test pieces tested at 77°K that the slip bands were formed already in the elastic range long before the yield point was reached. The microstructure of a test piece, pre-strained at 300°K under $\sigma_0 = 8.9$ kg/mm^2 and tested to fracture at 77°K, is illustrated in Fig 6 (x 100) showing (a) twins and slip bands at the point of fracture and (b) density of twins at a distance of 1.5 mm from the point of fracture. The variation of density of twins across the length of the test piece is illustrated in Fig 7, where N_g/N (%) is plotted against the distance (mm) from the point of fracture, curves 1 and 2 relating to specimens which have failed in the brittle and ductile manner respectively; N_g is the total number of grains in the portion of the test piece $dx = 0.25$ mm long and 3 mm wide and N is the number of grains with twins in that portion. The relationship between the intensity of twin formation I, % (calculated from the formula given at the bottom of p 448 as Eq (2)) and the magnitude of stress σ_0 applied

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S/126/60/009/03/021/033
E193/E483

On the Effect of Preliminary Straining at 300°K on the Mechanical Properties of Technical Iron at 77°K

during preliminary straining, is illustrated by the graphs reproduced in Fig 8 where the number ascribed to each point denotes the number of the test piece. Regarding the slip bands, they are straight when formed in the initial stages of the formation and curved in the heavily deformed material. Fig 9 (x 166) shows the straight and curved slip bands in specimen Nr 3, deformed at 77°K to δ = 4%. Curved slip bands in the region of local deformation in specimen Nr 3, deformed at 77°K to δ = 8% are shown in Fig 10 (x 360). Finally, Fig 11 shows the local deformation near the grain boundaries and broadening of the grain boundaries, revealed by micro-interference meter in test piece Nr 7, pre-strained at 300°K under a stress equal to the yield point. Several conclusions were reached. (1) Technical iron subjected to preliminary straining in the elastic range at 300°K and then cooled under load to 77°K, undergoes a transition from brittle to ductile condition; this transition is accompanied by an increase in the true

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E193/E483

On the Effect of Preliminary Straining at 300°K on the Mechanical Properties of Technical Iron at 77°K

tensile strength, as compared with the brittle strength of technical iron. (2) Technical iron, pre-strained under optimum conditions ($\sigma_0 \approx 9$ kg/mm^2) is characterized by elongation ≈ 10.5%, reduction of area ≈ 23% and tensile strength 20% higher than that of untreated material. (3) The transition of technical iron from brittle to ductile condition is due to special conditions of generation of elementary displacements brought about by high temperature straining at low rates of strain and cooling under load; these conditions are favourable for the formation of arrays of dislocations on various defects and for breaking these arrays without destroying the continuity of the metal. (4) Technical iron, pre-strained at 300°K, begins to deform plastically at 77°K under a stress lower than the yield point. (5) Brittle fracture of technical iron is not caused by twinning, since it has been found that maximum ductility corresponded to maximum intensity of the twin formation.

Card 7/8 (6) The critical temperature of cold brittleness of

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S/126/60/009/03/021/033
E193/E483

On the Effect of Preliminary Straining at 300°K on the Mechanical Properties of Technical Iron at 77°K

technical iron is not lowered by pre-straining at 300°K. There are 11 figures, 1 table and 12 references, 8 of which are Soviet and 4 English.

ASSOCIATION: Khar'kovskiy fiziko-tekhnicheskiy institut AN USSR (Khar'kov Institute of Physics and Technology AS UkrSSR)

SUBMITTED: July 15, 1959

Card 8/8

GINDIN, I.A.; LAZAREV, B.G.; STARODUBOV, Ya.D.

Characteristics of the mechanical properties of lithium connected with low-temperature polymorphic transitions. Fiz. met. i metalloved. 10 no.3:472-480 S '60. (MIRA 13:10)

1. Fiziko-tekhnicheskiy institut AN USSR.
(Lithium--Testing) (Metals at low temperatures)

S/053/60/070/01/002/007
B006/B017

24(2), 18(0)

AUTHORS: Garber, R. I., Gindin, I. A.

TITLE: The Physics of the Strength of Crystal Bodies

PERIODICAL: Uspekhi fizicheskikh nauk, 1960, Vol 70, Nr 1, pp 57-110 (USSR)

ABSTRACT: Although modern engineering makes ever increasing demands on the strength of materials there exists no modern physical theory of strength. The present paper gives a survey on the up-to-date physical concepts on the strength of crystalline bodies, the reasons for the low strength of the real materials, and the most important possibilites of raising them. Part 1 deals with the microscopic theory of strength, especially with the theory by Ya. I. Frenkel'; Frenkel' proved that the critical shear stress in the case of which the lattice becomes unstable is equal to $G/2\pi$ where G denotes the modulus of rigidity; this value is much higher than that for plastic crystals (10^{-5}G). By more accurate investigations other authors obtained a still theoretical value of G/30 which is much higher than that measured in single metal crystals. The reasons for this discrepancy are briefly discussed. Part 2 deals with the structural defects of a real crystal and gives a short survey. Part 3 deals somewhat more in detail with the influences of the microcracks

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APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051671(

The Physics of the Strength of Crystal Bodies

S/053/60/070/01/002/007
B006/B017

(P. A. Rebinder, Ya. I. Frenkel', B. Ya. Pines, A. F. Ioffe, S. N. Zhurkov, A. V. Stepanov; experiments and their results are mentioned). Part 4 reports on the scale effect and the strength of the thread-like crystals (A. P. Aleksandrov, S. N. Zhurkov - statistical theory, R. I. Garber - experiments with calcite crystals; figures 3-9 show different characteristics of strength, also Bartenov and Chepkov are mentioned). Part 5 gives a short survey on the statistical theory by N. N. Davidenkov, Ya. I. Frenkel' and T. A. Kontorova, and part 6 deals with the origin of cracks in the crystal nucleus (theory by A. V. Stepanov and its verification by N. N. Davidenkov, Ye. M. Shevandin, and M. V. Klassen-Neklyudova; experiments and their results obtained by S. O. Tsobkallo, Stepanov, S. N. Zhurkov, T. P. Sanfirova et al). Part 7 presents the theoretical and experimental investigation results of dislocations and micro-cracks (Ye. D. Shchukin and V. I. Likhtman). Part 8 investigates the influence of the surrounding medium on the mechanical strength of solids (solution of the body and extension of surface defects and adsorption; A. F. Ioffe, P. A. Rebinder, D. I. Shil'krug). Part 9 deals with the dependence of strength,

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The Physics of the Strength of Crystal Bodies S/053/60/070/01/002/007
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on temperature and time (I.V. Obreimov, S. N. Zhurkov, B. Ya. Pines, I. Ya. Dekhtyar, T. P. Sanfirova, and K. A. Osipov). Part 10: destruction on creeping, part 11: cold brittleness (theory by Ioffe for rock salt; experiments by N. N. Davidenkov and T. N. Chuchman; microstructure photographs by Garber, Gindin, Konstantinovskiy, Starodubov). Part 12: discussion of the structure of high-strength alloys (G. V. Kurdyumov, B. M. Rovinskiy, L. M. Bybakova, B. M. Rovinskiy, Perkas, and Khondras, V. A. Il'ina, V. K. Kritskaya, Grusin, Tyutyunik, Entin, V. I. Startsev, P. N. Aronova). Part 13 and 14 are devoted to fatigue and hardening; the two types of hardening are briefly discussed according to R. I. Garber. In conclusion it is then pointed out that the strong difference between theoretical and experimental strength is due to structural defects and that strength could be increased by a regular stress distribution in thermal and mechanical processing. There are 38 figures and 223 references, 108 of which are Soviet.

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S/181/61/003/001/021/042
B006/B056

AUTHORS: Garber, R. I. and Gindin, I. A.

TITLE: Elastic deformation and thermal expansion

PERIODICAL: Fizika tverdogo tela, v. 3, no. 1, 1961, 176-177

TEXT: When investigating deformations with temperature changes, thermal expansion is usually considered to be independent of deformation; the explanation of certain effects occurring in the temperature change of elastically deformed specimens, however, requires consideration of the stress dependence on the coefficient of thermal expansion. This may be done by taking third-order terms into account in the series expansion of the energy of elasticity. Whereas this is not possible in general, not only the required stress dependence of the expansion coefficient may be determined, but also the coefficients entering into the latter may be estimated for the special case of uniaxial deformation or uniform expansion in all directions. This is done in the present work. For a diatomic solid, the stress $\sigma = -f\varepsilon + g\varepsilon^2$ (1), where ε is the relative deformation, and f and g are constants. If ε is considered the sum of shifts due to applied

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Elastic deformation and thermal expansion S/181/61/003/001/021/042 B006/B056

forces (ε_1) and to thermal vibrations (ε_2), then $\sigma = \sigma_1 + (2g\varepsilon_1 - f)\varepsilon_2 + g\varepsilon_2^2$. Averaging over time gives $\bar{\sigma} = \sigma_1$ and $\overline{\varepsilon_2} = g\overline{\varepsilon_2^2}/(f-2g\varepsilon_1)$. $\overline{\varepsilon_2^2}$ may be determined from the mean density of the energy of elasticity of thermal vibrations: $\bar{W} \simeq \int_0^T \frac{C_V}{V} dT$, and $\bar{W} = -f\overline{\varepsilon_2^2}/2 + g\overline{\varepsilon_2^3}/3$. By taking into account that ε_2^3 small quantity changing its sign, one may assume that $\int_0^T \frac{C_V}{V} dT \simeq -f\overline{\varepsilon_2^2}/2$. If $\overline{\varepsilon_2} = \int_0^T \alpha dT$, where α is the coefficient of thermal expansion, one obtains $\alpha = 2gC_V/Vf(2g\varepsilon_1 - f)$. With $\sigma_1 = 0$, $\varepsilon_1 = 0$, $\alpha = \alpha_0 = -2gC_V/Vf^2$, one obtains $\alpha = \alpha_0(1+\beta\varepsilon_1)$. On the other hand, it follows from the Grüneisen relation that $\alpha_0 = KC_V\gamma/3V$, where K denotes compressibility, γ the Grüneisen coefficient, V the atomic volume. Thus, one obtains $\beta = -Kf\gamma/3$. From (1)

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it follows that f ≃ -E, where E is the modulus of linear elasticity. The value of β was calculated for several metals:

Metal	β
Pd	1.3
Ag	1.65
Pt	1.65
Cu	1.7
α-Fe	1.9
Ni	2.1
W	2.1
Co	2.3

Small deformations naturally lead to comparatively low changes in the coefficient of thermal expansion; in the case of high stress gradients, the change may become considerable and cause noticeable effects. There are 1 table and 1 Soviet-bloc reference.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR Khar'kov (Institute of Physics and Technology AS UkrSSR, Khar'kov)

SUBMITTED: June 6, 1960

Card 3/3

APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051671(

20798

24.7500 1143, 1160, 2807, 1418

S/181/61/003/003/024/030
B102/B205

AUTHORS: Garber, R. I., Gindin, I. A., and Shubin, Yu. V.

TITLE: High strength of single crystals

PERIODICAL: Fizika tverdogo tela, v. 3, no. 3, 1961, 918-919

TEXT: Numerous experimental studies of crystals of rock salt and other substances, performed by A. F. Ioffe and A. V. Stepanov, seem to indicate that the continuity of the crystals is disturbed in plastic deformation. By retarding or accelerating the plastic deformation of rock crystal, Stepanov was able to change their strength by a factor of 30. The highest strength is displayed by filament crystals if the entire process of deformation up to destruction is plastic. Iron filaments elastically deformed by 4.8%, for example, reach a strength of 1340 kg/mm^2. When the first indications of sliding are noticeable, the resistance of filament crystals to resistance decreases rapidly. If the orientation of a macroscopic crystal toward the external force is such that plastic deformation (chiefly sliding and twinning) is excluded, increased strength can be expected. Hexagonal crystals which have a limited number of slip and twinning planes at low temperatures, are partic-

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High strength ...

ularly suitable for such experiments. Plastic deformation of these crystals is effected chiefly by sliding in the basal plane (0001), on the faces of prisms of first order {10$\bar{1}$0}, and by twinning in the planes {10$\bar{1}$2}. This was studied with the help of prismatic Be single crystals (1.6 x 1.5 x 3 mm) of 99.9% purity. The crystals were compressed at 77°K by a force perpendicularly acting on the basal plane (deformation rate: 0.013%/sec). There were no indications of plastic deformation up to destruction. Sliding and twinning were impossible since no components of this force were acting in the respective directions. Under these conditions, the Be single crystals actually showed a very high strength: destruction occurred only under a pressure of 410 kg/mm^2; the crystal suddenly decomposed into very fine powder. With other positions of the basal plane, destruction occurred already at 34 kg/mm^2. At room temperature, the maximum stress is only 210 kg/mm^2 (perpendicular to the basal plane). Similar experiments were carried out with calcite single crystals (6 x 4 x 10 mm) at 300°K, which are deformed only by twinning. The orientation of the single crystals was such that the twinning plane (110) formed an angle of 45° with the axis of the specimen and the direction of displacement [001], opposite to the direction in which the tangential stresses acted, which deformed the specimen at a

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High strength ...

rate of 0.004%/sec. A strength of 23 kg/mm^2 was attained in this case. The lower bound is 40 g/mm^2. There are 7 references: 4 Soviet-bloc and 3 non-Soviet-bloc.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR Khar'kov (Institute of Physics and Technology, AS UkrSSR, Khar'kov)

SUBMITTED: August 10, 1960

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20799

24.1500 1143, 1160, 2807, 1418 S/181/61/003/003/025/030
B102/B205

AUTHORS: Gindin, I. A., Lazarev, B. G., and Starodubov, Ya. D.

TITLE: Discontinuous character of plastic deformation at low temperatures

PERIODICAL: Fizika tverdogo tela, v. 3, no. 3, 1961, 920-925

TEXT: The discontinuous character of plastic deformation of crystalline bodies has been known long (A. F. Ioffe, Ehrenfest, M. V. Klassen-Neklyudova), and the various effects of discontinuous deformation have been investigated many times. In the authors' view, however, this problem has not yet been studied in detail, which is the purpose of the present work. Elongation and compression diagrams of the following metals were recorded by a machine equipped with a sensitive, rigid dynamometer between 1.4 and 77^{o}K and at a deformation rate of 30 μ/sec: aluminum, beryllium, bismuth, tungsten, iron, cadmium, potassium, lithium, magnesium, molybdenum, copper, sodium, nickel, tin, lead, antimony, silver, mercury, tantalum, titanium, chromium, cesium, zinc, zirconium, and uranium. In this connection, it was necessary to classify the deformation jumps and to make a detailed study of

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Discontinuous character ...

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a new kind of faults which are important at 4.2°K and below this temperature. The principal results of these investigations are published here. The discontinuity of the low-temperature deformation is essentially caused by: 1) mechanical twinning, 2) polymorphous transitions, 3) peculiarities of the plastic deformation of high-purity metals (mechanical recrystallization, sliding along the grain faces, twinning), 4) relaxation processes with a regular increase of jumps. These four cases were investigated individually. Figs. 1, 2, and 3 show the diagrams of deformations on mechanical twinning (1), polymorphous transition (2), and of relaxative jumps (3). These diagrams were recorded by the computer machine. Ad 1: The authors studied the extension elongation of coarse-grained iron of 99.99% purity at 77°K. The jumps are only caused by twinning processes. The kind of the effect depends largely on the grain size. Fine-grained material showed no twinning jumps. Jumps of this kind can thus be prevented by an adequate thermomechanical treatment of the material. Ad 2: Jumps due to polymorphous transitions occur in the compression of Li or Na. Fig. 2 shows diagrams obtained for Li (purity of 99.93%) at 20 (1), 4.2 (2), and 1.4°K (3). The transition into the stable low-temperature modification takes place after a certain degree of deformation has been

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20793

reached, and is accompanied by the occurrence of considerable faults. These jumps occur only if the deformation takes place below the temperature of the polymorphous transition. Ad 3: High-purity metals, such as Al (99.994%) and Fe (99.99%) show mechanical recrystallization within the range of helium temperatures, i.e., grains are formed, which are larger than the initial ones. The process is somehow similar to mechanical twinning. Ad 4: Whereas the effects described above occur only under certain conditions, all the metals investigated show deformation jumps at sufficiently low temperatures and a corresponding stress strain, which are due to relaxation processes. These are characterized by a certain rule (Fig. 3 shows it for Fe (99.99% pure) at 4.2°K). They are due to the fact that elastic energy accumulates and is released at a certain value. For some of the metals examined here, a table contains the temperature and the degree of deformation at which the elongation process takes place discontinuously and regularly. In some metals, an increased elevated strain stress corresponds to an elevated temperature (e.g., in the case of Na), but there is still a temperature threshold above which no such jumps will appear any longer, not even at maximum stress; (for Na, e.g., above 20°K). The rules governing the jumps are observable both during compression and elongation. There are 7 figures,

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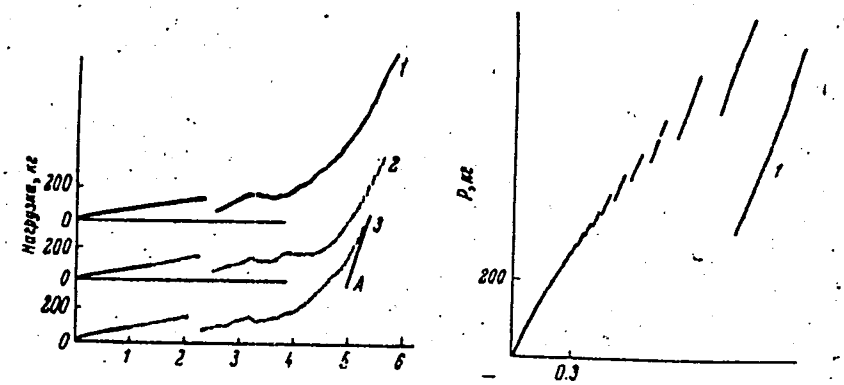
1 table, and 18 references: 16 Soviet-bloc and 2 non-Soviet-bloc.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR Khar'kov (Institute of Physics and Technology, AS UkrSSR, Khar'kov)

SUBMITTED: August 10, 1960

Figs. 2 and 3



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22051

24.7500 1160, 1136, 1143

S/181/61/003/004/017/030
B102/B214

AUTHORS: Garber, R. I., Gindin, I. A., and Shubin, Yu. V.

TITLE: Orientation dependence of the slipping and rupture of single crystals of beryllium on stretching

PERIODICAL: Fizika tverdogo tela, v. 3, no. 4, 1961, 1144-1151

TEXT: The present paper, which is in continuation of earlier investigations, makes a contribution to the clarification of the structural rules of beryllium which is highly anisotropic with respect to its mechanical properties. The single crystals studied were bred from a 99.98% pure starting material, using the method of slow cooling of the melt (crystallization rate: 5 mm/hr). Single crystals of 80 mm length and 60 mm diameter were obtained. The orientation was determined by X-rays. The crystals were cut in different forms by a special electro-spark device, after which they were etched, ground, and polished, first chemically and then mechanically. The tensile tests were made at the following angles to the basal plane: α = 0, 5, 10, 15, 20, 26, 45, 70, and 90° (see Fig. 2). The shearing direction [11$\bar{2}$0] coincided with one of the lateral faces.

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Orientation dependence ...

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B102/B214

The stretching was done at a constant rate of 0.005%/sec at room temperature. The crystallographic elements of plasticity and rupture were studied by crystallographic and microinterference methods. The results of the investigations are illustrated in Figs. 3 and 4. The curve P_{β} (Fig. 3) shows the α-dependence of the ultimate strength. The strongly non-monotonic behavior of this curve contradicts the law of constancy of normal stress on brittle rupture. The curve $P_{2\beta}$ is drawn according to this law and does not represent the experimental facts in any way. The experimental curve $P_{\beta}(\alpha)$ can be described well by the equation $P_{1\beta} = K(\sin^3\alpha\cos\alpha)^{-1/2}$ in the angular range $\alpha = 20\text{-}70^{\circ}$, where $K = 3$ kg/mm^2. This equation corresponds to the law $(\tau\sigma)_{destr} = K^2$. However, the experimental results do not correspond to this law between 0 and 15°. At $\alpha > 20^{\circ}$ slipping and rupture occur in the same system of planes, namely, (0001). At $\alpha < 20^{\circ}$, the crystallographic elements of plasticity and rupture alter and do not coincide (slipping: $\{10\bar{1}0\}$; rupture: $\{11\bar{2}0\}$). Further, investigations of the structure were made before and after the

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Orientation dependence ...

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rupture. The following conclusions are drawn from the results obtained: Highly pure Be single crystals and commercially pure crystals show marked anisotropy in their mechanical properties as well as in the elements of plasticity and rupture on stretching. There is an orientation limit which is characterized by the plasticity at room temperature. The peculiarity of rupture at this orientation is the absence of ideal cleavability and a complicated character of the fracture. Improved plastic properties of polycrystalline Be are obtained by preparing a definite fine-grained texture for which, in the process of deformation, the cleavage in the principal planes of rupture is strongly localized. There are 7 figures and 14 references: 4 Soviet-bloc.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR Khar'kov (Institute of Physics and Technology, AS UkrSSR, Khar'kov)

SUBMITTED: August 1, 1960

Card 3/5

X

S/126/61/011/001/005/019
E111/E452

AUTHORS: Gindin, I.A., Lazarev, B.G. and Starodubov, Ya.D.

TITLE: Low-Temperature Metallography of Lithium

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.11, No.1, pp.46-51

TEXT: The authors point out that no information is yet available on microstructural changes during martensitic transformation of alkali metals, in cooling to low-temperatures and heating or after "deformational" polymorphic transformation; or on the mutual effect of transformations on microstructure. In their present investigation, which is a continuation of their work in this field, the authors have studied by low-temperature metallography the microstructure of lithium and its changes in the polymorphic-transformation temperature region. Polished sections were prepared as previously described (Ref.1). For preliminary low temperature investigations, previously prepared lithium specimens (Ref.1) were used; these had been stored in liquid nitrogen and photomicrographs corresponding to this temperature could then be obtained directly. For other temperatures, a special cryostatic apparatus was constructed in which the required specimen temperature

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E111/E452

Low-Temperature Metallography of Lithium

was obtained by suitable selection of thermal resistance between it and a massive copper heat conductor whose other end was immersed in cooling liquid. The temperature of the 7 x 7 x 2 mm specimen, which could be microscopically observed, was measured with a copper-constantan thermocouple or, for below 20°K, with an indium resistance thermometer. The whole was inside a vacuum jacket connected to a separate pump and containing activated charcoal. The optical system was part of a type ПМТ-3 (PMT-3) apparatus with a photographic attachment. Microphotos show the original room temperature microstructure and also needles of the hexagonal modification and a chain of martensitic needles with a grain-boundary fracture. The extent of martensitic transformations does not exceed 25 to 30% and volume changes produce shear deformation. A further figure shows the changes from the original microstructure at a given point on the section during repeated cooling and warming. Preliminary plastic deformation at 78°K was found to impede formation of the hexagonal modification on subsequent cooling below the martensitic point:. on the microstructure, wavy slip lines are visible which represent regions of localized face-centred cubic

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Low-Temperature Metallography of Lithium

structure. This effect is similar to that in body-centred cubic metals (Ref.11). The work provides some confirmation for the authors' previous conclusions (Ref.1) on the behaviour of lithium. The low-temperature improvement of the mechanical properties of this metal is attributable to the fine dispersion of the two-phase structure produced through "deformational" polymorphous change. There are 6 figures and 11 references: 8 Soviet and 3 non-Soviet.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR (Physicotechnical Institute AS UkrSSR)

SUBMITTED: June 28, 1960

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22966

18.8200

S/126/61/011/005/014/015
E193/E183

AUTHORS: Gindin, I.A., Starodubov, Ya.D., and Vasyutinskiy, B.M.

TITLE: Plasticity and brittleness of cast molybdenum at temperatures between 4.2 and 700 °K. I.

PERIODICAL: Fizika metallov i metallovedeniye, Vol.11, No.5, 1961, pp. 794-800

TEXT: The object of the present investigation was to explore the possibilities of low-temperature application of refractory metals such as Mo, Cr, W, Nb, etc. To this end, the mechanical properties of Mo were determined by means of the standard tensile test at 4.2-700 °K, and the effect of preliminary heat- and mechanical treatment on the transition temperature from the ductile to brittle fracture was studied. Mo of 99.95% purity was used in the experiments, the main impurities consisting of (%): 0.005 Fe; 0.01 Ni; 0.017 Ca; 0.002 Al; 0.002 O; 0.0009 N; 0.0006 H. To ensure uniform grain size, the ingots cast in vacuum-arc furnace were hot-rolled at 1000 °C to 50% reduction in thickness, spark-machining having been used for the preparation of flat, tensile test pieces of 7 mm gauge length and 2 mm^2 cross-section.

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S/126/61/011/005/014/015

Plasticity and brittleness of cast E193/E183

After machining the test pieces were vacuum-annealed at 1280 °C. This treatment reduced the gaseous impurity content and produced a coarsely-crystalline structure with the average grain size of 200-400 μ. The tensile tests were carried out at 4.2, 20, 77, 183, 200, 223, 243, 300, 435 and 700 °K; at two rates of strain, 0.4 and 30 μ/sec. Some of the results obtained at the rate of strain of 0.4 μ/sec are reproduced in Fig.3, where the yield point (σ_s), U.T.S. (σ_b) and the true tensile strength (σ_u) measured in kg/mm^2 are plotted against the test temperature (°K). It will be seen that all these properties increase with decreasing temperature. The point of intersection of the σ_s and σ_b curves determined the transition temperature from ductile to brittle fracture, which in this case was 183 °K. The unusual feature of curves shown in Fig.3 is that they all pass through a maximum at approximately 80 °K, since it is generally believed that the tensile strength in the brittle fractural region does not depend on temperature. With increasing rate of strain, both σ_s and σ_b increased, and the temperature of the transition from ductile to brittle fracture was shifted to 208 °K. The plastic properties of Mo have been found to decrease with decreasing temperature at a rate which increases with

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S/126/61/011/005/014/015

Plasticity and brittleness of cast E193/E183

increasing rate of strain. This is illustrated in Fig.5, where elongation (δ, %) and reduction of area (ψ, %) are plotted against the test temperature (°K) for specimens extended at 0.4 (open circles and squares) and 30 μ/sec (black circles and triangles). In the second stage of the present investigation, the tensile test pieces were subjected to the following treatment: (1) loading at room temperature and at a rate of strain of 0.4 μ/sec to attain a stress equal to 0.5 σ_s; (2) slow cooling under constant load to 77.2 °K and holding at that temperature for 1-1.5 hours. It was found that after this preliminary treatment, the test pieces tested at 183 °K (i.e. at the critical temperature) exhibited some degree of ductility (δ 5%). Fig.6 shows the actual load (kg) versus strain (μ) curves for Mo tested at 183 °K at a rate of strain of 0.4 μ/sec for untreated (curve 1) and treated (curve 2) specimens. In Fig.7 the elongation (δ, %) of untreated (curve 1) and treated (curve 2) test pieces is plotted against the test temperature. It was found also that no significant improvement in ductility can be achieved by cooling the metal (during the treatment described above) to temperatures lower than 77 °K. An increase in

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S/126/61/011/005/014/015

Plasticity and brittleness of cast ... E193/E183

the low-temperature ductility of iron, subjected to similar treatment, has been attributed (Ref.1: Gindin, I.A., FMM, 1960, 9, 447) to the formation of twins with dislocation-free boundaries. In the case of molybdenum, the present authors postulate, the increased ductility attained by this treatment is associated mainly with the stress-dependence of the temperature coefficient of linear expansion and with the changes in the mosaic structure of the metal subjected to stresses at low temperatures.

There are 8 figures and 8 references: 6 Soviet and 2 non-Soviet. The English language reference reads as follows:

Ref.6: J.H. Bechtold, J. Metals, 1953, 5, 1469.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR
(Physico-technical Institute, AS Ukr.SSR)

SUBMITTED: August 15, 1960

Card 4/6

APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051671(

18 8200 2808, 2208, 1418, 1416 S/126/61/012/001/015/020
25923 E193/E480

AUTHORS: Gindin, I.A., Staradubov, Ya.D., Vasyutinskiy, B.M.

TITLE: Metallographic investigation of molybdenum deformed in tension at 4.2 to 700°K. II

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.12, No.1, pp.132-139

TEXT: Many of the metals with body-centred cubic lattice undergo a ductile-to-brittle transition at sub-zero temperatures. It is to be expected that as the temperature of this transition is approached changes occur not only in the mechanical properties of the metal but also in its microstructure. Since no study of molybdenum at temperatures lower than 77°C had been reported, the investigation, the results of which are described in the present paper, was undertaken with the object of studying the microstructure of molybdenum deformed in tension at 4.2 to 700°K. Both optical and electron microscopes were used in the examination of the specimens. No etching was used, the changes in the microstructure on the preliminarily polished specimen surface having been revealed with the aid of a microinterferometer. Qualitative assessment was made of the density of slip bands, degree of uniformity of deformation

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in different grains, mean magnitude of absolute displacement in slip, and the dependence of these characteristics on the temperature and degree of plastic deformation was evaluated. The results can be summarized as follows. (1) At all temperatures at which molybdenum remains plastic (that is down to 183°K) it deforms plastically by the mechanism of slip. As in other body-centred cubic metals, branched slip lines are formed on molybdenum, indicating a more complex mechanism of deformation than that obtaining in face-centred cubic metals. This shape of the slip lines can be observed already in the early stages of plastic deformation corresponding to an elongation of $\delta = 1 - 2\%$. The effect becomes more pronounced with increasing degree of deformation at any given temperature but the effect of heavy deformation is most pronounced near the ductile-to-brittle transition temperature. Fig.2 shows (magnified 330-fold) the microstructure (a) and the interference pattern (b) of the slip bands formed on molybdenum deformed at 200°K to $\delta = 0.8\%$; the magnitude of the absolute slip was in this case approx 0.25 μ. In suitably oriented grains (particularly at high temperatures) a

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system of intersecting slip lines is formed. Increasing the degree of deformation of molybdenum at 240 to 700°K brings about the appearance of new slip bands and an increase in the displacement along the slip planes. The development of the process of deformation, however, is manifested predominantly by growth of the initially-formed slip bands. Thus, for example, just before the fracture of a specimen ($\delta = 38\%$) at 700°K, the slip bands may become 6 to 7 μ wide. The density of the slip lines also changes with temperature. At 700°K, it is relatively small and slip bands, spaced at 12 to 15 μ, predominate. At 300°K, the density of slip bands corresponding to the same degrees of deformation is higher, the width of the slip bands and the spacing between them decreasing. With a further decrease in temperature, the density of slip bands again decreases approaching that obtaining at 700°K.
(2) In addition to deformation by slip (as revealed by the formation of slip bands) plastic deformation of molybdenum at room temperature entails a specific mode of deformation, localized at the grain boundaries and in the grain-boundary regions. This mechanism operates at relatively low strains (3 to 5%). With increasing strain some of the regions of localized deformation grow

in size and cracks are formed at the boundaries of these regions after heavy deformation. The width of these near-boundary regions can reach 25 to 30 μ, the relative displacement of adjacent grains along the grain-boundary being several tenths of a μ. This mode of plastic deformation which has been observed in pure iron at sufficiently low temperatures (Ref.4: Gindin I.A. and Starodubov Ya.D. FTT, 1959, 1, 1794) appears to be a property of pure metals. The microstructure and interference pattern of the grain-boundary and the grain-boundary region of molybdenum, deformed at 300°K to δ = 20%, is shown in Fig.5a and 5b respectively (magnified 440-fold). (3) With decreasing temperature the character of plastic deformation changes considerably. At temperatures approaching the ductile-to-brittle transition, fragmentation and block formation precede the appearance of slip bands. The formation of blocks (whose size, determined with the aid of an electron microscope, was found to be $(2 - 3) \times 10^{-4}$ cm) increases the resistance of molybdenum to slip and twinning; the process of deformation becomes less uniform and fracture takes place at relatively small strains. (4) In contrast to other metals with body-centred cubic crystal structure, twinning plays a relatively insignificant part in the plastic deformation of molybdenum. Thin twins (1 to 2 μ thick) appear in specimens deformed below 246°K but only in isolated grains. An electron microphotograph (magnified 11250 times) of a twin (approx 0.5 μ thick) in molybdenum deformed at 200°K to $\delta \approx 2\%$ is shown in Fig.8. A specific characteristic of twins of this type is the presence of lightly and heavily distorted zones showing, respectively, as dark and light bands on the microphotograph. It is postulated that the highly distorted zone is formed suddenly when a certain stress, required to initiate the process of twinning, is reached. The appearance of this zone is accompanied by the formation of a mosaic structure in the boundary region and by the formation of blocks and their elastic recovery. As in the case of iron, growth of a twin in molybdenum takes place by movement of one of its boundaries; on reaching the distorted region, the growth of the twin ceases owing to the strain-hardening of this zone. (5) The specific character of plastic deformation of molybdenum is reflected in the manner in which this metal fractures. At 300 and 700°K fracture takes place along the slip planes and a well-defined neck is formed in a tensile test piece. Cracks along the slip planes appear also in molybdenum, tested at 240°K, but in this case they are accompanied by cracks along the cleavage planes, the number of these cracks increasing with decreasing temperature. This is illustrated in Fig.9 (magnified 440-fold) showing a portion of a test piece deformed at 243°K to δ = 18% in which the parallel slip lines end at a crack along the cleavage plane. On approaching the ductile-to-brittle transition temperature, and particularly below it, cracks along the grain- and block-boundaries are formed. Side by side with the main crack a number of cracks parallel to it but not traversing the entire cross-section of the test piece can be observed. Fracture below the critical temperature is both trans- and inter-crystalline, although the latter is relatively less pronounced. The decrease in strength of molybdenum below 27°K has been attributed to the formation of a large number of surface cracks which cause premature fracture. The formation of the surface cracks is, in turn, associated with a high concentration of oxygen in the surface layer. It was concluded from the results of the present investigation that the character of plastic deformation of 99.95% molybdenum in the temperature interval

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studied changes considerably with decreasing temperature. In the plastic range deformation trans-crystalline slip predominates; at room temperature this mode of deformation is accompanied by localized deformation in the grain-boundary regions. On approaching the ductile-to-brittle transition temperature, block formation plays an increasingly important part and is mainly responsible for the absence of twinning at low temperature. Ductile fracture at 240 to 700°K takes place along the slip planes. At lower temperatures, cohesion of the metal is destroyed in the early stages of the deformation and the main crack develops along the block boundaries. There are 10 figures and 9 references: 5 Soviet and 4 non-Soviet. The four references to English language publications read as follows: Chen N.K., Maddin R. Trans. AIMME, 1951, 191, 461; Andrade E.N., Chow J.S. Proc.Roy. Soc., 1940, 175A, 290; Cahn R.W. J.Inst. Metals, 1954-55, 83, 493; Rendall J.H., Johnstone S.T.M., Carrington W.E. J.Inst.Metals, 1953-54, 82, 345.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR (Physicotechnical Institute AS UkrSSR)

Card 7/9

18.9500

30456

S/126/61/012/003/016/021
E193/E135

AUTHORS: Garber, R.I., Gindin, I.A., and Shubin, Yu.V.

TITLE: Tensile tests on beryllium single crystals in the 20-500 °C temperature range. V.

PERIODICAL: Fizika metallov i metallovedeniye, vol.12, no.3, 1961, 437-446

TEXT: Scarcity of data on the behaviour of beryllium single crystals under tensile stresses prompted the present authors to undertake the study of this subject. The experimental specimens were prepared from 99.98% pure Be by a pulling-out technique. The orientation of the single crystal tensile test pieces is shown in Fig.1, where p indicates the direction of the applied stress. A strain rate of 0.005%/sec was used in the tensile tests carried out at 20, 200, 400 and 500 °C, helium being employed as the protective atmosphere at elevated temperatures. The mechanical tests were supplemented by metallographic examination. The results of the mechanical tests are reproduced graphically. In Fig.2, the UTS and the yield point (p_b and p_s, kg/mm^2, left-hand scale)

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30456

and elongation and reduction of area (δ and ψ, %, right-hand scale) are plotted against the test temperature (°C). The fifth curve shows the temperature-dependence of the so-called "diffusion deformation" factor, χ, which is given by χ = (1 - φ) 100 °C, where φ denotes the deformation localised in the slip on the basal plane, its magnitude being calculated from

$$\varphi = \frac{\sum_i n_i a_{si}}{(\Delta \ell)_s}$$

where n_i is the number of basal slip bands with the absolute slip displacement of a_{si}, and $(\Delta \ell)_s = \Delta \ell \cos 45°$ represents the strain of the specimen in the direction of slip. Fig.2 shows the true tensile stress/elongation curve for beryllium single crystals at temperatures indicated by each curve. The effect of temperature on the mode of slip is illustrated in Fig.4, showing (X 200) slip lines on the faces of specimens extended (from left to right) at 20, 200 and 400 °C. The variation of the mode of slip with rising temperature was also studied by determining the magnitude of the

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Tensile tests on beryllium single S/126/61/012/003/016/021
E193/E135

relative slip, γ, and density of the slip bands, ρ, these two parameters being given by $\gamma = b/a_s$ and $\rho = 1/h$ (for the meaning of b/a_s and h see Fig.1). In the regions of uniformly distributed slip lines, γ increased from 0.4 at 20 °C to 2.0 at 500 °C; in the region of macroscopically localised slip, at 400 °C, γ reached 70. The parameter ρ also initially increased with temperature, reaching a maximum of 0.12 1/μ at 200 °C after which it decreased again, reaching at 400-500 °C a value similar to that at room temperature (~ 0.3 1/μ). Analysis of the results of mechanical tests, correlated with the examination of slip bands and microstructure of specimens after fracture, led to the following conclusions. 1) Plasticity of Be single crystals increases monotonically with rising temperature, showing no peak at 400 °C which is a characteristic of polycrystalline beryllium. The increase in plasticity in the 20-200 °C range is caused by the formation of new slip bands with the material within the bands hardening at a sufficiently fast rate. The increase in plasticity at higher temperatures is associated with the onset of localised slip, characterised by a

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Tensile tests on beryllium single ... S/126/61/012/003/016/021
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large magnitude of γ (about 70). Both UTS and the so-called strain-hardening modulus $\bar{D}$ passed through a maximum at 200 °C; $\bar{D}$ is given by $\bar{D} = (p_u - p_s)\delta$, where p_u is the true UTS of the metal. This effect is a manifestation of the simultaneously occurring processes of strain-hardening and relaxation.
2) Deformation of Be single crystals with an orientation as illustrated in Fig.1 takes place mainly by slip along the basal planes (0001) in the [11$\bar{2}$0] direction. At higher temperatures, prismatic slip along the {101X} plane in the general [11$\bar{2}$0] direction and diffusion deformation play an increasingly important part. 3) Brittleness of Be single crystals at room temperature is caused by non-uniform plastic deformation along the basal plane which causes the formation and growth of cracks along the main cleavage plane. At high temperatures, slip becomes more uniform and deformation takes place partly by prismatic slip.
There are 10 figures, 1 table and 1 Soviet-bloc reference.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR
(Physicotechnical Institute, AS Ukr.SSR)

SUBMITTED: January 2, 1961

Card 4/4

S/126/61/012/006/007/023
E193/E383

AUTHORS: Gindin, I.A., Lazarev, B.G., Starodubov, Ya.D. and Lazareva, M.B.

TITLE: Mechanical properties of sodium in the range of low-temperature polymorphic transformations

PERIODICAL: Fizika metallov i metallovedeniye, v. 12, no. 6, 1961, 846 - 852

TEXT: As is the case with Li, the body-centred cubic crystal structure of Na undergoes a partial change to close-packed hexagonal on cooling below 35 °K. A so-called "deformation" modification of this metal can be obtained by straining it plastically at temperatures below 80 °K and the object of the present investigation was to check whether the effect of low-temperature polymorphism of Na on its mechanical properties is similar to that observed earlier by the authors (Ref. 1: FMM, 1960, 10, 472) in Li. To this end, tensile tests were carried out at 1.6 - 290 °K on polished and etched test pieces of 99.8% pure Na and the following properties were

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Mechanical properties of S/126/61/012/006/007/023
E193/E383

determined: 0.2% proof stress; UTS; true tensile strength; elongation; reduction in area and the strain-hardening coefficient. In addition, the microhardness of each fractured specimen was measured at 77 °K, side-by-side with that of a pilot (i.e. untested) specimen. Typical results are reproduced graphically. In Fig. 2, the elongation (δ, % - lefthand scale) and reduction in area (ψ, % - righthand scale) are plotted against the test temperature (°K). The temperature-dependence of 0.2% proof stress ($\sigma_{0.2}$), UTS (σ_b) and true tensile strength (σ_u) is reproduced in Fig. 3. Finally, in Fig. 4 the microhardness (H, kg/mm^2) measured at 77 °K is plotted against the temperature (°K) to which the test piece had been cooled prior to hardness test; the lower curve relates to pilot specimens, the upper curve representing results obtained near the neck of fractured tensile-test pieces. Several conclusions were reached.

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1) Anomalous variation of mechanical properties of Na in the sub-zero temperature range is associated with polymorphic transformations taking place at these temperatures.
2) The martensitic transformation which on cooling takes place in Na at about 35 °K is reflected in a sharp increase in its yield strength, UTS and microhardness.
3) A minimum in the elongation versus temperature curve is situated in the temperature range within which the deformation-induced polymorphic transformation takes place. The rapid increase in elongation on cooling from 70 to 1.6 °K can be attributed to the deformation-induced change from body-centred cubic to close-packed hexagonal crystal structure.
4) The low-temperature polymorphic transformations (particularly the martensitic transformation) bring about an increase in the degree of strain-hardening and uniformity of the plastic flow of Na. There are 4 figures, 1 table and 12 references: 6 Soviet-bloc and 6 non-Soviet-bloc. The four latest English-language references mentioned are:

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Mechanical properties of S/126/61/012/006/007/023
E193/E383

Ref. 2: C.S. Barrett - Phys.Rev., 1947, 72, 245; Acta crystallog., 1956, 9, 671; Ref. 8: D. Hull, H.M. Roserberg: Phys.Rev.Let., 1959, 2, 5; Ref. 10: D. Hull, H.M. Rosenberg - Phil.Mag., 1959, 4, 303; Ref. 12: D. Gugan, J.S. Dugdall, J. Can: Phys. Rev., 1958, 36, 1248.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR (Physicotechnical Institute of the AS UkrSSR)

SUBMITTED: May 3, 1961

Card 4/4

S/053/61/074/001/001/003
B117/B212

AUTHORS: Garber, R. I., and Gindin, I. A.

TITLE: Physical properties of high-purity metals

PERIODICAL: Uspekhi fizicheskikh nauk, v. 74, no. 1, 1961, 31 - 60

TEXT: The present survey deals with papers which have been published in recent years in the field of high-purity metals. The papers show a trend to obtain specimens of ever-increasing purity. They also show that the progress made varies for different metals (appendix). The physical problems associated with such metals are discussed, for whose analysis the purity of the specimens is decisive. These problems include the electrical resistance, the reflectance of the metals, the magnetic permeability, nuclear reactions, effects of radioactive irradiation, grain boundaries, latent energy of plastic deformation, relaxation, recrystallization, internal friction, moduli of elasticity,and mechanical properties. The latter include the plasticity, deformation curve, cold-brittleness and creeping. A glance at the material available shows that great progress has been made in the analysis of high-purity metals. The most urgent task at present

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seem to be to develop methods for industrial production of these metals. So far, it has been impossible to solve the problem concerning the changes of physical properties of metal effected by small additions. Regarding the electrical resistance, the joint effect of local distortions by foreign atoms and other causes, such as vacancies etc., may be considered to be proved. The mechanical properties are very sensitive toward additions, especially with respect to structural changes occurring during crystallization or other thermal processes. Vacancies and local distortions seem to play a minor role only. The brittleness of various metals can be eliminated by purifying them from additions. A further development of new methods for the separation of metals will find new fields of application for high-purity metals. References to publications on high-purity metals are given for the following elements: Al, Ba, Be, V, W, Bi, Ga, Ha, Fe, Au, In, Cd, Ka, Ko, Mg, Mn, Cu, Mo, Ni, Nb, Pt, Sn, Pb, Ag, Sr, Sb, Ta, Ti, Th, U, Cr, Zn, and Zr. The following Soviet authors are mentioned: L. S. Kan, B. G. Lazarev (Ref.1: DAN SSSR 81, 1027 (1951); V. B. Zernov, Yu. V. Sharvin (Ref.7: ZhETF 36, 1038 (1959); B. N. Aleksandrov, B. I. Verkin (Ref.8: ZhETF 34, 1655 (1958); A. I. Sudovtsov, Ye. Ye. Semenenko (Ref.18: ZhETF

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B117/B212

35, 305 (1958); I. M. Lifshits, M. I. Kaganov (Ref.29: UFN 69, 419 (1959); B. Leks (Ref.30: UFN 70, 111 (1960); A. S. Zaymovskiy, G. Ya. Sergeyev, V. V. Titova, B. M. Levitskiy, Yu. N. Sikurskiy (Ref.34: Atomnaya energiya 5, 412 (1958); M. Ya. Gal'perin, Ye. P. Kostyukova, B. M. Rovinskiy, Izv. AN SSSR, ser. tekhn. 4, 82 (1959); D. Ye. Ovsiyenko, Ye. I. Sosnina, (Ref. 60: Voprosy fiziki metallov i metallovedeniya, sb. no. 9, Kiyev (1959) str. 185); V. A. Pavlov (Ref.64: Fiz. metallov i metallovedeniye 4, 1 (1957); V. A. Zhuravlev, (Ref.72: Zavodskaya laboratoriya 14, 687 (1959); V. S. Yemel'yanov, A. I. Yevstyukhin, D. D. Abonin, V. I. Statsenko, ("Metallurgiya i metallovedeniye chistykh metallov" vyp. 1, 1959, 44). There are 18 figures, 7 tables, and 144 references: 61 Soviet-bloc and 83 non-Soviet-bloc. The six references to English-language publications read as follows: D. J. Maykut, Prod. Engineering 24, 186 (1953) - (Ref.31); A. N. Holden, Phys. Metal. of Uranium Massachus., 1958, str. 7 (Ref.33); J. C. Blade, Rev. metallurgie 54, 769 (1957) (Ref.50); P. Gordon, J. Metals 7, 1043 (1955); (Ref.51); C. Zener, Phys. Rev. 74, 639 (1948) (Ref.68); T. R. Barrett, G. G. Ellis, R. A. Knight, Proc. Sec. Int. Conf. Geneva 5, 319, 320 (1958) (Ref. 100).

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S/181/62/004/002/027/051
B101/B102

AUTHORS: Gindin, I. A., Kozinets, V. V., and Starodubov, Ya. D.

TITLE: Comparison of structural changes in nickel caused by deformation at 4.2 and 300°K and by subsequent creeping

PERIODICAL: Fizika tverdogo tela, v. 4, no. 2, 1962, 465-469

TEXT: Experiments with high-purity nickel (99.994%) tempered at 800°C and $3\cdot10^{-6}$ mm Hg and subsequently deformed by 3.5% at 4.2 or 300°K by stretching are reported. Some of the specimens were subsequently kept at room temperature for 80 - 100 hrs and subjected to creep tests at 700°C and constant pressure (2.8 kg/mm²), while others were heated from 4.2°K to 700°C within 1.5 - 2 min and likewise subjected to creep tests. Both stretching and creeping were carried out with machines described in FMM, 7, 794, 1959. A sharply focused X-ray tube, designed by B. Ya. Pines (Ostrofokusnyye rentgenovskiye trubki i prikladnoy rentgenostrukturnyy analiz (Sharply Focused X-ray Tubes and Applied X-ray Analysis) GITTL,

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1955) was used to examine the X-ray structure of the specimens. The disorientation was calculated according to P. B. Hirsch (see below). Results: The original specimens possessed large subgrains (80μ), the lattice was not distorted, and the disorientation was less than 1°. Disorientation reached 8° at 4.2°K, but was less at 300°K. Specimens deformed at 4.2°K underwent relaxation when heated to room temperature. The distortion of the lattice decreased as a result of polygonization of the subgrain fragments. Microdistortions diminished further on heating to creep temperature. The specimen deformed at 4.2°K and subsequently kept at room temperature had a more uniform and more disperse structure than the specimen heated directly from 4.2°K to 700°C. The removal of microdistortions of the specimens, especially of that deformed at 4.2°K, and the increase in disorientation during the creeping process, indicate that the substructure depends on the temperature at which deformation has taken place. There are 2 figures and 9 references: 8 Soviet and 1 non-Soviet. The reference to the English-language publication reads as follows: P. B. Hirsch, J. N. Kellar, Acta Crystal., 5, 162, 1952.

Comparison of structural changes in ... S/181/62/004/002/027/051
B101/B102

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR, Khar'kov (Physicotechnical Institute, AS UkrSSR, Khar'kov)

SUBMITTED: September 22, 1961

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APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051671(

GINDIN, I.A.; KOZINETS, V.V.; STARODUBOV, Ya.D.; KHOTKEVICH, V.I.

Structural changes in copper depending on low-temperature deformation and subsequent annealing. Fiz.met.i metalloved. 14 no.6:864-873 D '62. (MIRA 16:2)

1. Fiziko-tekhnicheskiy institut AN UkrSSR i Khar'kovskiy gosudarstvennyy universitet.

(Copper--Metallography)
(Metal, Effect of temperature on)

S/032/62/028/001/014/017
B116/B108

AUTHORS: Garber, R. I., Gindin, I. A., Neklyudov, I. M., Chechel'nitskiy, G. G., and Stolyarov, V. M.

TITLE: Device for programmed metal hardening

PERIODICAL: Zavodskaya laboratoriya, v. 28, no. 1, 1962, 107 - 109

TEXT: A device has been designed for programming the load on samples. It permits determining the effect of the charging rate on the material properties up to 800°C in a vacuum of 10^{-6} mm Hg or in inert gases. The charging rate can be increased from 10 g/mm² per hr to 3 kg/mm² per hr. Moreover, rates of up to 80 kg/mm² per hr are possible. The maximum load is 350 kg. The sample elongation (up to 4 - 5 mm with an error of 0.5 μ) is measured with an optical strain gauge. Reduction of the charging rate to values corresponding to diffusion hardening lowers both the total deformation and the rate of steady creep. The device (Fig. 1) operates as follows: Dynamometer spring (6) is compressed by the reducing gear (7). The charging rate is regulated by varying the periodic operation of the motor (8) (РД-09 (RD-09)-type) driving the gear

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Device for programmed metal hardening

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(7). The sample is heated by a tubular furnace with molybdenum coil, and the temperature is regulated by an ЭПД-12 (EPD-12) electronic potentiometer. There are 4 figures and 6 Soviet references.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk USSR (Physicotechnical Institute of the Academy of Sciences UkrSSR)

Fig. 1. Diagram of device for programmed hardening.
Legend: (1) sample; (2) and (3) fastenings; (4) cross piece; (5) three bars; (6) dynamometer spring; (7) reducing gear; (8) motor; (9) ball-bearing joint; (10) indicator; (11) mains connection; (12) base plate; (13) vacuum chamber; (14) sylphon; (15) limiter; (16) to pump.

Device for programmed metal hardening

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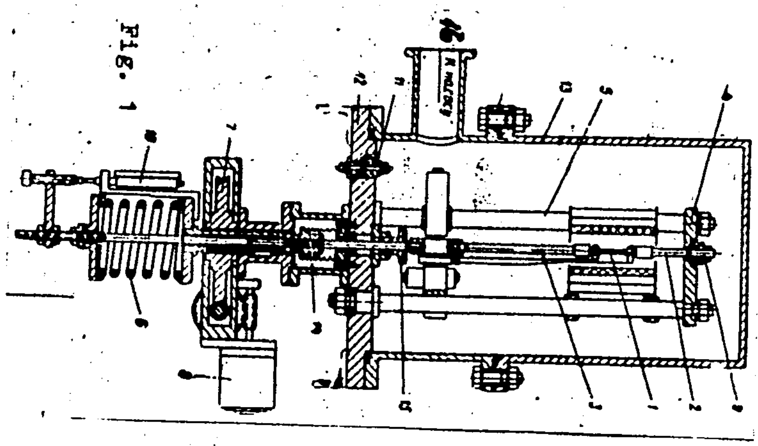
Fig. 1



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APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051671(

GARBER, R.I.; GINDIN, I.A.; MALIK, N.I.; STARODUBOV, Ya.D.

Machine for testing materials for tension and compression at the temperatures from 1,4 to 1500 K. Zav.lab. 28no.7:865-868 '62. (MIRA 15:6)

1. Fiziko-tekhnicheskiy institut AN USSR.
(Testing machines)

37382

S/020/62/143/006/011/024
B164/B101

18.8200

AUTHORS: Gindin, I. A., Starodubov, Ya. D., and Azhazha, V. M.

TITLE: Increase of the creep resistance of nickel by prior deformation at 4.2°K

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 143, no. 6, 1962, 1325-1327

TEXT: The effect of small deformations of nickel at 4.2°K on its creep resistance at higher temperatures was examined by tempering small specimens of high-purity nickel (99.994%) in vacuo at 800°C and then drawing them at 4.2°K, the rate of drawing being 0.03 mm/sec and the degree of deformation 1.7 or 3.5%, afterward establishing the creep curves under a constant stress of 2.8 kg/mm^2 in vacuo at 700°C. For comparison, tempered specimens which had been deformed at room temperature were used as standards. An increase in creep endurance from 40 to 106 hrs (after 3.5% deformation) and a 4.5-fold increase in creep strength were obtained. Specimens prestrained at 300°C gave much lower values amounting to 51.5 hrs and to a 1.37-fold increase, respectively.

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B164/B101

Increase of the creep resistance ...

Microphotographs of the specimens show that those deformed at 4.2°K present greater homogeneity of fine structure than the others. There are 2 figures and 1 table.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk USSR (Physicotechnical Institute of the Academy of Sciences UkrSSR)

PRESENTED: January 26, 1962, by G. V. Kurdyumov, Academician

SUBMITTED: September 22, 1961

Card 2/2

ACCESSION NR: AT4013981 S/3070/63/000/000/0116/0118

AUTHOR: Gindin, I. A.; Starodubov, Ya. D.

TITLE: Device for metallographic and radiographic investigations of the structure of solid bodies during deformation at low temperatures

SOURCE: Novy*ye mashiny*i pribory*dlya ispy*taniya metallov. Sbornik statey. Moscow, Metallurgizdat, 1963, 116-118

TOPIC TAGS: low temperature metallography, low temperature radiography, microphotography, deformation, metal deformation

ABSTRACT: Devices described in the literature are intended either for determination of mechanical properties of solid bodies at low temperatures, or for low-temperature metallography. However, these devices do not permit direct observation of changes in structure of a specimen during the process of its stressing at low temperatures. Metallographic and usually radiographic investigations of structure of deformed specimens are performed after the specimens have regained room temperature, despite irreversible changes in them. A device has been developed by the authors permitting observation, photographing and taking of motion pictures of changes on the surface of a specimen during cooling, deformation at

ACCESSION NR: AT4013981

low temperature, and subsequent heating. The device is also suitable for radiographic investigations of structure in solid bodies during cooling, low-temperature deformation, and heating. The design of the device permits cooling a specimen down to approximately 10K, measuring this temperature, deforming a specimen in tension or compression, and simultaneously recording values for the "load-deformation" diagram. A schematic illustration of the device is given in Fig. 1 of the Enclosure. The test specimen 1, in the form of flat plate enlarged at its ends, is gripped by jaws 2 located in a depression of the mounting table. One of the jaws is fixed to the table; the other is connected to rod 3 of the loading mechanism and is guided by grooves in the table. The cooling of the specimen to the required temperature is provided through a copper conductor 4 (25 mm in diameter), the lower part of which is immersed in a liquid coolant contained in the vacuum-bottle 5. In order to increase the cooling rate and to reduce the temperature difference between test specimen and coolant, circulation of the coolant is provided through an axial bore in the conductor 4 and tubes 6 and 7. For regulation of the specimen temperature and of the cooling rate, a resistance 8 is provided and a heater 9 in the lower part of the mounting table. The specimen temperature is measured by a thermocouple or a pick-up resistor. The wire connections of the temperature pick-up pass through vacuum insulators 10. The mounting table with the

ACCESSION NR: AT4013981

specimen and part of the cooling conductor are located in a vacuum test chamber 11. The upper part of the chamber is flanged for connection with cover 12. Observation and photographing of the specimen microstructure during the test are conducted through a window in the cover. For observation and photographing of specimen surface changes, the optical part of the device PMT-3 with a photographic attachment are used; and for taking motion pictures, the "Kiyev"-type camera. To avoid condensation of moisture on the specimen, high vacuum is applied to the test chamber 11 by an adsorption-type pump through the hose connection 14. The vacuum is maintained by a thin layer of activated charcoal 15. A copper shield is provided for heat protection of the specimen. The loading device consists of a worm gear reducer 16, driven by the electro-motor 17. The worm gear is mounted on a threaded spindle rotating freely in bushing 18. The bushing is fixed in body 19 of the loading device and takes the thrust during loading of the specimen. The thrust from the spindle is transmitted to a moving cylinder 20, closed from one side and containing the calibrated loading spring 21, acting from one side on the bottom of the cylinder 20 and from the other side on a flange connected to the rod 3 of the movable jaw 2. To a thicker part in the central portion of the rod 3, a bellows 22, having a working stroke of 12 mm, is soldered. The working pins of two dial gages 23 tie to rod 3. The left gage (see Fig. 1 of the Enclosure) is fixed to the body 19 of the device and serves for measuring the absolute elongation (or shortening) of the specimen. The right gage is fastened to the movable cylinder 20 through a plate 24, and

ACCESSION NR: AT4013981

measures the deflection of spring 21, i.e., the load applied to the specimen. A yoke with three ribs 25 provides greater bending stiffness to conductor 4. The specimen is subjected to a constant-speed axial deformation of 0.03 mm/sec, and a maximum load of 200 kg can be applied. For X-ray investigations at low temperatures, a small chamber for photographing by reflection has been devised (see Fig. 2 of the Enclosure), which can be flanged to the test chamber and sealed by a rubber gasket. A beryllium window 2, 12 mm in diameter and 0.3 mm thick, is used to introduce the X-ray beam into the test chamber. Inside the chamber, a magazine with film 3 is mounted and a sector screen 4 of lead underneath the magazine. The screen permits taking four X-ray pictures without disturbing the vacuum in the chamber, and consequently without heating the specimen. The screen has to be rotated 90° after each exposure. The height of the film magazine location over the sample is adjustable. For making of radiograms, a sharp-focussed X-ray tube designed by B. Ya. Pines is used. A photographic camera can be installed to take microphotographs and radiograms of the same spot of the sample. The residual pressure in the vacuum chamber is 10^{-5} to 10^{-6} mm Hg. The temperature of the specimen depends on the coolant used and is 78K with liquid nitrogen, 25K with liquid hydrogen, and 10K with liquid helium. Orig. art. has: 2 figures.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR (Institute of Physics and Technology AN USSR)

Card 4/7

ACCESSION NR: AT4013981

SUBMITTED: 00 DATE ACQ: 20Feb64 ENCL: 02

SUB CODE: MM NO REF SOV: 010 OTHER: 000

Card 5/7

ACCESSION NR: AT4013981

ENCLOSURE: 01

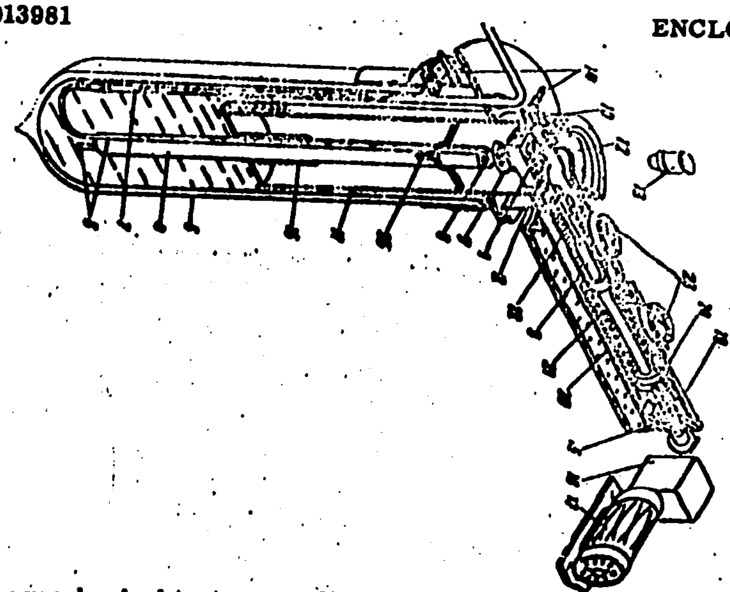

Fig. 1. Device for mechanical tests, metallographic and X-ray investigations at low temperatures

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ACCESSION NR: AT4013981 ENCLOSURE: 02

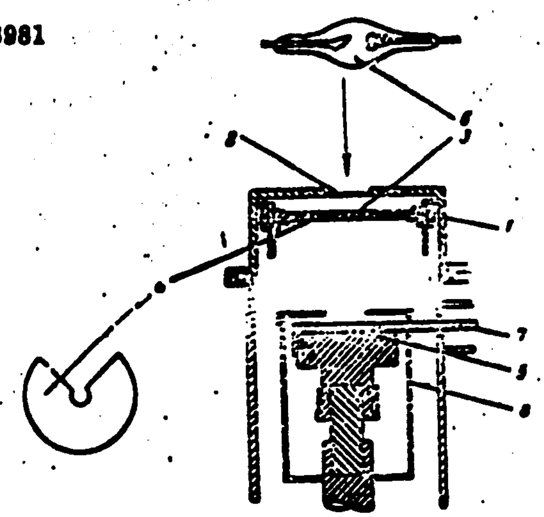

Fig. 2. Chamber for X-ray investigation of structure of solids under deformation at low temperatures. 1 - body of chamber, 2- beryllium window, 3 - magazine with film, 4 - sector screen (lead), 5 - test specimen, 6 - X-ray tube, 7 - jaw for loading of specimen, 8 - shield

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L 13385-63 EPF(n)-2/EWP(j)/BDS/EWP(r)/EWT(l)/EWT(m) AFFTC/ASD/
SSD Pu-4 JD
ACCESSION NR: AP3002746 S/0120/63/000/003/0169/0171

AUTHOR: Gindin, I. A.; Kravchenko, S. F.; Starodubov, Ya. D.; Godzhayev, V. M.

TITLE: Outfit for studying metal creep at low temperatures

SOURCE: Pribory* i tekhnika eksperimenta, no. 3, 1963, 169-171

TOPIC TAGS: metal creep, low-temperature creep

ABSTRACT: A new design of the outfit for studying metal creep within 300-4.2K at a 100-kg maximum load is described. The outfit comprises: (1) a mechanism for program loading the specimen, (2) a high-sensitivity mechano-optical primary detector of small deformations, (3) an optical device with a camera for recording the elongation-time chart, (4) a liquid-level controller for the Dewar vessel, and (5) clamps for fastening the specimen. A functional diagram illustrates operation of the outfit. The following characteristics are given: rate of loading is 2.5 kg/min; deformation-time scale factor is 0.5 micron in 1 mm of the elongation axis or 30, 60, 120 min in 1 mm of the time axis; average daily variation of the light spot about the horizontal time axis is 0.5 micron; lever sensitivity is 0.1 micron/g; specimen diameter is 1, 2, or 3 mm; specimen length is 130 mm; error in deformation

Association: [illegible] Physico-Technical Inst. AN UkrSSR

Card 1/2

GARBER, R.I.; GINDIN, I.A.; CHIRKINA, L.A.

Twinning and annealing of nonequilibrium iron-nickel alloy of the Sikhote-Alin iron meteorite. Meteoritika no.23:45-55 '63. (MIRA 16:9)

(Sikhote-Alin Range—Meteorites)

GARBER, R.I.; GINDIN I.A.; SHUBIN, Yu.V.

Compression of beryllium single crystals along the hexagonal axis in the temperature range 4.2° to 900° K. Fiz. tver. tela 5 no .2: 434-442 F '63. (MIRA 16:5)
(Beryllium crystals) (Strength of materials)

GINDIN, I.A.; KRAVCHENKO, S.F.; STARODUBOV, Ya.D.; GODZHAYEV, V.M.

Apparatus for studying the creep of metals at low temperatures.
Prib. i tekh. eksp. 8 no.3:169-171 My-Je '63. (MIRA 16:9)

1. Fiziko-tekhnicheskiy institut AN UkrSSR.
(Creep of metals) (Metals at low temperatures)

GARBER, R.I.; GINDIN, I.A.; STOLYAROV, V.M.; CHECHEL'NITSKIY, G.G.; CHIRKINA, L.A.

Apparatus for studying the damping of low-frequency torsional oscillations. Prib. i tekh. eksp. 8 no.3:172-174 My-Je '63.
(MIRA 16:9)

1. Fiziko-tekhnicheskiy institut AN UkrSSR.
(Oscillations--Electromechanical analogies)

AZHAZHA, V.M.; GINDIN, I.A.; STARODUBOV, Ya.D.

Comparing the effect of prestressing at 4.2 and 300° K on the creep characteristics of nickel at 700°C. Fiz.met. i metalloved. 15 no.1:119-124 Ja '63. (MIRA 16:2)

1. Fiziko-tekhnicheskiy institut AN UkrSSR.
(Nickel—Cold working) (Creep of nickel)

S/126/63/015/003/022/025
E073/E320

AUTHORS: Garber, R.I., Gindin, I.A. and Neklyudov, I.M.

TITLE: Influence of "programmed strengthening" on the creep and recrystallization of iron at elevated temperatures

PERIODICAL: Fizika metallov i metallovedeniye, v. 15, no. 3, 1963, 473- 475

TEXT: In earlier investigations on calcite, bismuth and iron, the authors found that in addition to ordinary strengthening caused by lattice distortions during the process of plastic deformation under a continuous load, there is also "programmed strengthening" due to diffusion-blocking and strengthening of weak and overloaded lattice nodes. This produces an increase in the yield point, plasticity at low temperatures and an increased creep resistance. So far, an improvement in the mechanical properties has been observed only at temperatures lower than or equal to the temperature of the programmed treatment. In the work described here, specimens of Fe (0.03% C) were polished and chemically etched, vacuum-annealed at 880 °C for 3 hours and then slowly cooled. After "programmed loading" up to 8 kg/mm^2 at 300 °C at

APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051671(

S/126/63/015/003/022/025
E073/E320

Influence of ....

a rate of 90 g/mm^2/h, the specimens were subjected to a 100-hour creep test at 400 °C with a load of 7 kg/mm^2. The creep rate of previously program-loaded specimens was significantly lower (about 5.6 x 10^{-3} %/h) both in the initial and in the steady-state stages) than that of specimens to which the final load had been applied quickly (1.3 x 10^{-2} %/h in the steady-state section). This indicates that overheating does not eliminate the effect of increased resistance to creep of program-strengthened specimens. Microstructures are reproduced of both types of specimens after annealing at 830 °C for 3 hours: of specimens loaded at 400 °C with a load increasing to 16 kg/mm^2, whereby the rate of increase varied between 220 and 6 x 10^5 g/mm^2/h; of specimens loaded quickly. The residual deformations were 1.3 and 1.6%, respectively. The microstructure of specimens which were subjected directly to the final load showed signs of selective recrystallization, whilst the microstructure of the program-loaded specimens was almost the same as prior to annealing. The authors consider the results as a further proof that program-loading leads to a more

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equilibriated stable structure in that the strengthening does not seem to be accompanied by an increase in the free energy of the crystal. There are 3 figures.

SUBMITTED: August 15, 1962

L 10109-63 EPF(c)/EPF(n)-2/EWP(q)/EWT(m)/BDS AFFTC/ASD/SSD Pr-4/
Pu-4 WW/JD/IJP(C)
ACCESSION NR: AP3001699 S/0126/63/015/005/0729/0735

AUTHOR: Azhazha, V. M.; Gindin, I. A.; Starodubov, Ya. D.; Shapoval, B. I.

TITLE: Effect of low-temperature prestrain on the creep and internal friction of copper

SOURCE: Fizika metallov i metallovedeniye, v. 15, no. 5, 1963, 729-735

TOPIC TAGS: commercial-grade copper, subzero-temperature prestraining, annealing, creep characteristics, internal friction, microstructure changes

ABSTRACT: The effect of low-temperature prestrain on the creep, microstructure, and internal friction of commercial-grade copper was studied. Test specimens annealed in a high vacuum for 2 hr at 850C were prestretched 2.5, 5.0, 7.5, 12.5, or 35% at a constant rate of 0.03 mm/sec at temperatures of 300 or 4.2K. Specimens prestretched at 4.2K were annealed at room temperature for 100 hr. Both groups of specimens were then subjected to short-time creep tests in a vacuum of 0.02 mm Hg at 500C under a stress of 2 kg/mm sup 2. The tests showed that a prestrain of up to 7.5% at room temperature or subzero temperature sharply decreased the rates of the first and second creep stages. The second-stage creep rate, for instance, decreased from 0.95%/hr for annealed specimens, to 0.09 and 0.05%/hr for specimens

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L 10109-63
ACCESSION NR: AP3001699

3

prestrained 7.5% at 300 and 4.2K. The rupture strength of approximately 6.5 hr for annealed specimens increased to approximately 10.0 and 12.3 hr for the specimens prestretched 7.5% at 300 and 4.2K. The purer the metal and the coarser the grain, the higher the effect of prestraining. Oxygen-free copper prestretched 7.5% at 300 or 4.2K and tested under the above conditions had a creep rate of 0.02 or 0.01%/hr and a rupture life of 19.5 or 24 hr. The 10% elongation and reduction of area of the annealed specimen decreased to 4% for the specimens prestrained 7.5% at 4.2 and 300K. Prestrain at 4.2K strengthens grain boundaries and adjacent grain zones and promotes formation of a substructure. This sharply reduces the number of microcracks formed along grain boundaries during creep and inhibits intergranular failure of the metal. Low-temperature prestrain reduces internal friction in copper and significantly increases the temperature at which it begins to rise sharply, e.g., from approximately 100C for annealed specimens to 320 and 470C for specimens prestrained at 300 and 4.2K. Orig. art. has: 1 table and 8 figures.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR (Physicotechnical Institute, AN USSR)

SUBMITTED: 11Nov62 DATE ACQ: 11Jul63 ENCL: 00

SUB CODE: 00 NO REF SOV: 016 OTHER: 003

Card 2/2

L 10751-63 EPR/EWT(1)/EWP(q)/EWT(m)/BDS--AFFTC/ASD--Ps-4--WW/JD

ACCESSION NR: AP3001700 S/0126/63/015/005/0736/0747

AUTHOR: Gindin, I. A.; Starodubov, Ya. D.

TITLE: Concerning the ductility of polycrystalline niobium at helium temperatures

SOURCE: Fizika metallov i metallovedeniye, v. 15, no. 5, 1963, 736-747

TOPIC TAGS: mechanical properties of Nb, helium temperatures, microstructure, microhardness, deformation mechanism, multiple necking, nonductility transition temperature

ABSTRACT: The mechanical properties of Nb in the temperature range from 1.4 to 300K have been investigated. Nb wire (0.1% Ta, 0.058% Ti, 0.05% Fe, 0.03% Si) 3 mm in diameter was drawn to diameters of 1.94, 1.17, or 1.03 mm with process annealing. The specimens were then vacuum annealed at 1800—2400C to remove impurities, especially gases (see Table 1 of Enclosure). The average grain size in all annealed specimens was the same, approximately 75—100 μ. Tensile tests at 1.4—300K at a strain rate of 0.03 mm/sec showed that pure Nb retains substantial ductility even at temperatures close to absolute zero (see Table 2 of Enclosure). Between 200 and 140K the elongation drops; at temperatures below 20K reduction of area rises sharply. At temperatures below 20K the strain-stress curves have a sawlike shape, which is caused by multiple necking. Up to 9 neckings formed on the specimens tested at 4.2K. The microhardness along the gage

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L 10751-63

ACCESSION NR: AP3001700

length varied from a maximum of 92.5 kg/mm² in the neckings to a minimum of 54—60 kg/mm² between the neckings. Microscopic examination showed that plastic deformation in the whole range from 1.4 to 300K occurs by a slip. Some slip lines were straight and some wavy. Twin crystals were observed only with deformation temperatures and only in some specimens below 77K. "The authors are grateful to B. G. Lazarev for continued interest in the work and for valuable advice." Orig. art. has: 9 figures, 2 tables, and 2 formulas.

ASSOCIATION: none

SUBMITTED: 15Aug62 DATE ACQ: 11Jul63 ENCL: 02

SUB CODE: ML NO REF SOV: 006 OTHER: 017

Card 2/2

L 18049-63 EWP(q)/EWT(m)/BDS AFFTC/ASD JD

ACCESSION NR: AP3002850 S/0126/63/015/006/0908/0913

AUTHORS: Garber, R. I.; Gindin, I. A.; Neklyudov, I. M.

60
57

TITLE: Programmed hardening of commercial iron 21

SOURCE: Fizika metallov i metallovedeniye, v. 15, no. 6, 1963, 908-913

TOPIC TAGS: programmed hardening, iron, mechanical property

ABSTRACT: One of the possible methods for improving mechanical properties of solid bodies consists of diffusive blocking and strengthening of weak or over-stressed parts of a specimen. Such parts may develop shearing, sliding surfaces, twinning bands, or dislocation sources. This method was called "the programming of hardening." The device used in the programming procedure is described. It allows the stretching of a specimen at high temperatures and at very small rates of load increase. The commercial iron samples that underwent a programmed hardening at 200C were studied. The tensile test was conducted at the temperature of liquid nitrogen and also at room temperature. The creep test was also conducted at 200C. Preliminary deformation at high temperatures and low rates of loading resulted in: 1) increase of flow limit and hardening modulus; 2) increase in plasticity at the temperature of liquid nitrogen; 3) a substantial decrease in creep velocity;

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L 18049-63

ACCESSION NR: AP3002850

3

4) elimination of creep at 300C. It is concluded that the observed effects are due to a diffusive hardening of weak and overstressed regions in the samples. The authors express their appreciation to V. M. Stolyarov and G. G. Chechel'nitskiy for their help in the construction of this device. Orig. art. has: 6 figures.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR (Institute of Physics and Technology, Academy of Sciences, UkrSSR)

SUBMITTED: 26Jun62 DATE ACQ: 23Jul63 ENCL: 00

SUB CODE: ML NO REF SOV: 008 OTHER: 001

Card 2/2

GINDIN, I.A.; LAZAREV, B.G.; KHVEDCHUK, I.R.

Dilatometric investigation of the low-temperature deformation transition to lithium. Fiz. met. i metalloved. 16 no.5:793-794 N '63. (MIRA 17:2)

1. Fiziko-tekhnicheskiy institut AN UkrSSR.

ACCESSION NR: AP4037066 S/0129/64/000/005/0044/0046

AUTHOR: Gindin, I. A.; Lazareva, M. B.; Nikishov, A. S.; Rink, L. P.; Starodubov, Ya. D.; Yarov, I. A.

TITLE: Mechanical properties of structural alloys at low temperature

SOURCE: Metallovedeniye i termicheskaya obrabotka metallov, no. 5, 1964, 44-46

TOPIC TAGS: alloy, structural alloy, austenitic iron alloy, Kh25N16G7AR alloy, Kh12N20T3R alloy, Kh16G9AN4 alloy, KhN35VTYu alloy, titanium alloy, OT4 alloy, copper alloy, BrKh08 alloy, ZhS6KP alloy, steel, martensitic steel, VNS2 steel, EI659 steel, cryogenic alloy

ABSTRACT: Mechanical properties and fracture tests of Kh25N16G7AR, Kh12N20T3R, Kh17G9AN4, KhN35VTYu; austenitic iron base alloys VNS2 (EP225) and EI659, martensitic steels, ZhS6KP high-strength alloy, OT4 titanium alloy, BGKh08 copper alloy, and other [unidentified] alloys were investigated at temperatures in the 4.2—300K range.

ACCESSION NR: AP4037066

Specimens (either flat with a cross section of 1.5 x 2 mm or round and 2.2 mm in diameter) were tested in a heat-treated condition [shown in the article]. With a decreasing test temperature the resistance to plastic deformation and the tensile strength of all alloys increased. This was found to be particularly pronounced in the case of VNS2 alloy which at 293, 77, and 20K had a tensile strength of 97.5, 155.0, and 180.0 kg/mm^2 (annealed at 950C, air cooled, and tempered at 620C for 1 hr). All alloys were found to maintain some ductility at temperatures as low as that of liquid hydrogen except for E1659 steel and OT4 alloy which failed with respective elongations of 0%(at 20K) and 0.7% (at 77K). The elongation of the VNS2 alloy, on the contrary, was found to increase with a decrease of temperature from 15% at 293K to 20% at 20K. BGKh08 copper-base alloy was also very ductile at low temperatures (at 4.2K an elongation of 18.6%). A simultaneous increase of the ductility and strength of VNS2 alloy might be explained by some changes of phase composition under the effect of low-temperature deformation. All the materials tested at temperatures down to 20K yielded uniformly, some with, some without necking. Only in the case of the VNS2 steel did the strain-stress curve at 20K have a saw-like

ACCESSION NR: AP4037066

shape. However, at temperatures above 20K the steel yielded uniformly. The fracture mode was ductile with clearly expressed necking even at 20K. Orig. art. has: 1 figure and 1 table.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR (Physico-technical Institute, AN USSR)

SUBMITTED: 00 DATE ACQ: 05Jun64 ENCL: 00

SUB CODE: MM NO REF SOV: 002 OTHER: 000

Card 3/3

GARBER, R.I.; GINDIN, I.A.; MOGIL'NIKOVA, T.T.; NEKLYUDOV, I.M.

Internal friction of iron hardened by programming. Fiz. met. i metalloved. 18 no.3:443-447 S '64. (MIRA 17:11)

1. Fiziko-tekhnicheskiy institut AN UkrSSR.

L 43856-65 EWT(m)/EWP(w)/EWA(d)/T/EWP(t)/EWP(z)/EWP(b)/EWA(c) Pad IJP(c)
MJW/JD/JW/HW

ACCESSION NR: AP4048767 S/0126/64/018/004/0511/0517

AUTHOR: Azhazha, V. M.; Gindin, I. A.; Starodubov, Ya. D.

TITLE: Effect of stress and temperature on creep in nickel preliminarily deformed at 4.2 K.

SOURCE: Fizika metallov i metallovedeniye, v. 18, no. 4, 1964, 511-517

TOPIC TAGS: creep, nickel, stress, temperature effect, nickel deformation, low temperature deformation

ABSTRACT: The effect of stress and temperature was investigated on creep in nickel which underwent a deformation at 4.2 K. It was found that this low temperature deformation increases the life of N-O-nickel during creep. In the investigated temperature range (4.2 to 300 K), the lifetime of nickel is an exponential function of the stress and of the inverse temperature. The tensile strength is also increasing. The activation energy of creep in nickel corresponds to the activation energy of selfdiffusion. The increased resistance to creep is connected with the formation of fine-grained, disoriented substructure which resists

APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051671(

L 43856-65
ACCESSION NR: AP4048767

intergranular slipping. Orig. art. has: 4 figures, 2 tables.

ASSOCIATION: Khar'kovskiy fiziko-tekhnicheskiy institut AN UkrSSR (Khar'kov Physical Technical Institute, AN UkrSSR)

SUBMITTED: 01Aug63 ENCL: 00 SUB CODE: MM

NR REF SOV: 017 OTHER: 002

Card 2/2

L 43653-65 EWT(m)/EWP(w)/EWA(d)/T/EWP(t)/EWP(b) IJP(c) JD
ACCESSION NR: AP4048776 S/0126/64/018/004/0605/0611

17
15
B

AUTHOR: Gindin, I. A.; Starodubov, Ya. D.

TITLE: Direct observation of the generation and growth of mechanical twinning at low temperature tension of pure iron

SOURCE: Fizika metallov i metallovedeniye, v. 18, no. 4, 1964, 605-611

TOPIC TAGS: mechanical twinning, low temperature iron tension, pure iron twinning

ABSTRACT: The generation and growth of a twin layer in pure (99.99%) iron was studied under tension at 78 K. It is shown that as the twin thickens upon application of a continuous load, the coefficient of mechanical strengthening of the boundary decreases. Annealing at 300 K restores the original high strengthening coefficient. The data obtained show that the boundary and the region near the boundary change in a different manner on the twin-layer appearance, at its growth and after annealing. The pattern of microdestruction indicates that there is no direct connection between the crack formation and the twinning of pure iron.

Card 1/2

L 43653-65
ACCESSION NR: AP4048776 2

The authors are grateful to A. A. Ilyas. for his help in the investigation. Orig. art. has: 6 figures.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN USSR (Physicotechnical Institute AN UkrSSR)

SUBMITTED: 03Aug63 ENCL: 00 SUB CODE: MM

NR REF SOV: 010 OTHER: 000

Card 2/2

L 22898-65 EWT(m)/EWP(b)/T/EWA(d)/EWP(w)/EWP(t) IJP(c) JD
ACCESSION NR: AP5001246 S/0126/64/018/005/0762/0769

AUTHOR: Gindin, I.A.; Starodubov, Ya. D.

TITLE: Extending the life of pretwinned pure iron and the development of twins in the course of high-temperature creep

SOURCE: Fizika metallov i metallovedeniye, v. 18, no. 5, 1964, 762-769

TOPIC TAGS: iron life, pretwinned iron, high temperature creep, iron creep, iron twinning, iron microstructure

ABSTRACT: The authors studied the influence of small preliminary deformations at low temperatures (300, 77, and 4.2K) on the high-temperature (600C) creep of pure iron (99.99%). The microstructure of the deformed samples and its change in the course of creep was studied by the metallographic and microinterferential method at room temperature. It was found that the small preliminary deformation at low temperatures causes an appreciable increase in the creep strength and life of iron; this hardening effect is explained by the interaction of twinning and glissile dislocations. A new type of shear plasticity was observed during the high-temperature creep of the iron. Creep after a small low-temperature deformation is characterized by an increase in the plasticity

APPROVED FOR RELEASE: Thursday, July 27, 2000 CIA-RDP86-00513R00051671(

L 22898-65
ACCESSION NR: AP5001246

3

reserve, caused by a more uniform distribution of the slip bands over the length of the specimen and by the development of twinning interlayers. The results obtained confirm the view that there is no direct relationship between brittle fracture and twinning. "In conclusion, the authors thank P. V. Ivanitskiy and A. A. Yayes for assistance in carrying out the experiments." Orig. art. has: 8 figures.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR (Physicotechnical Institute, AN UkrSSR)

SUBMITTED: 19Aug63 ENCL: 00 SUB CODE: MM

NO REF SOV: 014 OTHER: 000

Card 2/2

L 36625-65 EWT(m)/EWP(w)/EWA(d)/T/EWP(t)/EWP(k)/EWP(b)/EWA(c) IJP(c) JD/HM

ACCESSION NR: AP5002348 S/0126/64/018/006/0904/0908

AUTHOR: Garber, R. I.; Gindin, I. A.; Zalivadnyy, S. Ya.; Mikhaylovskiy, V. M.; Malik, A. K.; Neklyudov, I. M.

TITLE: Effect of programmed hardening on creep of polycrystalline zinc and stability during cyclic heat treatment

SOURCE: Fizika metallov i metallovedeniye, v. 18, no. 6, 1964, 904-908

TOPIC TAGS: polycrystalline zinc, creep, programmed hardening, heat treatment, cyclic heat treatment

ABSTRACT: The effect of programmed hardening (hardening by controlled application of stress at slow rates) on the creep of polycrystalline zinc at room temperature and on its resistance to forming during cyclic heat treatment was studied. The linear deformation of annealed polycrystalline zinc and of samples subjected to loading ($1-6 \times 10^{-4}$ kg/mm^2/min) and to loading beyond the yield point (2.5 kg/mm^2/min) was compared. The elongation of the programmed samples

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L 36625-65

ACCESSION NR: AP5002348

2

was less than in the annealed and rapidly stressed samples; was reduced two times as the programmed rate was decreased from 5 to 1.5×10^{-4} kg/mm^2. Samples subjected to normal treatment were less resistant to heating-cooling cycles than programmed samples. The hardening increased as the maximum temperature of the cycle was reduced. The maximum temperature approached the melting temperature ($0.9T_m$ K). The creep in program hardened samples was less than in those otherwise deformed. Metallographic analysis showed slip bands and the formation of substructures in a small number of the grains. Small migration of the boundaries occurred in samples after programmed and after ordinary hardening prior to thermal cycling; after that the migration in the programmed samples was much less noticeable. Thus programmed hardening of polycrystalline zinc increased its creep strength and its resistance to forming during cyclic heat treatment. Orig. art. has: 3 figures and 1 table

ASSOCITTION: Fiziko-tekhnicheskiy institut AN UkrSSR (Physical-technical Institute AN UkrSSR)

SUBMITTED: 01Aug63 ENCL: 00 SUB CODE: MM

NR REF SOV: 009 OTHER: 001

Card 2/2

GARBER, R.I.; GINDIN, I.A.; [illegible], I.M.; [illegible], [illegible]

Hardening and dislocation structure of lithium fluoride crystals loaded according to program. Kristallografiia 10 no.3:435-437 My-Je '65. (MIRA 18:7)

1. Khar'kovskiy fiziko-tekhnicheskiy institut.

L 39679-65 EWT(m)/EWP(w)/EWA(d)/T/EWP(t)/EWP(z)/EWP(b) Pad IJP(c) MJW/JD/HW

ACCESSION NR: AP5008790 S/0126/65/019/003/0439/0442

AUTHOR: Azhazha, V. M.; Gindin, I. A.; Kozinets, V. V.; Starodubov, Ya. D.

TITLE: Effect of annealing temperature on the substructure and strength of nickel deformed at 4.2K

SOURCE: Fizika metallov i metallovedeniye, v. 19, no. 3, 1965, 439-442

TOPIC TAGS: nickel, preliminary nickel deformation, nickel process annealing, nickel property, nickel creep resistance, nickel substructure

ABSTRACT: The effect of annealing temperature on the substructure and mechanical properties of N-O-type nickel stretched 3.5% at 4.2K has been studied. Annealing was done at 300, 500, 700, 900, or 1000K. Annealing at 300 to 700K slightly reduced the subgrain size, while annealing at 900 or 1000K increased it. The optimal annealing temperature was 500K at which a fine polygonized substructure with a large disorientation angle between the subgrain

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L 39679-65
ACCESSION NR: AP5008790 2

fragments and subgrains was formed. Nickel with such a substructure has the highest resistance to plastic deformation at room temperature, the longest rupture life, and the highest creep resistance. Specimens annealed at 500K showed almost no first creep stage and the creep rate in the second stage was six times lower than that of the initial metal and five times lower than that of nickel annealed at 1000K. The subgrain size was found to be practically the same with any annealing temperature, and to be considerably smaller than that of the initial metal. Orig. art. has: 3 figures. [ND]

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR (Physico-technical Institute, AN UkrSSR); Khar'kovskiy gosuniversitet (Khar'kov State University)

SUBMITTED: 07Jan64 ENCL: 00 SUB CODE: MM

NO REF SOV: 007 OTHER: 002 ATD PRESS: 3230

Card 2/2

GINDIN, I.A.; NEKLYUDOV, I.M.; SMELOVA, D.F.

Influence of grain size on the effect of iron hardening during programmed loading. Fiz. met. i metalloved. 19 no.4:627-629 Ap '65. (MIRA 18:5)

1. Fiziko-tekhnicheskiy institut AN UkrSSR.

L 8841-66 EWT(m)/T/EWP(t)/EWP(b)/EWA(c) IJP(c) JD/JG

ACC NR: AP5027148 UR/0126/65/020/004/0603/0607

AUTHOR: Garber, R.I.; Gindin, I.A.; Chirkina, L.A.

ORG: Physicotechnical Institute, AN UkrSSR (Fiziko-tekhnicheskiy institut AN UkrSSR)

TITLE: Low temperature "deformation" polymorphism in lithium by the internal friction method

SOURCE: Fizika metallov i metallovedeniye, v.20, no.4, 1965, 603-607

TOPIC TAGS: lithium, phase transition, internal friction

ABSTRACT: Measurements were made by the method of damping free torsional vibrations of the samples in the temperature interval embracing the transition from a body-centered cubic lattice to a face-centered cubic lattice (78-200°K), at frequencies of 0.7, 0.8 and 1.3 cycles, in the region independent of amplitude. The logarithmic decrement of damping was taken as the measure of internal friction. The lithium samples, of a purity of 99.3%, were prepared by pressing in the mold at room temperature under a layer of kerosene for protection from oxidation. The length of the effective cylindrical section of each sample was 30 mm and the diameter 3 mm. For stress measurements, the sample was annealed for 2-3 days at 300°K, then pickled in methyl alcohol and

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UDC: 548.33:539.67

ACC NR: AP5027148

cooled to the temperature of liquid nitrogen (78°K), at which temperature it does not oxidize or undergo phase transition, and was mounted in the apparatus for measurement of internal friction in the single phase state (body-centered cubic). To induce the polymorphic transition from the body-centered cubic to the face-centered cubic lattice and to investigate internal friction, part of the samples were previously deformed by torsion at 78°K up to the relative shear, 5.2×10^{-2}. The martensite nature of the "deformation" nature of the transition from a body-centered to a face-centered cubic lattice in lithium is marked in an especially clear manner in experiments on measurement of internal friction during heating of the samples to determined temperatures above and below the temperature of the reverse transitions with intermediate cooling to 78°K, as well as in a study of the frequency dependence of internal friction. Orig. art. has: 3 figures.

SUB CODE: MM,IC/ SUBM DATE: 28Oct64/ ORIG REF: 010

OTH REF: 005

BVK

Card 2/2

L 24575-66 EWT(m)/T/EWP(t) IJP(c) JD/JH
ACC NR: AP6009671 SOURCE CODE: UR/0181/66/008/003/0842/0845

AUTHORS: Bezuglyy, P. A.; Gindin, I. A.; Neklyudov, I. M.; Rabukhin, V. B.

ORG: Physicotechnical Institute of Low Temperatures AN UkrSSR, Khar'kov (Fiziko-tekhnicheskiy institut nizkikh temperatur AN UkrSSR)

TITLE: Securing of dislocations on point defects during programmed loading of aluminum single crystals

SOURCE: Fizika tverdogo tela, v. 8, no. 3, 1966, 842-845

TOPIC TAGS: hardening, crystal dislocation phenomenon, crystal defect, static load test, ultrasonic absorption, aluminum, single crystal

ABSTRACT: This is a continuation of earlier work (FMM v. 18, 443, 1964 and earlier papers) dealing with various hardening mechanisms that can be activated by varying the rate of increasing an external stress on a crystal and the possibility of programming the hardening on the basis of such mechanisms. The present paper presents the re-

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ACC NR: AP6009671

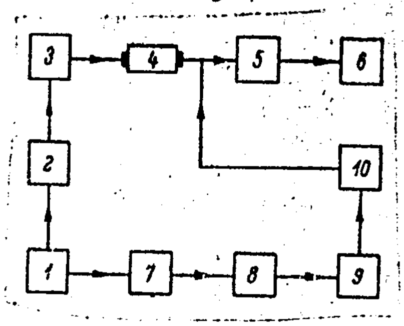

Fig. 1. Block diagram of pulsed ultrasonic installation. 1 -- Master pulse generator, 2 -- modulator, 3 -- high frequency generator, 4 -- sample, 5 -- superheterodyne receiver, 6 -- oscilloscope, 7 -- controlled pulse delay, 8 -- pulse generator, 9 -- standard hf generator, 10 -- attenuator.

sults of an investigation of the dependence of absorption of longitudinal ultrasound on the level of prestressing attained during programmed (slow) hardening of single-crystal aluminum, and the results obtained with fast loading are also given for comparison. Both annealed and non-annealed samples were tested. The absorption was measured by comparing two successive reflected pulses, using an ultrasonic pulsed setup (Fig. 1). All measurements were made with a longitudinal compression-rarefaction wave operating at 72 Mc. From

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