LIKHACHEV, V.A., kapitan meditsinskoy sluzhby

Treatment of infected wounds during the incubation stage of radiation sickness; experimental studies. Voen. med. zhur. no.4: 49-50 Ap '59. (MIRA 12:8)

(WOUNDS AND INJURIES, experimental,
ther. of infected wds. in early radiation sickness (Rus))
(RADIATIONS, eff.
same)

LIKHACHEV, V.A.

The RUMB-2 high-speed multichannel recording unit. Biul.tekh.-ekon.inform. no.12:33-35 '59. (MIRA 13:4)
(Punched card systems)

24.4200 LIKHACHEV V.A

44360
S/044/62/000/012/016/049
A060/A000

AUTHOR: Likhachov, V.O.

TITLE: Certain solutions of Lamé equations in cylindrical coordinates

PERIODICAL: Referativnyy zhurnal, Matematika, no. 12, 1962, 58, abstract 12B264 (Zb. robit aspirantiv Mekhan.-matem. ta fiz. fak. L'vivs'k. un-t, 1961, no. 1, 123 - 131; Ukrainian)

TEXT: Lamé equations in cylindrical coordinates in the absence of volumetric forces take the form:

$$\begin{cases} \frac{\partial Y}{\partial \xi} - \frac{\partial R_c Z}{\partial \theta} = \frac{2(\nu - 1)}{\nu - 2} x \frac{\partial R_c \Theta}{\partial x}; \\ \frac{\partial R_c X}{\partial \theta} - \frac{\partial Y}{\partial x} = \frac{2(\nu - 1)}{\nu - 2} x \frac{\partial R_c \Theta}{\partial \xi}; \\ \frac{\partial Z}{\partial x} - \frac{\partial X}{\partial \xi} = \frac{2(\nu - 1)}{\nu - 2} \frac{1}{x} \frac{\partial \Theta}{\partial \theta}; \\ \frac{\partial (x R_c X)}{\partial x} + \frac{1}{x} \frac{\partial Y}{\partial \theta} + x \frac{\partial R_c Z}{\partial \xi} = 0; \end{cases} \quad (1)$$

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Certain solutions of Lamé equations in ....

where

$$\left.\begin{aligned} &\frac{\partial (xu_\theta)}{\partial \xi} - \frac{\partial u_z}{\partial \theta} = xR_c X;\ \frac{\partial u_r}{\partial \theta} - \frac{\partial (xu_\theta)}{\partial x} = xR_c Z; \\ &\frac{\partial u_z}{\partial x} - \frac{\partial u_r}{\partial \xi} = \frac{1}{x}\ Y;\ \frac{1}{x}\ \frac{\partial (xu_r)}{\partial x} + \frac{1}{x}\ \frac{\partial u_\theta}{\partial \Theta} + \frac{\partial u_z}{\partial \xi} = R\Theta \end{aligned}\right\} \quad (2)$$

ν is the Poisson number, $R_c\Theta$ are the volume expansions. The author considers the boundary conditions

1) u_z, $\frac{\partial u_r}{\partial \xi}$, $\frac{\partial u_\theta}{\partial \xi}$ are equal to zero for $\xi = 0$, and simultaneously

2) u_r, u_θ, $\frac{\partial u_z}{\partial \xi}$ differ from zero for $\xi = 0$. (3)

Further, solutions are constructed corresponding to the boundary conditions (3). From system (1) it follows that the solution may be expressed in terms of two functions $\varphi_1 (x, \xi, \theta)$ and $\varphi_2 (x, \xi, \theta)$. If one takes $\theta (x, \xi, \theta) = \varphi_1 (x, \xi, \theta)$, $Z (x, \xi, \theta) = \varphi_2 (x, \xi, \theta)$, then

$$Y (x, \xi, \theta) = \frac{2 (\nu - 1)}{\nu - 2} \times \frac{\partial \varphi^{x_1}}{\partial x} + \frac{\partial \varphi^{x_2}}{\partial \theta};$$

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Certain solutions of Lamé equations in ....

$$X(x, \xi, \theta) = -\frac{2(\nu - 1)}{\nu - 2} \frac{1}{x} \frac{\partial \varphi^{x_1}}{\partial \theta} + \frac{\partial \varphi^{x_2}}{\partial x};$$

where

$$\varphi^{x_1} = \int_0^{\xi} \varphi_1(x, z, \theta)\, dz, \quad \varphi^{x_2} = \int_0^{\xi} \varphi_2(x, z, \theta)\, dz.$$

From system (2) follows that the solution may be expressed in terms of three harmonic functions φ_1, φ_2, φ_3, provided one assumes that $u_z(x, \xi, \theta) = u_z^{(1)}(x, \xi, \theta) + u_z^{(2)}(x, \xi, \theta)$, $u_z^{(1)} = \varphi_3(x, \xi, \theta)$, where $u_z^{(1)}(x, \xi, \theta)$ is the general solution of the homogeneous equation and $u_z^{(2)}(x, \xi, \theta)$ is the particular solution of the equation

$$\Delta u_z(x, \xi, \theta) = -\frac{\nu}{\nu - 2} \frac{\partial \varphi_1}{\partial \xi}.$$

Thus, the solution of the system of Lamé equations is expressed in terms of three harmonic functions and the form of the whole solution depends on the choice of

Card 3/4

Certain solutions of Lamé equations in ....

the harmonic functions. For a problem symmetric with respect to an axis, the solution is expressed in terms of two harmonic functions $\psi_1(x, \zeta)$, and $\psi_2(x, \zeta)$. No solutions of a system of Lamé equations other than for the axially symmetric problem are known. The author cites four possible forms of the functions ψ_1 and ψ_2 and some of their applications.

A.S. Fokht

[Abstracter's note: Complete translation]

Card 4/4

BUNIN, G.G.; LIKHACHEV, V.A.

Some characteristics of the distribution of mineralization in complex metal veins of southern Daghestan. Trudy Geol.inst.Dag. fil. AN SSSR 2:213-227 '60. (MIRA 15:12)
(Daghestan--Ore deposits)

PHASE I BOOK EXPLOITATION SOV/5514

Likhachev, Vitaliy Afanas'yevich

Mnogokanal'noye bystrodeystvuyushcheye registriruyushcheye ustroystvo RUMB-2 (Multichannel High-Speed Recorder RUMB-2) Moscow, Gosenergoizdat, 1961. 61 p. (Series: Biblioteka po avtomatike, vyp. 23) 11,000 copies printed.

Editorial Board: I. V. Antik, S. N. Veshenevskiy, V. S. Kulebakin, A. D. Smirnov, B. S. Sotskov, and N. N. Shumilovskiy; Ed.: N. A. Kuznetsov; Tech. Ed.: N. I. Borunov.

PURPOSE: This booklet is intended for engineers and technicians engaged in automation and telemechanics and also for students of these fields in schools of higher education.

COVERAGE: The booklet gives a brief description of structural and operational principles and an analysis of the basic units of logging and data-reduction systems for centralized industrial control. The description is based on the multichannel high-speed recorder RUMB-2, which, according to the author, is the first

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transistorized recorder developed in the USSR. No personalities are mentioned. There are 12 references: 6 Soviet and 6 English.

TABLE OF CONTENTS:

LIKHACHEV, Vladimir Andreyevich; BOGATOVA, V.S., red.; PANKRATOVA, M.A., tekhn. red.

[Use of pyrotechnics in motion pictures] Pirotekhnika v kino. Izd.2., ispr. i dop. Moskva, Iskusstvo, 1963. 148 p. (MIRA 16:12)

(Motion pictures--Special effects)

Likhachev, V. A.

USSR/Physics · Elastic plate FD-1654

Card 1/1 Pub. 85-16/16

Author : Likhachev, V. A.

Title : Comments on A. I. Kalandiya's article "Bending of an elastic plate in the form of an elliptic ring," ibid., Vol. 17, No 6, 1953

Periodical : Prikl. mat. i mekh., Vol. 19, 255-256, Mar-Apr 1955

Abstract : That author states that, although A. N. Kalandiya's work is an important and needed investigation on the regularness of the infinite systems obtained by him, it contains an incorrect assertion in a footnote. He concludes that the principal equations can be obtained from one and the same equation by way of different combinations of its terms. Reference: M. P. Sheremet'yev, "Elastic equilibrium of an elliptic ring," PMM, Vol. 17, No 1, 1953.

Institution : --

Submitted : November 15, 1954

LIKHACHEV, V.A.; ANDREYEV, I.V.

Changes in the shape of tin subjected to a cyclic thermal treatment. Nauch.tekh.inform.biul.LPI no.12:36-43 '58. (MIRA 13:2)

(Tin--Thermal properties)

LIKHACHEV, V.A.; PETROVA, T.G.; ANDREYEV, I.V.

Irreversible change in the dimensions of cadmium samples subjected to a periodic thermal treatment. Nauch.tekh.inform. biul.LPI no.12:44-55 '58. (MIRA 13:2)
(Cadmium--Thermal properties)

SOV/137-59-12-27231

Translation from: Referativnyy zhurnal, Metallurgiya, 1959, Nr 12, p 212 (USSR)

AUTHORS: Likhachev, V.A., Moskvin, A.I.

TITLE: Changes in the Dimensions of Aluminum Specimens Subjected to Cyclic Temperature Action

PERIODICAL: Nauchno-tekhn. inform. buyl. Leningr. politekhn. in-t, 1958, Nr 12, pp 56 - 69

ABSTRACT: The authors investigated basic regularities of irreversible changes in the dimension and shape of Al (99.7% Al) subjected to a periodic temperature action. The authors investigated the dependence of these changes on the number of thermal cycles, the heating and cooling rate, the temperature range, preliminary plastic deformation, grain size, dimensions and shape of the original specimen. The cyclic temperature action was brought about by transferring the specimen from one temperature zone into another one. The time of transfer was two seconds. It was established that an increased number of cycles caused usually increased deformation of the specimen and that this augmentation was proportional to the number of cycles. A higher cooling rate furthered the increase in the coefficient

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Changes in the Dimensions of Aluminum Specimens Subjected to Cyclic Temperature Action

of growth, equal to one cycle; however, higher heating rate raised the proneness to contraction of the specimen. Raised temperature ranges caused a noticeable increase in the coefficient of grwoth. For annealed and rolled specimens the temperature dependence of the coefficient of growth was different; this was particularly noticeable within the range of temperature drop of 300°C. In preliminary deformation to 50% the coefficient of growth increased 4 times, compared to the initial value (non-deformed specimen). Annealing of the specimen after preliminary cyclic thermal action entailed a considerable rise of the coefficient of growth. Different grain size caused a difference in the coefficient of growth only under conditions of speeded-up heating and slow cooling-off. Generally, deformation of large-diameter specimens was higher if the initial diameter changed during a given number of cycles, although such dependence was rather complicated in a number of cases. During the tests the authors observed intensive dislocation, migration of grain boundaries and sometimes crack formation. The conclusion is drawn that irreversible changes in the shape are due to relaxation of stresses arising during the heating and cooling process. These stresses may develop on account of the temperature gradient along the cross section of the specimen, whose

Changes in the Dimensions of Aluminum Specimens Subjected to Cyclic Temperature Action

surface is at first rapidly heated up (in speeded-up heating) and then tends to expand. Stresses may cause plastic deformations, and since the periphery is heated up more than the center, the specimen may turn out to be plastically compressed. In the case of speeded-up cooling of the heated specimen, the effect of stresses is reversed and the specimen may deform plastically in the direction of the expansion.

Yu.L.

Card 3/3

LIKHACHEV, V. A. Cand Phys-Math Sci -- (diss) "Study of certain cases of irreversible thermal expansion of metals." Len, 1959. 16 pp (Min of Higher and Secondary Specialized Education RSFSR. Len Polytechnic Inst im M. I. Kalinin), 150 copies (KL, 52-59, 116)

24 (2)

AUTHORS: Vasil'yev, D. M., Likhachev, V. A. SOV/32-25-6-38/53

TITLE: X-Ray Ionization System for the Investigation of Deformations of the Structure of Polycrystalline Samples (Rentgenovskaya ionizatsionnaya ustanovka dlya issledovaniya iskazheniy struktury polikristallicheskikh obraztsov)

PERIODICAL: Zavodskaya Laboratoriya, 1959, Vol 25, Nr 6, pp 747-748 (USSR)

ABSTRACT: An ionization system is described which permits operating in the broad range of diffraction angles, up to values of θ near 90°. From the scheme (Fig 1) it may be seen that the X-ray tube BSV-1 with the anode directed to the top, is arranged in such a manner that the X-ray beam runs in horizontal direction. A selective filter absorbs the Kβ-rays. The sample is deformed by means of a lever with a weight. It is possible to heat the sample during the investigation. The diffraction maximum is recorded by means of an electron potentiometer EPPV-51. The radiotechnical part of the system is connected according to the scheme of the system URS-50 I. The X-ray diagram of a deformation of a flat sample of Armco iron is mentioned as example (Fig 2). The diagram of

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the function between the width of the diffraction line β and time - obtained on a sample of electrolyte nickel under constant voltage (σ = 15 and 20 kg/mm^2) - is given as the second example (Fig 3). There are 3 figures.

LIKHACHEV, V.A.

PHASE I BOOK EXPLOITATION SOV/4502

Akademiya nauk SSSR. Nauchnyy sovet po probleme zharoprochnykh splavov

Issledovaniya po zharoprochnym splavam, tom 6 (Investigations of Heat-Resistant Alloys, Vol. 6) Moscow, 1960. 319 p. Errata slip inserted. 3,000 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Institut metallurgii imeni A. A. Baykova. Nauchnyy sovet po probleme zharoprochnykh splavov.

Editorial Board: I. P. Bardin (Deceased) Academician, G. V. Kurdyumov, N. V. Ageyev, Corresponding Member, Academy of Sciences USSR (Resp. Ed.), I. A. Oding, I. M. Pavlov, and I. F. Zudin, Candidate of Technical Sciences; Ed. of Publishing House: V. A. Klimov; Tech. Ed.: S. G. Tikhomirova.

PURPOSE: This book is intended for research workers in the field of physics of metals and for metallurgists, particularly those working on heat-resistant alloys.

COVERAGE: This collection of 45 articles deals with various problems in the production of heat-resistant alloys. Special attention is paid to the mechanisms of deformation of such metals as aluminum, copper, iron, and nickel. Various defects and failures of metals are analyzed, and means for increasing the heat resistance and plasticity are described. Among the special problems discussed are: electrolytic conductivity of iron-aluminum alloys in the solid state; the mobility of atoms in nickel-iron alloys, depending upon defects of their crystalline structure; the kinetics of change in isolated pores; the irreversible thermal transformation of solid bodies, etc. No personalities are mentioned. References follow each article.

AVAILABLE: Library of Congress

2/2

24,7100

S/058/61/000/010/073/100
A001/A101

AUTHORS: Likhachev, V.A., Likhacheva, N.A.

TITLE: On microstructural stresses of thermal anisotropy

PERIODICAL: Referativnyy zhurnal. Fizika, no. 10, 1961, 242, abstract 10E87 ("Nauchno-tekhn. inform..byul. Leningr. politekhn. in-t", 1960, no. 7, 56 - 67)

TEXT: The authors consider thermo-elastic stresses in a polycrystal caused by anisotropic thermal expansion of each crystallite. Thermo-elastic stresses are calculated for a bicrystal hexagonal axes of whose both parts are mutually perpendicular. The magnitude of stresses is estimated for the arbitrary orientation of hexagonal axes relative to the interface. Numerical estimates of thermo-elastic stress values at heating by 1°C are presented for a number of metals. The authors discuss the possibility of appearance of plastic deformation and crack formation.

N. Fastov

[Abstracter's note: Complete translation]

Card 1/1

84593

18.7100 2308,1045 only S/181/60/002/010/015/051
B019/B056

AUTHORS: Davidenkov, N. N., Likhachev, V. A., and Malygin, G. A.

TITLE: The Irreversible Thermal Change in the Shape of Cadmium-lead and Cadmium-zinc Alloys

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 10, pp. 2450 - 2454

TEXT: In the introduction the relaxation of the thermal microstructural stresses due to the anisotropy coefficient of the thermal expansion is shown to be the cause of thermal irreversible structural changes in the case of periodic actions of temperature. Investigations of these structural changes have hitherto been carried out only on technically pure materials. Here, two-phase systems are investigated. Fig. 1 shows the relative change in length as a function of the temperature cycles for seven different cadmium-lead alloys. Fig. 2 shows the grain-growth coefficient as a function of the lead content

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84593

The Irreversible Thermal Change in the Shape of Cadmium-lead and Cadmium-zinc Alloys

S 181/60/002/010/015/051
B019/B056

of cadmium-lead alloys. In Figs. 3 and 4, the analogous results of investigations of the cadmium-zinc alloys are shown. From these results, the authors draw the conclusion that in heterogeneous systems the anisotropy of the thermal expansion must be considered to be the cause of the irreversible expansions of parts due to heat. The grain-growth coefficient is a nonlinear function of composition in consequence of phase interaction. In principle, it is possible to produce alloys, in which the anisotropy of thermal expansion does not lead to changes in the shape of the parts. For this purpose, a control of the treatment of the alloys is necessary. There are 4 figures and 3 Soviet references.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN SSSR Leningrad (Institute of Physics and Technology of the AS USSR, Leningrad)

SUBMITTED: April 4, 1960

Card 2/2

DAVIDENKOV, N.N.; LIKHACHEV, V.A.; MALYGIN, G.A.

Investigating the irreversible thermal shape changing of zinc. Fiz. met. i metalloved. 10 no.3:412-424 S '60. (MIRA 13:10)

1. Fiziko-tekhnicheskiy institut AN SSSR i Leningradskiy politekhnicheskiy institut im. M.I.Kalinina.
(Zinc crystals) (Thermal stresses)

34515
S/659/61/007/000/002/044
D217/D303

18.8200
AUTHORS: Likhachev, V.A., and Likhacheva, N.A.

TITLE: Irreversible dimensional changes due to cyclic temperature effects studied from the point of view of the rheology theory

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Issledovaniya po zharoprochnym splavam, v.7, 1961, 11 - 19

TEXT: The most probable cause of irreversible dimensional changes is the combined action of stresses arising in components for any reason, and of the influence of temperature. Stresses, whose relaxation lead to the above effect, can arise on heating and cooling as a result of (1) anisotropy of the coefficient of thermal expansion; the stresses arising are balanced in the regions commensurate with the grain size or component size; (2) difference in expansion between neighboring phases; (3) temperature gradient along the cross-section of the specimen and (4) different types of phase transformations accompanied by a change in specific volume of the phases.

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Irreversible dimensional changes ... S/659/61/007/000/002/044
D217/D303

In this paper, the authors attempt a mathematical interpretation, from the point of view of the theory of rheology, of the aforementioned theoretically possible causes of the irreversible changes in dimension and shape as the result of periodic temperature variations. There are 4 figures and 22 references: 14 Soviet-bloc and 8 non-Soviet-bloc. The 4 most recent references to the English-language publications read as follows: J.E. Burke and A.M. Turkalo, Trans. Amer. Inst. Mining Met. Engrs. 194, 1952; H.H. Chiswick, Trans. Amer. Soc. Met., 49, 48, 1957; J.E. Burke, and A.M. Turkalo, Trans. Amer. Soc. Met., 50, 1958; R. M. Mayfield, Trans. Amer. Soc. Met., 50, 1958.

Card 2/2

18.8200
24.4200

24926

S/181/61/003/006/023/031
B102/B214

AUTHOR: Likhachev, V. A.

TITLE: Microstructural strains of thermal anisotropy

PERIODICAL: Fizika tverdogo tela, v. 3, no. 6, 1961, 1827 - 1834

TEXT: In heating or cooling polycrystalline systems composed of grains that are an isotropic in regard to thermal expansion, second-type thermal strains appear in these grains. The author attempts to estimate the orders of magnitude of these strains taking into account not only the anisotropy of thermal expansion but also that of the elastic constants. The solutions are given for all the 32 symmetry classes. The author together with I. A. Likhacheva) published earlier partial results relating to crystals of the hexagonal syngonie. In the meantime he has developed a method for calculating the microstructural strains of the thermal anisotropy for crystals of all systems. The exact solution involves very great mathematical difficulties; therefore, only an estimate is made here. The treatment is not done with statistical methods which consider random orientations of the other grains surrounding one. Instead, it is assumed that an anisotropic grain is surrounded by a matrix possessing all the

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properties of the polycrystal (elasticity, thermal expansion). The problem can therefore, be treated by matrix algebra. Hooke's law is formulated in the form $(\sigma) = (C)(\varepsilon)$, or $(\varepsilon) = (S)(\sigma)$, where the strain tensor and the deformation tensor are (6.1) matrices, (C) is a (6.6) matrix built from the elastic coefficients C_{ik}, and (S) is a matrix formed in an analogous manner from the elastic coefficients S_{ik}. The coefficients of linear expansion, α_1, obey the conditions $(\xi_1-1)\alpha_1+(\xi_2-1)\alpha_2+(\xi_3-1)\alpha_3 = 0$, and $\xi_i = (\sum_{k=1}^{3} a_k)/3\alpha_i$ $(i = 1, 2, 3)$. The coefficient a_q of thermal expansion is a (6.1) matrix in which the upper three elements are equal to α_0 and the lower three equal to zero; $\alpha_0 = (\alpha_1+\alpha_2+\alpha_3)/3$. If the grain is in an absolutely hard medium, $(\sigma)_0 = (C)[(\alpha_0)-(\alpha)]\Delta T$, hooks, where ΔT is the change in temperature. On introducing the diagonal matrix (M) of the order (6.6):

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$$(M)=\begin{pmatrix} \frac{1}{1+\frac{1}{2}\frac{A_1}{C_{11}^{(0)}+C_{12}^{(0)}}}, & 0, & \ldots, & 0 \\ 0, & \frac{1}{1+\frac{1}{2}\frac{A_2}{C_{11}^{(0)}-C_{12}^{(0)}}}, & \ldots, & 0 \\ \cdots & \cdots & \cdots & \cdots \\ 0, & 0, & \ldots, & \frac{1}{1+\frac{1}{2}\frac{A_6}{C_{11}^{(0)}-C_{12}^{(0)}}} \end{pmatrix}, \quad (5)$$

where $\bar{A}_i = \sum_{k=1}^{3} C_{ik}$ $(i = 1, 2....6)$, and $C_{11}^{(o)}$ and $C_{12}^{(o)}$ are taken from Hooke's law, one obtains for the desired microstructural strain $(\sigma) = (M)(C)\left[(\alpha_o)-(\alpha)\right]\Delta T$ or, in another form: $(\sigma) = (M)\frac{adj(S)}{det(S)}\left[(\alpha_o)-(\alpha)\right]\Delta T$, where det (S) is the determinant of (S) and adj (S) is the matrix conju-

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gate to (S); $(\bar{M})$ is a diagonal matrix of the same form as (5), where $C_{11}-C_{12}$ is replaced by $1/(C_{11}^{(o)}-C_{12}^{(o)})$, and A_i by $1/\bar{A}_i$ being equal to $\sum_{k=1}^{3} S_{ik}$ ($i = 1, 2....6$). The expressions for $\sigma_{ik}^{(o)}$ are explicitly given for all the 32 symmetry classes. The numerical values of $a_{ik} = \sigma_{ik}/\Delta T$ for some substances are given in Table 2. As is seen, the microstructural strains of thermal anisotropy can reach dangerous values, for example, in zinc. It was assumed in the calculation that the material has no texture. In materials with texture the values are smaller. Finally the maximal values of the microstructural strains of the thermal anisotropy for some polycrystalline substances are given:

α uranium (monoclinic)	α_o = 0.254 kg/mm^2·deg
β uranium (tetragonal)	0.200
selenium (hexagonal)	0.154
zinc (hexagonal)	0.125
cadmium (hexagonal)	0.0645
beryllium (hexagonal)	0.0450
bismuth (rhombohedral)	0.0066
graphite (hexagonal)	0.000666

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There are 3 tables and 5 references: 3 Soviet-bloc and 2 non-Soviet-bloc.

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR
Leningrad (Institute of Physics and Technology imeni
A. F. Ioffe AS USSR, Leningrad)

SUBMITTED: December 1, 1960 (initially) and
January 20, 1961 (after revision)

Table 2

Материал (1)	α_{11}, кг/мм² · град.	α_{33}, кг/мм² · град.
2 Цинк	0.0492	—0.0260
3 Кальцит	0.0350	—0.0304
4 Кадмий	0.0315	—0.0127
5 Олово	0.0148	—0.0265
6 Турмалин	0.0123	—0.0197
7 Кварц	—0.00095	0.00776
8 Сурьма	0.00528	—0.00367
9 Висмут	0.00176	—0.00145
10 Магний	0.000564	—0.00108

Legend to Table 2: 1) material,
2) zinc, 3) calcite, 4) Cd, 5) Sn,
6) tourmaline, 7) quartz, 8) Sb,
9) Bi, 10) Mg. Given in kg/mm^{2}deg.

Card 5/5

LIKHACHEV, V.A.

Equation of state of a real (inhomogeneous) solid. Fiz.tver.tela 3 no.10:3187-3196 O '61. (MIRA 14:10)

1. Fiziko-tekhnicheskiy institut imeni A.F.Ioffe AN SSSR, Leningrad.
(Equation of state)

27559
S/170/61/004/010/014/019
B108/B102

18.8100

AUTHORS: Likhachev, V. A., Moskvin, A. I.

TITLE: Change in density of aluminum due to heat variations

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, v. 4, no. 10, 1961, 111-114

TEXT: The authors studied the thermal fatigue of cylinders of 99.97%-pure copper which were subjected to a cyclic thermal treatment. The specimens were put into a furnace, kept there for about 5.7 min, and then chilled in 10°C water for 2 min. This process was repeated cyclically. After about 1000 cycles over a temperature interval of some 500°C, the thermal stresses led not only to a crinkling of the surface but also to a relative deformation (elongation) of the specimens by 5 - 7%. The relative change in the apparent density of the specimens rised with the number N of cycles according to a parabolic law. The anomalous course of the curve corresponding to cycles over an interval of 400°C could not be explained. The relative change in density was due to thermal fatigue which causes

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28914
S/170/61/004/011/017/020
B108/B138

15.2610

AUTHORS: Likhachev, V. A., Malygin, G. A.

TITLE: Irreversible thermal deformation of bismuth

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, v. 4, no. 11, 1961, 123-124

TEXT: The authors studied the deformation of low-ductility materials as a result of repeated heating and cooling. 6 mm thick and 100 mm long rods of cast bismuth were used as test objects. The experimental procedure has been described in an earlier paper (Likhachev V. A., Andreyev I. V. Nauchno-tekhnicheskiy informatsionnyy byulleten' LPI im. M. I. Kalinina (razdel fiziko-matematicheskikh nauk), no. 12, 1958). The samples were transferred from the low (10°C) to the high temperature region in the space of 2 seconds and were kept there for 4 min. It was found that bismuth undergoes deformations similar to those in high-ductility materials, such as aluminum, cadmium, etc. Slow heating and slow cooling of the samples caused no deformation and showed that this is due to temperature stresses. The latter arise as a result of the low heat conductivity of bismuth. The relative change in size, ε, as a function of the number N of thermal

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S/126/61/012/003/005/021
E021/E180

AUTHORS: Likhachev, V.A., and Malygin, G.A.

TITLE: Change in density of zinc during thermal cycling

PERIODICAL: Fizika metallov i metallovedeniye, v.12, no.3, 1961, 365-371

TEXT: The change in density of several anisotropic metals (cadmium, zinc, tin) and their alloys (cadmium-zinc, cadmium-tin) during cyclic changes of temperature was investigated. The method of periodic heating (Ref.10: V.A. Likhachev, I.V. Andreyev, Nauchno-tekhn. inform. Byuleten' LPI im. M.I. Kalinina (razdel fiz.-mat. nauk), 1958, No.12, 44) enabled the liberation of stresses connected with a temperature gradient across the section. Samples of 6 mm diameter and 100 mm length were prepared. The relative drop in density was measured by differential hydrostatic weighing with an accuracy of 2 x 10^{-3}%. The drop in density is a linear function of the number of thermal cycles; after 3000 cycles the density of zinc decreases by 0.45%, that of cadmium by 0.1%; whereas tin shows no change. This is thought to be due to the anisotropy of the coefficient of thermal expansion. The decrease

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Change in density of zinc during ...

in density also depends on the plastic properties of the material, cadmium and tin being more plastic than zinc. Further experiments were carried out on zinc to study the effect of other parameters such as temperature interval and texture of material. It was shown that with a temperature interval of 50°C a change in density was not detected; with 100°C there was a small change, and with wider temperature intervals there was a much greater effect. After 1000 cycles, density changes were 0.26 and 0.005% at intervals of 200 and 100 °C, respectively. Tests on specimens oriented to various degrees showed that variation in texture had little effect on density change. The density of pure metals usually changes linearly with the number of cycles; this is not so for alloys. Figs. 6 and 7 show the relative change in density of Cd-Zn and Cd-Sn eutectic alloys against the number of cycles; the density falls very quickly at first and then reaches a constant value, at least in the Cd-Sn alloy. The method of observing changes in density of materials enables a better understanding of thermal fatigue. The role of various parameters can be determined.
There are 7 figures, 1 table and 11 references: 10 Soviet-bloc and 1 English. The English language reference reads as follows:

Change in density of zinc during ... S/126/61/012/003/005/021
E021/E180

Ref.7: W. Boas, R. Honeycomb. Nature, 1944, No.153-154;
Proc. Roy. Soc., 1946, A186; Proc. Roy. Soc., 1947, A188;
J. Inst. Metals, 1946, 73.

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

SUBMITTED: January 24, 1961

Card 3/4 3

10.6400
18.8100

31051
S/126/61/012/004/007/021
E193/E383

AUTHORS: Davidenkov, N.N., Likhachev, V.A. and Ivanov, V.G.

TITLE: The effect of the size factor on irreversible changes of shape due to thermal cycling

PERIODICAL: Fizika metallov i metallovedeniye, v. 12, no. 4, 1961, 541 - 549

TEXT: Metal components subjected to thermal cycling may irreversibly change their shape and/or dimensions. When these changes are caused by relaxation of internal stresses of the first type, i.e. those set up as a result of a temperature gradient in the component, their magnitude and sign should be affected by its dimension. Published data on the effect of this factor (Ref. 4 - authors - Nauchno-tekhnicheskiy informatsionnyy byulleten' (razdel fiziko-matematicheskikh nauk), Leningrad politekhn. in-t, 1958, no. 12, 56; Ref. 5 - G.P. Lazarev - Izv. AN SSSR, OTN, Metallurgiya i toplivo, no. 5, 1959, 57) are contradictory and since this problem is of both theoretical and practical importance, the investigation described in the present paper was undertaken. The experiments were conducted on

Card 1/8 5

cylindrical specimens of aluminium (99.97%), α-brass (30% Zn) and β-brass (47% Zn) with a length/diameter ratio not less than 6. The thermal cycling consisted of holding a test piece in a nitrate bath for at least two minutes and transferring it in two seconds to cold water (10 °C). All the test pieces were annealed prior to thermal cycling. The dimensional changes were determined by measuring the variation of the distance between two reference lines inscribed circumferentially on the cylindrical wall, well away from the flat faces of the specimens. In the first series of experiments a pure sodium nitrate bath was used; owing to the high melting point of this salt, it formed a solid crust on the immersed test pieces, whereby the rate of heat transfer was slowed down and steep temperature gradients were avoided. The results are reproduced in Fig. 1, where the, so-called, "growth coefficient" ($\gamma \times 10^{-5}$/cycle) of α-brass is plotted against the diameter (mm) of the test pieces, thermally cycled through a temperature interval of ΔT = 500 °C,

the results obtained for β-brass being reproduced in a similar manner in Fig. 2. The results for aluminium are reproduced in Fig. 3, where $\gamma = 10^{-5}$/cycle is plotted against the specimen diameter (mm), Curves 1-4 relating to specimens (1) heated in pure sodium nitrate ($\Delta T = 300\ ^{o}C$), (2) heated in pure sodium nitrate ($\Delta T = 420\ ^{o}C$), (3) heated in a nitrate eutectic ($\Delta T = 420\ ^{o}C$) and (4) heated in a nitrate eutectic ($\Delta T = 490\ ^{o}C$). The different behaviour of aluminium specimens of the same diameter but tested under different conditions (higher or lower heating and cooling grades) confirmed the findings of Likhachev and Moskvin (Ref. 4) that aluminium cylinders increased in length when slow heating was followed by rapid cooling and contracted when heated rapidly and cooled slowly. At high heating and cooling rates, the final result will be a combined effect of expansion and contraction, as a result of which minima and maxima can appear on the γ versus test-piece diameter curves. Other material may be subject to the same effect and to elucidate this point the present authors analyse this problem in terms of, so-called, "criteria of transition to plastic state". They conclude that when the

relaxation time and/or the yield strength of a metal are markedly affected by temperature variation, thermal cycling should bring about a decrease in the largest dimension of a specimen, irrespective of the relationship between the cooling and heating rates; when these two properties vary little with temperature, a metal specimen will increase its length after slow heating and rapid colling and contract when rapidly heated and then slowly cooled. The effect of shape on the phenomenon studied was determined in the final series of experiments. To this end aluminium specimens of equal cross-sectional area ($1.56\ cm^2$) but of a different shape and length were subjected to thermal cycling through $\Delta T = 370\ ^{\circ}C$. The results are reproduced in Fig. 7, where $\gamma \times 10^{-5}$/cycle is plotted against the specific volume/surface (V/S) ratio, the various experimental points relating to the following shapes: 1 - cylinder, D = 14.1 mm; 2 - hexagonal, D = 13.5 mm; 3 - square, a = 12.5 mm; 4 - rectangle, a = 8.0 mm and $\mathcal{G}$ = 19.5 mm; 5 - rectangle, a = 5.0 mm and $\mathcal{E}$ = 31.5 mm.

Card 4/6 5

The effect of the size factor ....

In every case, the test piece increased in length and, contrary to the findings of A.A. Zuykova (Ref. 6 - Izv. AN SSSR, OTN, 1958, no. 10, 92), γ was practically independent of the number of thermal cycles. The increase was most pronounced in thin specimens of rectangular cross-section and least marked in cylindrical specimens.
There are 7 figures and 8 Soviet-bloc references.

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

SUBMITTED: January 25, 1961

Fig. 1:

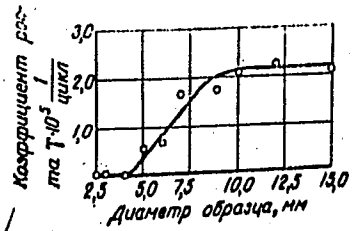
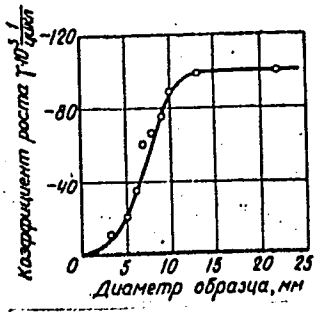


Fig. 2:



Figs. 1, 2, and 3 attached hereto.

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LIKHACHEV, V.A.

Methods of investigating irreversible thermal deformation (survey). Zav.lab. 27 no.7:867-876 '61. (MIRA 14:7)
(Deformations (Mechanics))

LIKHACHEV, V.A.; MALYGIN, G.A.

Irreversible thermal deformation of bismuth. Inzh.-fiz.zhur. 4 no.11:123-124 N '61. (MIRA 14:10)

1. Fiziko-tekhnicheskiy institut, g. Leningrad.
(Deformations (Mechanics)) (Bismuth--Thermal properties)

LIKHACHEV, V.A.

Thermal stresses in textured materials. Fiz. met. i metalloved. 12 no.6:792-794 D '61. (MIRA 16:11)

1. Fiziko-tekhnicheskiy institut AN SSSR.

LIKHACHEV, V. A.

PHASE I BOOK EXPLOITATION SOV/6158

Seminar "Sovremennyye voprosy fizicheskogo metallovedeniya," Leningrad, 1961.

Sovremennyye voprosy fizicheskogo metallovedeniya; materialy seminara, provedennogo v Leningradskom Dome nauchno-tekhnicheskoy propagandy 9 - 11 maya 1961 g. (Present Problems in Physical Metallurgy; Materials of the Seminar Held in Leningrad House of Scientific and Technical Propaganda, 9 - 11 May 1961). Leningrad, 1962, 60 p. (Series: Leningradskiy Dom nauchno-tekhnicheskoy propagandy. Sektsiya metallovedeniya i termoobrabotki. Seriya: Metallovedeniye i termicheskaya obrabotka) 4500 copies printed.

Sponsoring Agency: Obshchestvo po rasprostraneniyu politicheskikh i nauchnykh znaniy RSFSR, and NTO Mashprom Leningradskoye oblastnoye pravleniye. Leningradskiy Dom nauchno-tekhnicheskoy propagandy. Sektsiya metallovedeniya i termoobrabotki. Ed.: N. F. Vyaznikov, Engineer, Candidate of Technical Sciences; Ed. of Publishing House: D. P. Freger; Tech. Ed.: V. A. Bol'shakov.

Card 1/3

PURPOSE: This booklet is intended for scientists and engineers interested in physical metallurgy.

COVERAGE: This booklet contains five of the fourteen reports presented at the seminar on "Present Problems of Physical Metallurgy," held in the Leningrad House of Scientific and Technical Propaganda on May 9-11th, 1961. The program of the seminar was worked out by the Organizational Committee under the supervision of Academician N. N. Davidenkov. The reports review a number of new trends in the development of physical metallurgy. No personalities are mentioned. Each report is accompanied by references, mostly Soviet.

TABLE OF CONTENTS:

AVAILABLE: Library of Congress

SUBJECT: Metals and Metallurgy

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2/7/63

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S/659/62/009/000/017/030
I003/I203

AUTHORS: Davidenkov, N. N., Likhachev, V. A., Malygin, G. A and Ch'en Ch'ing -Kuei

TITLE: Irreversible thermal deformations in cadmium-zinc alloys

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Issledovaniya po zharoprochnym splavam v. 9. 1962. Materially Nauchnoy sessii po zharoprochnym splavam (1961 g.). 126–133

TEXT: The basic regularities are investigated in the sum of the irreversible dimensional changes that take place in binary alloys during cyclic variations of temperature when both phases are thermally anisotropic and have identical crystal lattices. Cylindrical samples 6 mm in diameter and 100 mm long, annealed for 1 hour at 170°C, were used. The thermal cycles were created either by heating the samples in hot transformer oil and then cooling them in cold oil (10°C), or by cooling them in liquid nitrogen and then bringing them back in the air to room temperature. The conclusion drawn is that the thermal deformations taking place in binary alloys differ from those occuring in pure metals, and that for binary alloys they cannot be predicted from the values of the termal deformation of the component phases. The most characteristic feature of binary alloys is the high resistance of eutectic compositions to the thermal deformation at low and medium temperatures. On the other hand some alloys have a much greater tendency to thermal deformation than the pure metals composing this alloy. In the discussion, I. Ya. Dekhtyar suggested that the thermal deformation must be chiefly due to dislocations in the crystal lattice, and that the samples for carrying out investigations on thermal deformations should be 0.1–0.3 mm. thick. There are 5 figures

Card 1/1

DAVIDENKOV, Nikolay Nikolayevich; LIKHACHEV, Vladimir Aleksandrovich; DENINA, I.A., red. izd-va; PETERSON, M.M., tekhn. red.

[Irreversible deformations in metals under the effect of cyclic thermal stress]Neobratimoe formoizmenenie metallov pri tsiklicheskom teplovom vozdeistvii. Moskva, Mashgiz, 1962. 221 p. (MIRA 15:9)

(Deformations (Mechanics))
(Metals, Effect of temperature on)

S/139/62/000/003/015/021
E111/E135

AUTHORS: Likhachev, V.A., Malygin, G.A., and Chen' Ch'ing-Kuei

TITLE: Irreversible thermal changes of shape of cadmium-tin alloys

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Fizika, no.3, 1962, 127-132

TEXT: Causes of irreversible changes in dimensions produced on heating some alloys, particularly Cd-Sn, are discussed. The authors studied the growth coefficient for various temperature cycles. The experimental results previously published show that the dimensional changes in two-phase alloys prepared from metals with non-cubic lattices of different types differ substantially from those of pure metals; consequently it is impossible to forecast the change for an alloy from knowledge of the changes for each component. A specially noteworthy characteristic of two-phase alloys is the high resistance of eutectic compositions to the irreversible changes when temperature cycles are carried out at low and medium temperatures. Some alloys, however, have a tendency to irreversible dimensional changes which is greater

than for pure metals. At low temperatures these compositions lie between eutectic and pure metal; at higher temperatures at about equal composition. Evidently, when the maximum cycle temperature is raised, internal-stress removal in multi-phase alloys by the ordinary mechanism characteristic for pure metals begins to be supplemented by a mechanism associated with the heterogeneity of the system and phase interaction; it is the simultaneous action of the two that causes the experimentally observed peculiarities in the change of the growth coefficient with composition when the parameters of the thermal cycling are changed. These conclusions do not apply to the irreversible dimensional changes due to ordinary microscopic temperature stresses caused by non-uniform temperature distribution through the specimen.
There are 6 figures and 1 table.
ASSOCIATION: Leningradskiy fiziko-tekhnicheskiy institut AN SSSR imeni A.F. Ioffe (Leningrad Physicotechnical Institute AS USSR imeni A.F. Ioffe)
SUBMITTED: January 25, 1961

LIKHACHEV, V.A.; ASSUR, K.P.

Deformation of two-phase alloys. Fiz. met. i metalloved. 16 no.1: 97-101 Jl '63. (MIRA 16:9)

1. Leningradskiy fiziko-tekhnicheskiy institut imeni A.F. Ioffe AN SSSR.

(Nonferrous alloys—Metallography)
(Deformations (Mechanics))

LIKHACHEV, V.A.; MALYGIN, G.A.

Temperature effect on metals. Fiz. met. i metalloved. 16 no.3: 435-443 S '63. (MIRA 16:11)

1. Fiziko-tekhnicheskiy institut AN SSSR imeni A.F.Ioffe.

LIKHACHEV, V.A.; MALYGIN, G.A.

Temperature aftereffect in zinc. Fiz. met. i metalloved. 16 no.5: 686-692 N '63. (MIRA 17:2)

1. Fiziko-tekhnicheskiy institut im. A.F.Ioffe AN SSSR.

LIKHACHEV, V.A.; MALYGIN, G.A.; NIKIFOROV, A.V.; VLADIMIROVA, G.V.

Creep of zinc during heating-cooling cycles. Fiz. met. i metalloved. 16 no.6:908-917 D '63. (MIRA 17:2)

1. Fiziko-tekhnicheskiy institut imeni A.F.Ioffe AN SSSR.

LIKHACHEV, V.A.; VLADIMIROV, V.I.

Vacancy mechanisms of a temperature aftereffect. Fiz. met. i metalloved. 17 no.5:655-663 My '64. (MIRA 17:9)

1. Fiziko-tekhnicheskoy institut imeni Ioffe AN SSSR.

LIKHACHEV, V.A. [Likhachov, V.O.]

Torsion of a circular cylinder soldered to a rigid shaft.
Visnyk L'viv. un. Ser. mekh.-mat. no.1:57-60 '65.
(MIRA 18:12)

L 53787-65 EWT(d)/EWT(m)/EWP(w)/EWA(d)/EWP(v)/EPR/T/EWP(t)/EWP(k)/EWP(b)/
EWA(c) Pf-4 JD/HM/EM
ACCESSION NR: AP5014830 UR/0198/65/001/005/0129/0131

33
32
B

AUTHOR: Likhachev, V. A. (L'vov)

TITLE: Some formulae for calculating plates with soldered cylinders

SOURCE: Prikladnaya mekhanika, v. 1, no. 5, 1965, 129-131

TOPIC TAGS: elasticity theory, tensile stress, stress load, plate deflection

ABSTRACT: Approximate formulae are given to calculate the stress distribution in a thin plate with a hole reinforced with an elastic cylinder. At infinity the plate is assumed to be under a uniform tensile stress

$$X_x^{(\infty)} = P; \quad Y_y^{(\infty)} = P,$$

and at the contact zone between the cylinder and the plate

$$\sigma_r = \sigma_{r_0}, \quad \tau_{r\theta} = \tau_{r\theta_0} \quad \text{при } -h < z < h;$$
$$u_\rho = u_{r_0} \quad \text{при } z = 0.$$

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L 53787-65

ACCESSION NR: AP5014830

Two formulae are given describing the maximum stress $\sigma_{r_0}^{max}$ as a function of cylinder thickness d and plate thickness 2b with a Poisson ratio of $3 < m < 4$. Working graphs are prepared from these formulae to aid in the selection of optimum reinforcement parameters for the plate. Orig. art. has: 5 formulas and 2 figures.

ASSOCIATION: L'vovskiy gosudarstvennyy universitet (L'vov State University)

SUBMITTED: 10Dec64 ENCL: 00 SUB CODE: AS

NO REF SOV: 002 OTHER: 000

Card 2/2

L 30121-65 EWT(m)/EWP(w)/EWA(d)/T/EWP(t)/EWP(b) JD/JW

ACCESSION NR: AP5004260 S/0126/65/019/001/0003/0013

34
33
B

AUTHOR: Likhachev, V. A.; Vladimirov, V. I.

TITLE: The role of toughening in creep and the temperature aftereffect

SOURCE: Fizika metallov i metallovedeniye, v. 19, no. 1, 1965, 3-13

TOPIC TAGS: creep, strain hardening, weakening, temperature aftereffect, activation energy, plastic deformation, yield stress, steady creep, temperature cycle

ABSTRACT: This study deals with the kinetics of the creep process, taking strain hardening and weakening into account. A closed system of equations has made it possible to define the laws governing both the speed of creep and the temperature aftereffect. The activation energy of the creep, as measured by Dorn, is highly complicated from a physical point of view. The experimental discovery of its dependence on temperature does not necessarily indicate (despite Dorn's opinion) that different mechanisms of activation energy participate in the creep process. The role of various factors (stress, duration of the cycle, temperature changing intervals, etc.) in the magnitude of the temperature aftereffect has been ascertained. The activation energy of the creep process may not be characterized by a

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L 30121-65

ACCESSION NR: AP5004260

conventional physical aspect. The magnitude of that energy depends on the method by which it is determined. The well-known Dorn method is not superior to the ordinary method; in a number of cases, it makes the definition of the physical content of the activation energy even more difficult. Orig. art. has: 32 formulas.

ASSOCIATION: Fiziko-tekhnicheskiy institut imeni A. F. Ioffe (Physics and Engineering Institute)

SUBMITTED: 21Apr64 ENCL: 00 SUB CODE: MM

NO REF SOV: 005 OTHER: 005

Card 2/2

L 56074-65 EWT(m)/EWP(w)/EPF(n)-2/EWA(d)/EPR/T/EWP(t)/EWP(b)/EWA(c) Pu-4
IJP(c) JD/WW/JG/EM

ACCESSION NR: AP5013811 UR/0126/65/019/005/0726/0734
546.48 : 539.376 + 536.389.3

AUTHOR: Likhachev, V. A. ; Malygin, G. A.

TITLE: Temperature aftereffect in cadmium

SOURCE: Fizika metallov i metallovedeniye, v. 19, no. 5, 1965, 726-734

TOPIC TAGS: polycrystalline cadmium, temperature aftereffect, creep curve, thermal stress, shear stress, torsion angle, unsteady state, stress relaxation

ABSTRACT: In polycrystals with noncubic spatial lattice and in multiphase materials the temperature aftereffect may, as is known, arise owing to the relaxation of thermal stresses of the second kind. This mechanism of aftereffect has already been the subject of several studies, concerned mainly with polycrystalline uranium. But this effect must be inherent in a larger group of materials. Therefore, the authors investigated it with respect to 99.97% pure polycrystalline cadmium. Specimens of this cadmium were machined from forged rods (reduced approx. 80% in area) and annealed at 100°C for an hour. The grain size averaged 0.025 mm. The techniques of determining the temperature aftereffect were taken from a previous study by the authors (V. A. Likhachev

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L 56074-65

ACCESSION NR: AP5013811

and G. A. Malygin, Fizika metallov i metallovedeniye, 1963, 16, 5, 686). The aftereffect was determined according to the angle of torsion of a tubular specimen (with inside diameter of 2 r and outside diameter of 2 R (5.5 and 9 mm, respectively) and working length $l = 60$ mm) through which water was passed at specified temperatures. The upper temperature of the cycle was 86°C, and the lower, 13°C. The rate of variation in temperature was such that no large temperature gradients appeared (heating and cooling within 1-2 min).

The mean shear stress τ was determined from the formula $\tau = \frac{M}{I} \frac{r+R}{2}$ where M is the torque and I is the moment of inertia; the mean shear ϵ (aftereffect) was calculated as $\epsilon = \frac{r+R}{2} \varphi$, where φ is the angle of torsion per unit length. Contrary to theoretical calculations, the experimentally plotted curves of the creep of cadmium at constant and variable temperatures proved to be much lower; examination of experimental curve 3 in Fig. 1 reveals that the cause of this discrepancy lies in the failure to consider the reproduction of unsteady state at every variation in temperature, i.e., in the occurrence of the temperature aftereffect, which arises both at heating and at cooling. Further, it is shown that aftereffect and creep

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ACCESSION NR: AP5013811

acceleration are highly dependent on external stress (torque) applied and feebly dependent on grain size and texture. The experimental findings are in satisfactory agreement with Davidenkov's and Likhachev's (Neobratimoye formoizmeneniye metallov pri tsiklicheskom teplovom vozdeystii [Irreversible deformation of metals exposed to heat cycles], Leningrad, Mashgiz, 1962) theory of the aftereffect as a means of relaxation of the temperature stresses associated with the anisotropy of thermal expansion. Orig. art. has: 8 figures, 1 table, 6 formulas.

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR (Physico-technical Institute, AN SSSR)

SUBMITTED: 16Apr64 ENCL: 01 SUB CODE: MM, TD

NO REF SOV: 006 OTHER: 002

Card 3/4

L 55074-65

ACCESSION NR: AP5013811

ENCLOSURE 01

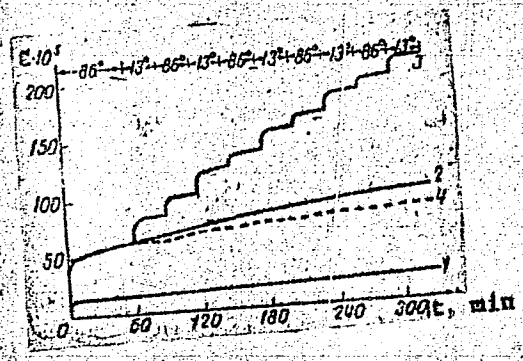

Fig. 1. Creep curves of cadmium at constant and variable temperatures (τ = 0.125 kg/mm^2):

1 - T = 13°C; 2 - T = 86°C; 3- fluctuations from 13 to 86°C; 4 - theoretical creep curve in the absence of aftereffect

Card 4/4

L 32634-66 FBD/EWT(l)/EWP(e)/EWT(m)/EEC(k)-2/T/EWP(k) IJP(c) WG/WH

ACC NR: AP6018797 SOURCE CODE: UR/0056/66/050/005/1187/1201

AUTHOR: Ashkinadze, B. M.; Vladimirov, V. I.; Likhachev, V. A.; Ryvkin, S. M.; Salmanov, V. M.; Yaroshetskiy, I. D.

ORG: Physicotechnical Institute im. A. F. Ioffe, Academy of Sciences SSSR (Fiziko-tekhnicheskiy institut Akademii nauk SSSR)

TITLE: Breakdown of transparent dielectrics by intense laser radiation

SOURCE: Zh eksper i teor fiz, v. 50, no. 5, 1966, 1187-1201

TOPIC TAGS: dielectric breakdown, laser effect, laser radiation, phonon interaction

ABSTRACT: The transparent dielectrics investigated were alkali-halide single crystals (LiF, NaCl, CsI, KBr, KI, and others), polymers (polymethyl methacrylate and polystyrene), and glasses (K3 silicate glass and fused quartz). Ruby and neodymium lasers generating 1.79 and 1.17 ev photons, respectively, were used at first, but when it was found that the breakdown was qualitatively the same for polarized (ruby) and unpolarized (neodymium) radiation, only the latter was used, since it could operate in both the ordinary (20 J) and giant-pulse (2 J) modes. The diagram of the experiment is given in Fig. 1. The samples were parallelepipeds with polished faces of varying lengths and cross sections. The character of the breakdown was examined under a microscope and its size measured with a horizontal comparator. The laser-induced breakdown begins in locations exposed to high light-flux intensity and spreads to lower-intensity regions. In the case of focused beams, no destruction occurs behind the focal point. The breakdown occurs in very short time intervals, shorter than

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L 32634-66

ACC NR: AP6018797

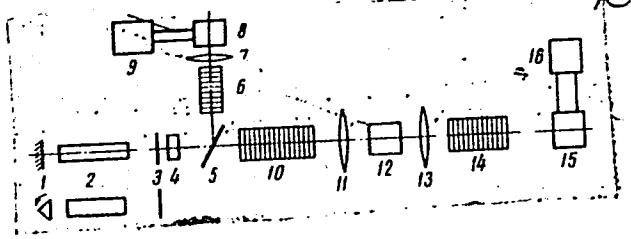

Fig. 1. Diagram of experiment. 1 - Totally reflecting mirror or rotating prism, 2 - ruby or neodymium rod, 3 - partially reflecting mirror or plane-parallel plate, 4 - light filter, 5 - plane parallel-plate, 6,10,14 - neutral filters, 12 - tested sample, 7,11,13 - lenses, 8,15 -photodiodes, 9,16 - oscilloscopes.

the length of the light pulse, and develops independently at various points of the solid. Estimates of stresses caused by the hypersonic wave due to the laser beam indicate that local effects play a substantial role in the breakdown process. In the case of an ordinary laser pulse, the breakdown mechanism is governed by the peak power, whereas in the case of a giant pulse the decisive factor is the total energy. The cause of the breakdown is shown to be connected with the action of coherent acoustic phonons generated in the course of a stimulated Brillouin scattering, thermal effects being secondary. Study of the breakdown makes possible comparison of volume and surface strengths of the material and can be used to evaluate the time of phonon coherence loss, which is found to be of the order of 6 μsec for polymethyl methacrylate. The authors thank B. P. Konstantinov for continuous interest and valuable discussions, and A. M. Prokhorov, P. P. Pashinin, A. V. Prokhindeyev, I. N. Filimonova, G. V. Vladimirova, G. M. Malyshev, F. F. Vitman, V. P. Pukh, and G. A. Malygin for help with the experiments and for discussions. Orig. art. has: 10 figures and 11 formulas. [02] 18/

Card 2/2 SUB CODE: 20/ SUBM DATE: 30Nov56/ ORIG REF: 004/ OTH REF: 004/ ATD PRESS: 3024

L 43025-66 EWD/EWT(l)/EWP(e)/EWT(m)/EEC(k)-2/EWP(j)/T/EWP(t)/ETI/EWP(k)
ACC NR: AP6030009 IJP(c) WG/JD/WW/JW/ SOURCE CODE: UR/0020/66/169/005/1041/1043
JG/RM/WH

77
76
B

AUTHOR: Ashkinadze, B. M.; Vladimirov, V. I.; Likhachev, V. A.; Ryvkin, S. M.; Salmanov, V. M.; Yaroshetskiy, I. D.; Konstantinov, B. P. (Academician)

ORG: Physicotechnical Institute im. I. F. Ioffe, Academy of Sciences SSSR (Fiziko-tekhnicheskiy institut Akademii nauk SSSR)

TITLE: Laser induced damage in transparent dielectrics

SOURCE: AN SSSR. Doklady, v. 169, no. 5, 1966, 1041-1043

TOPIC TAGS: laser ~~induced damage, material damage,~~ glass, dielectric, alkali halide, crystal

ABSTRACT: Damage induced by standard and giant-pulse lasers in a broad class of materials (alkali halide single crystals, polymers, glasses) was investigated experimentally. Plane cracks were observed in poly(methyl methacrylate) (PMMK) under standard-pulse radiation at a 45° angle with respect to the laser beam axis and at random with respect to the crack rotation plane around the same axis. A large number of isolated cracks was observed at superthreshold energies. A 20-j beam focused at f = 6 cm caused tail-end damage in glasses. The same pulse caused total destruction along the cleavage planes in alkali-halide crystals at energies slightly above threshold. In each instance, damage was observed when a giant-pulse beam was focused on the inside of specimens. In single crystals the damage occurred along

Card 1/2 UDC: 535.89:537.226.004.74

L 13025-66

ACC NR: AP6030009

all three cleavage planes; in the case of PMMK it had the form of an extended cone consisting of small individual cracks (of the order of 0.1—0.5 mm); in glasses, filiform damage appeared sharply with the thickening at the focus.
To explain the damage mechanism and kinetics, the effects of pulse energy, focus position, temperature, and the focal length on the nature and extent of the damaged region were investigated. The experimental data indicate a strong dependence of the nature and extent of damage on the test material and the operating (peak or total energy) conditions. The damage in each spot occurred independently and was caused by beams of a small critical density. The most probable damage mechanism is thought to be the coherent hypersonic phonons generated as the result of stimulated Brillouin scattering. The thermal explosion accompanying damage due to hypersonic phonons in the case of strong optical absorption is suggested as a secondary mechanism. The experiments showed that the thermal explosion occurred basically near the focus and that its role varied with materials and energy density. Crack formation occurred during a period not exceeding the pulse duration (for a giant pulse laser 10^{-9} sec), the damage taking place first at the focus and traveling backwards. Damage induced by powerful laser beams can be used as a method of comparing the bulk and surface strength of a material. Orig. art. has: 2 figures and 1 formula. [YK]

SUB CODE: 20/ SUBM DATE: 24NOV65/ ORIG REF: 002/ OTH REF: 002/ ATD PRESS: 5065

Card 2/2

ACC NR: AP7005127 SOURCE CODE: UR/0126/66/022/004/0514/0519

AUTHOR: Likhachev, V. A.

ORG: Physicotechnical Institute im. A. F. Ioffe, AN SSSR [Fiziko-tekhnicheskiy institut AN SSSR)

TITLE: Mechanical equation of state

SOURCE: Fizika metallov i metallovedeniye, v. 22, no. 4, 1966, 514-519

TOPIC TAGS: equation of state, creep, tensile test, rheologic property, plasticity, ~~aftereffect, relaxation~~ STRESS RELAXATION

ABSTRACT:
Numerous attempts have been made to develop a universal equation of state for inelastic materials in tension and compression tests. However, temperature effects have not been sufficiently accounted for, and the physical interpretation of numerical constants has not always been clear. The mathematical formulation of the authors takes into account the available wealth of experimental facts. It involves an auxiliary physical parameter σ_0 which has the nature of "counterstress" or "internal yield point", and consists of a system of two linear differential equations for $\dot{\varepsilon}$, σ, σ_0, T and the derivatives of these functions with respect to time. At constant temperature, this system reduces to Zener's equation [Zener, C.M.,

UDC: 539.3 + 536.01

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ACC NR: AP7005127

Elasticity and Inelasticity of Metals, Chicago, 1948, p. 43]. Numerical constants for the general case are the relaxation time at constant stress τ_σ, the relaxational expansion coefficient λ_r, the relaxational and non-relaxational moduli E_r, E_n, an activation parameter Q, and a sixth constant n representing a typical increase of strain rate with stress. The proposed formulation includes heterogeneity effects and applies in particular to transient phenomena accompanying discontinuous variations of temperature and strain rate. Orig. art. has: 17 formulas. [WA-72]

SUB CODE: 20/ SUBM DATE:

Card 2/2

ACC NR: AP7005849 SOURCE CODE: UR/0181/66/008/012/3595/3601

AUTHOR: Volkova, N. V.; Likhachev, V. A.; Salmanov, V. M.; Yaroshetskiy, I. D.

ORG: Physicotechnical Institute im. A. F. Ioffe, AN SSSR, Leningrad (Fiziko-tekhnicheskiy institut AN SSSR)

TITLE: Kinetics of formation and healing of damage produced in lithium-fluoride single crystals by a laser beam

SOURCE: Fizika tverdogo tela, v. 8, no. 12, 1966, 3595-3601

TOPIC TAGS: laser effect, semiconductor laser, semiconductor single crystal, crystal lattice dislocation, ~~cracking~~ CRACK PROPAGATION

ABSTRACT: This is a continuation of earlier work (ZhETF v. 50, 1187, 1966 and elsewhere), where it was shown that a laser beam produces cracks in alkali-halide crystals although no detailed description was given of the nature of the cracks). To determine this structure and to explain the mechanism whereby the damage is initiated, the authors investigated LiF single crystals measuring 20 x 20 x 20 mm cleaved along the cleavage planes. A neodymium laser operating in the spiked mode was used. The beam focusing procedure was the same as in the earlier work, the damage was examined under a microscope, and the dislocation structure was revealed by selective etching. Besides confirming the earlier results, the present tests demonstrated that the damage produced by the laser pulse consists of a main crack in the cleavage plane (001) normal to the beam, and dislocation slip along directions forming a rosette-like

Card 1/2 UDC: none

ACC NR: AP7005849

pattern, the occurrence of which can be interpreted by assuming a suitable combination of thermal and elastic stresses produced in the crystal by the passage of the laser beam and hypersonic oscillations accompanying it. Annealing the crystal after the damage, either in air or in the oven, led to healing of the cracks characterized by a unique structure of the front of the annealed rosette. While the causes of this healing are not clear, they definitely can be ascribed to transport of matter via the gas phase, as proposed in a number of papers. The authors thank S. M. Ryvkin for continuing interest and a discussion of the results. Orig. art. has: 5 figures.[02]

SUB CODE: 20/ SUBM DATE: 27May66/ ORIG REF: 007/ OTH REF: 003 /
ATD PRESS: 5117

Card 2/2

L 45783-66 EWT(l)/EWT(m)/EEC(k)-2/EWP(k)/T/EWP(t)/ETI IJP(c) WG/JD/JW/JG

ACC NR: AP6030966 SOURCE CODE: UR/0181/66/008/009/2668/2671

AUTHOR: Volkova, N. V.; Likhachev, V. A.; Ryvkin, B. M.; Salmanov, V. M.; Yaroshetskiy, I. D.

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B

ORG: Physicotechnical Institute im. A. F. Ioffe AN SSSR, Leningrad (Fiziko-tekhnicheskiy institut AN SSSR)

TITLE: Destruction of LiF single crystals by laser radiation 25

SOURCE: Fizika tverdogo tela, v. 8, no. 9, 1966, 2668-2671

TOPIC TAGS: lithium fluoride, laser radiation, laser effect, crystal defect, crystal dislocation phenomenon, laser r and d

ABSTRACT: This is a continuation of earlier studies of damage to transparent dielectrics by laser radiation (ZhETF v. 50, 1187, 1966), where principal attention was paid to amorphous substances. The present article deals with the effect of the energy contained in the laser pulse on the general evolution of damage to single-crystal LiF and describes the dislocation structure in the cleavage surfaces. The experimental procedure is similar to that described in the earlier paper. A pulsed neodymium glass laser was used, with the light beam directed always along the (001) crystal axis. Damage occurred at pulsed energy density exceeding 100 J/cm^2, corresponding to $\sim 0.2 \times 10^6$ W/cm^2. At this threshold value, damage usually started

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L 45783-66

ACC NR: AP6030966

with a single crack in the (001) plane, perpendicular to the beam direction. With increasing energy, additional cracks appeared and their character and pattern varied with the energy. The evolution of the damage is explained from the point of view of the existence of a hypersonic damage mechanism, wherein the crack is produced first by a hypersonic wave, and absorption of heat in the crack leads to further disintegration. The peculiar dislocation pattern observed on the cleavage surface (concentric circles or ellipses) is attributed to the intermittent character of propagation of the crack front, due in turn to spiking. Orig. art. has: 3 figures. [02]

SUB CODE: 20/ SUBM DATE: 31Jan66/ ORIG REF: 003/ OTH REF: 001/ ATD PRESS: 5085

Card 2/2 pb

L 45779-66 EEC(k)-2/EWP(j)/EWP(k)/EWT(l)/EWT(m)/T/EWP(c) IJP(c) RM/WH/WG/WW
ACC NR: AP6030971 SOURCE CODE: UR/0181/66/008/009/2735/2737

68
67
B

AUTHOR: Ashkinadze, B. M.; Likhachev, V. A.; Ryvkin, S. M.; Salmanov, V. M.; Tomashevskiy, E. Ye.; Yaroshetskiy, I. D.

ORG: Physicotechnical Institute im. A. F. Ioffe AN SSSR, Leningrad (Fiziko-tekhnicheskiy institut AN SSSR)

TITLE: Occurrence of paramagnetic centers in polymers under the effect of laser radiation

SOURCE: Fizika tverdogo tela, v. 8, no. 9, 1966, 2735-2737

TOPIC TAGS: laser radiation, laser effect, laser r and d, polymethylmethacrylate, polystyrene, electron paramagnetic resonance

ABSTRACT: The authors report observation of paramagnetic centers in polymethylmethacrylate (PMMA) and polystyrene (PS) under the influence of radiation from pulsed ruby and neodymium lasers (0.69 and 1.08 μ, respectively) and also under the influence of a giant-pulse neodymium laser. The samples (20 mm long, 7 mm dia) were investigated in a standard radiospectrometer, using a procedure described earlier (ZhETF v. 50, 1187 (1966). In both materials, clearly pronounced electron paramagnetic resonance (EPR) was observed above a certain threshold radiation. The EPR spectra obtained at nitrogen and room temperatures constitute single

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L 45779-66

ACC NR: AP6030971

lines characterized by g factors close to 2.002 and small width (1 and 3 Oe between maximum-slope points for PMMA and PS, respectively). The Curie law is satisfied for the EPR signals from PMMA, but not PS. The observed paramagnetic centers have a concentration estimated at $\sim 4 \times 10^{15}$ cm^{-3} and are quite stable. No difference was seen between the effect of the ruby and neodymium laser, or between ordinary and giant pulses. The paramagnetic centers appeared only in the presence of cracks produced in the material by the laser radiation. In view of some unusual features of the observed paramagnetic centers (absence of macroradicals and absence of hyperfine structure), it is difficult to draw definite conclusions concerning their nature, but it is suggested that they may be the results of the decomposition of the polymers under the influence of the laser beam. The differences between the centers of PMMA and PS may be caused either by differences in the centers themselves, or by differences in their local concentration. Orig. art. has: 3 figures. [02]

SUB CODE: 20/ SUBM DATE: 28Feb66/ ORIG REF: 004/ ATD PRESS: 5085

Card 2/2

ACC NR: AP6037017 (A,N) SOURCE CODE: UR/0181/66/008/011/3432/3434

AUTHOR: Likhachev, V. A.; Ryvkin, S. M.; Salmanov, V. M.; Yaroshetskiy, I. D.

ORG: Physicotechnical Institute im. A. F. Ioffe, AN SSSR, Leningrad (Fiziko-tekhnicheskiy institut AN SSSR)

TITLE: Fatigue under optical damage to transparent dielectrics

SOURCE: Fizika tverdogo tela, v. 8, no. 11, 1966, 3432-3434

TOPIC TAGS: fatigue strength, dielectric material, polymethylmethacrylate, polystyrene, laser effect, irradiation damage, crack propagation

ABSTRACT: This is a continuation of earlier work (ZhETF v. 50, 2735, 1966), and contains more detailed information on the fatigue produced during optical destruction of transparent bodies in polymers (polymethylmethacrylate and polystyrene). The experimental procedure was the same as in the earlier investigation. The radiation source was a neodymium laser operating in the ordinary-pulse mode. The tests consisted of determining the influence of energy on the number of irradiations necessary for the first visible crack in the material to appear, or the change in the dimension of the damaged region with changing number of pulses. Comparison of the results of the two tests has shown that the true threshold of optical strength is approximately one-third as high as expected from an analysis of results of damage produced by single irradiation. An investigation was made of the nature of the irreversible changes due to the fatigue occurring at pulse energies lower than critical (necessary

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LIKHACHEV, V.F.

TSEGE, A.S.; DMITRIYEV, D.A.; LIKHACHEV, V.F.

Method of determining the thickness of an anode film. Prom. energ. 12 no.4:19-20 Ap '57. (MLRA 10:5)
(Electroplating)

ROSHCHIN, K.S.; TSVETKOV, A.I.; SIDNEV, N.F.; TSEGE, A.S.; LIKHACHEV, V.F.; SHIBANOV, K.I.; LEVITINA, Kh.K.; OSTROVKINA, M.Ya.; BAYBAKOV, P.M.; KROL', A.I.

Improvement in the operation of the rectifying devices of electroplating tanks. Prom. energ. 15 no.11:19-20 N '60. (MIRA 14:9)
(Electroplating) (Electric current rectifiers)

LIKHACHEV, V.

LIKHACHEV, V. State of railroad transportation in Western Europe. p.29.
Railroad construction in the people's Vietnam.p.36.

Vol. 7, no. 10, 1955, TRANSPORTNO DELO, SOFIYA, BULGARIA.

SO: Monthly List of East European Accessions, (EEAL), LC, Vol. 5, No. 10, Oct. 1956.

VORONICHEV, M.P.; LIKHACHEV, V.G.

New stage in railroad cooperation among socialist countries. (MIRA 11:6)
Zhel. dor. transp. 40 no.6:46-50 Je '58.
(Railroads--Management)

LIKHACHEV, V.G.; STEPANOV, L.A.

Third session of the Conference of Ministers of the Railroad Cooperation Organization. Zhel.dor.transp. 40 no.11:88-91 N '58. (MIRA 11:12)

(Railroads)

LIKHACHEV, V.G.; STEPANOV, L.A.

Fourth session of the Conference of Ministers of the Railroads Cooperation Organization. Zhel.dor.transp. 41 no.8: 87-89 Ag '59. (MIRA 12:12)
(Railroads--International cooperation)

VORONICHEV, M.P.; LIKHACHEV, V.G.

Further strengthening of cooperation among the railroads of socialist countries. Zhel. dor. transp. 43 no. 1:79-83 Ja '61. (MIRA 14:4)

1. Nachal'nik Upravleniya mezhdunarodnykh soobshcheniy Ministerstva putey soobshcheniya (for Voronichev). 2. Nachal'nik otdela Upravleniya mezhdunarodnykh soobshcheniy Ministerstva putey soobshcheniya (for Likhachev).
(Railroads--International cooperation)

LIKHACHEV, V. M.

Study of relativistic particles by the use of nuclear emulsions in a pulsed magnetic field. V. M. Likhachev, A. V. Kutsenko, and V. P. Voronkov (P. N. Lebedev Phys. Inst., Moscow). *Soviet Phys. JETP* 2, 766–7(1956)(English translation); *Zhur. Eksptl. i Teoret. Fiz.* 29, 894–5(1955). —The sign of the charge and the energy of particles were detd. by measuring their tracks in a nuclear emulsion. The plate was positioned in a pulsed magnetic field (synchronized with the accelerator) of 1.5×10^5 gausses. The results of 800 pairs measured so far are given. J. B. S.

FD-3277

USSR/Nuclear Physics - Relativistic particles

Card 1/1 Pub. 146 - 36/44

Author : Likhachev, V. M.; Kutsenko, A. V.; Voronkov, V. P.

Title : Problem of the investigation of relativistic particles by the method of nuclear photo-emulsions in an impulse magnetic field

Periodical : Zhur. eksp. i teor. fiz., 29, No 6(12), Dec 1955, 894-895

Abstract : The emulsion method rarely solves the problem of the sign and exact energy of particles. This problem can be solved more completely if the nuclear emulsion is placed during irradiation into a powerful magnetic field, computations showing that sign and impulse (momentum) analysis of particles according to magnetic bending can be carried out sufficiently accurately only in magnetic field strengths of the order 1 to $1.5 \cdot 10^5$ G and higher, which is at present possible only in the form of individual impulses. In works with accelerators also giving beams of particles by individual impulses, the present authors found the use of impulse magnetic fields very convenient thanks to the possibility of synchronization of the beam of particles and the field (they acknowledge that the idea of creating such an arrangement was proposed by G. M. Strakhovskiy in 1951). They employed such an impulse magnetic field for measuring the spectra of photons from the synchrotron of the Physical Institute, Acad. Sci. USSR. The apparatus consists of a current oscillator (P. L. Kapitsa, Proc. Roy. Soc., A 105, 1924), coil and control. They thank Professor V. I. Veksler for assistance.

Institution: Physical Institute im. P. N. Lebedev, Acad. Sci. USSR

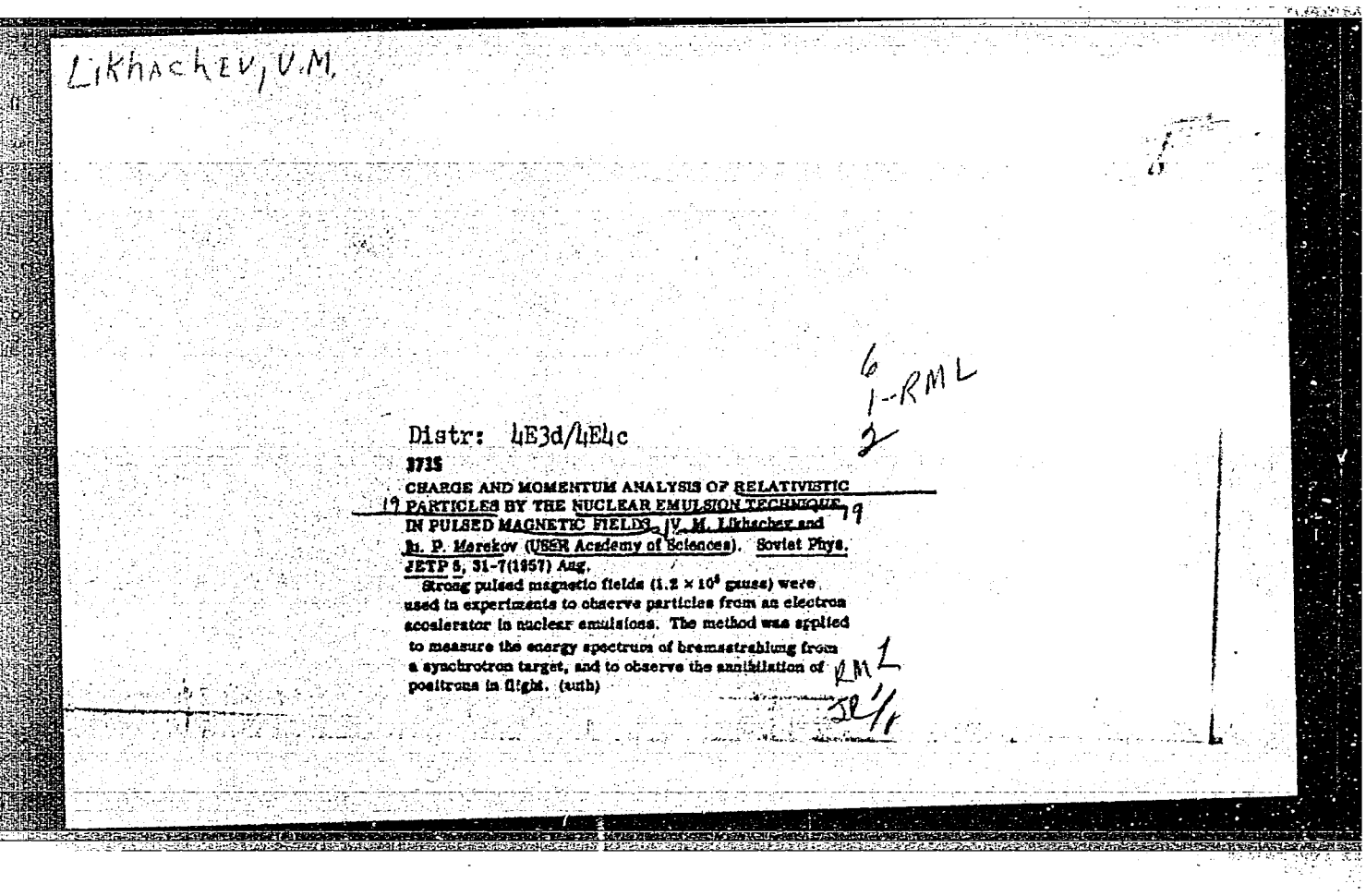
Submitted : August 12, 1955

APPROVED FOR RELEASE: 07/12/2001 CIA-RDP86-00513R000929910015-5"

LIKHACHEV, V. M. Cand Phys-Math Sci -- (diss) " Symbol and impulse analysis of relativity particles by the method of nuclear photoemulsions in a magnetic impulse field (H-1,2.10^{5}G)." Mos 1957. 8 pp 22 cm. (Acad Sci USSR. Physics Inst im P. N. Lebedev), 140 copies

(KL, 8-57, 108)

3



LIKHACHEV, V.M.

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3715

CHARGE AND MOMENTUM ANALYSIS OF RELATIVISTIC PARTICLES BY THE NUCLEAR EMULSION TECHNIQUE IN PULSED MAGNETIC FIELDS. V. M. Likhachev and Yu. P. Morekov (USSR Academy of Sciences). Soviet Phys. JETP 5, 31-7(1957) Aug.

Strong pulsed magnetic fields (1.2×10^6 gauss) were used in experiments to observe particles from an electron accelerator in nuclear emulsions. The method was applied to measure the energy spectrum of bremsstrahlung from a synchrotron target, and to observe the annihilation of positrons in flight. (auth)

RML 1

PA - 2104

AUTHOR: LICHAČEV,V.M., MEREKOV,JU.P.

TITLE: Charge and momentum analysis of relativistic particles by the nuclear emulsion technique in pulsed magnetic fields. (Russian).

PERIODICAL: Zhurnal Eksperim. i Teoret. Fiziki, 1957, Vol 32, Nr 1, pp 31-38 (U.S.S.R.)

Received: 3 / 1957 Reviewed: 4 / 1957

ABSTRACT: Here electron-sensitive NIKFI-emulsions of the type P are fitted in a device generating a pulse-like magnetic field and are irradiated in a magnetic field with $1{,}2.10^5$ Gauss by γ-quanta. The analysis of electron-positron pairs carried out in this way was used for the investigation of the problem of the annihilation of protons during flight and for the energy spectra of the bremsstrahlung of the synchrotron of the FIAN (=Physical Institute of the Academy of Science).

Methodical investigations: First, the method of the measurements of magnetic curvature and of the multiple scattering of the particles in the emulsion are discussed. For these measurements there are several methods, but the authors made use of a variety of the angle method worked out by themselves: The trace of the particle in the photoemulsion was, like in the case of other methods, devided into equal parts of a length of 100μ; hereupon the angles between the chords following one another were measured by means of the ocular eyepiece-scale. The procedure

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Charge and momentum analysis of relativistic particles by the nuclear emulsion technique in pulsed magnetic fields.

of measuring is discussed. There follows a discussion of the distortions of "false scattering" and of the analysis of particles with respect to the sign of the charge. In conclusion, several conclusions in connection with method are discussed.

The spectrum of bremsstrahlung and the annihilation of positrons during flight: The results obtained by computing the energy spectrum of the bremsstrahlung of the FIAN-synchrotron are demonstrated by means of a diagram. As a target of the synchrotron a tungsten rod with 1 mm diameter was used. For computation the formulae worked out by BETHE and HEITLER were used, and the absorption of the γ-quanta in the target as well as the twofold emission of electrons was taken into account. On the occasion of the construction of the histograms of the spectral distribution of electron-positron pairs only those pairs were selected of which each component in the emulsion had a trace of more than 540 μ length. The theoretically and experimentally determined histogram agrees within the limits of measuring errors. Also the experimental data for the determination of intensity from the dependence of electron-positron pairs on the

Charge and monumentum analysis of relativistic particles by the nuclear emulsion technique in pulsed magnetic fields.

energy of the γ-quanta are shown in form of a diagram. Accordingly intensity decreases with growing energy E_γ, and at $E_\gamma \sim 200$ MeV it becomes equal to zero.

On the occasion of the inspection of photoemulsions 4 cases of the annihilation of a particle during flight were found to occur, and the particles concerned were found to be positrons. The probability of annihilation was estimated at $\sim 1,7.10^{-3}$, while experimental estimation of this process amounted to $1,5.10^{-3}$

ASSOCIATION: Physical Institute "P.N.Lebedev" of the Academy of Science of the U.S.S.R.

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S/120/60/000/01/034/051
E032/E314

AUTHORS: Aleksandrov, Yu.A., Gorbunkov, V.M., Delone, N.B. and Likhachev, V.M.

TITLE: On the Formation of Image in Bubble-chamber Track Photography

79

PERIODICAL: Pribory i tekhnika eksperimenta, 1960, Nr 1, pp 113 - 114 (USSR)

ABSTRACT: The bubbles which form the particle tracks in a bubble chamber are light scattering irregularities. They may be looked upon as spherical lenses having a refractive index which is different from that of the surrounding medium. The optical properties of such irregularities are determined by their relative refractive index and radius of curvature (Ref 1). In a bubble chamber, the refractive index of the liquid is greater than that of the bubble and, therefore, the latter behaves as a negative lens. The incident light is therefore refracted in the bubble and produces a virtual image of the source of light near the image of this "lens". Rays refracted by the lens and entering the objective of the photographic camera produce an image, not of the

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On the Formation of Image in Bubble-chamber Track Photography

bubble, but the virtual source which lies near the focus of the bubble. It is therefore of interest to consider the effect of the difference in the position of the bubbles and the corresponding images of the source of light. For paraxial rays incident from infinity the distance from the centre of the spherical lens of radius R to the image is given by:

$$f' = \frac{1}{2} Rn_2/\Delta n$$

where Δn is the difference between the refractive indices of the liquid and the bubble. Each point of the source of light is imaged near the focus of the spherical lens, and the entire source is imaged with a magnification given by $\beta \cong f'/L$ where L is the distance from the source of light to the bubble. Clearly, in the case of bubble chambers and particularly in the case of liquid-hydrogen bubble chambers in which Δn is small, the spatial separation of the bubbles and the images of the light sources will be very small. It has

On the Formation of Image in Bubble-chamber Track Photography

been found with the aid of a model that aberration and diffraction effects are negligible. A large-scale photograph was taken of bubbles in a propane chamber using the apparatus shown in Figure 1. The illuminating system consists of a source of light S , an opaque screen A and a diffuse reflector B . Figure 2 shows photographs of electron tracks in the propane bubble chamber. The electrons were due to Co^{60} sources. In Figure 2, photograph (a) was obtained with a single source (a small hole in a screen); (б) with two holes; (B) with three holes; (г) and (д) with a ring source. From a knowledge of the geometry of the experiment it was possible to estimate the diameters of the bubbles. They were found to be between 0.1 and 0.4 mm, depending on illumination conditions. It is concluded that the recorded bubbles are in fact images of the source of light. The spatial displacement of the image of the source relative to the centre of the bubble is not small. Thus, in the case of liquid hydrogen the quantity f' is

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21.5200 (1033, 1144, 1191)

S/120/60/000/006/032/045
E032/E314

AUTHORS: Aleksandrov, Yu.A., Delone, N.B., Likhachev, V.M. and Gorbunkov, V.M.

TITLE: Formation of the Image in the Photography of Bubble-chamber Tracks

PERIODICAL: Pribory i tekhnika eksperimenta, 1960, No. 6, pp. 118 - 119

TEXT: It was shown in Ref. 1 that when bubble-chamber tracks are photographed, the object which is actually photographed is the virtual image of the source in the bubbles. The refractive index of the vapour in the bubble is smaller than the refractive index of the surrounding liquid and hence the bubble is divided into two zones. The bubble constitutes a negative lens for rays incident at angles smaller than the angle of the total internal reflection, and a convex spherical mirror for rays incident at angles greater than the angle of total internal reflection. This is illustrated in Fig. 1. The point source S_o is located at infinity on the left of

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Formation of the Image in the Photography of Bubble-chamber Tracks

the bubble. The ray 1 is refracted, while the ray 2 is reflected. Intermediate rays having angles of incidence $i_1(i_2)$ have the corresponding values of $h_1(h_2)$ and $\varphi_1(\varphi_2)$. They form virtual images $S'_{01}(S'_{02})$ of the source S_o on the axis S_oO. Both for the refracted and reflected rays we have

$$h_{1|(2)} = r \sin i_{1(2)}, \quad h_{1(2)} = H_{1|(2)}$$

while for the refracted rays we have

$$\varphi_1 = 2(i'_1 - i_1) \quad \text{and} \quad n_{\text{air}} \sin i_1 = n_{\text{m}} \sin i'_1$$

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where $n_ж$ is the refractive index of the liquid and

$n_п$ is the refractive index of the vapour.

For the reflected rays $\varphi_2 = 2(90^\circ - i_2)$. The objective of the photographic camera receives a narrow pencil of rays whose aperture is defined by the diameter of the entrance pupil of the objective and the distance to the working volume of the camera. For an objective with a focal length of 50 mm, a relative power of 1:20 and a distance to the working volume of 500 mm, the aperture of the pencil is about 0.5°. It follows that the image formed by the objective is due only to a very narrow pencil of rays. Such a pencil will experience only paraxial aberrations, i.e. astigmatism and distortion. In order to confirm the above theory of image formation, an experiment was carried out using two sources of light located symmetrically with respect to the objective-bubble axis. In this geometry each bubble forms four virtual images, two of

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which are produced by the refracting zone and two by the reflecting zone. The distance between each corresponding pair of images, which is equal to $2H_1$ and $2H_2$ in the two cases, respectively, depends on the radius of the bubble. For all bubbles, $2H_2$ is determined by the relative refractive index of the liquid and the vapour $n_{ж}/n_{п}$.

In the experiment, an objective having a focal length of 240 mm and a relative power of 1:16 was employed. It was found that the above theory describes the experimentally obtained results to a high degree of accuracy.

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