PLEKHANOV, G.F.; VASIL'YEV, N.V.; DEMIN, D.V.; ZHURAVLEV, V.K.; ZENKIN, G.M.; KOVALEVSKIY, A.F.; L'VOV, Yu.A.; FAST, V.G.; TUL'SKIY, A.S. [deceased]

Some results of the study of the problem of the Tunguska meteroite. Geol.i geofiz. no.1:111-123 '63. (MIRA 16:4)

1. Tomskiy meditsinskiy institut, Nauchno-issledovatel'skiy institut Tomskogo politekhnicheskogo instituta i Institut geologii i geofiziki Sibirskogo otdeleniya AN SSSR.
(Podkamennaya Tunguska Valley—Metecrites)

ACCESSION NR: AR4039246 S/0269/64/000/004/0074/0074

SOURCE: Ref. zh. Astronomiya, Abs. 4.51.495

AUTHOR: Fast, V. G.; Kovalevskiy, A. F.; Plekhanov, G. F.

TITLE: Certain comments on an article by G. M. Idlis and Z. V. Karyagina entitled "The Cometary Nature of the Tunguska Meteorite"

CITED SOURCE: Tr. Tomskogo otd. Geogr. o-va SSSR, Betatron, labor. Tomskogo med. in-ta, v. 5, 1963, 203-211

TOPIC TAGS: Tunguska meteorite, meteorite, astronomy, comet, atmospheric turbidity, geomagnetic effect, solar corpuscular stream, airglow, cometary tail

TRANSLATION: In the article cited in the title (reviewed in RZhAstr., 1962, 7A580) there are a number of unwarranted assumptions and unconvincing computations. The conclusions drawn by the authors therefore cannot be regarded as evidence of the cometary nature of the Tunguska meteorite. The authors have failed to explain the enormous energy of the explosion because

Card 1/2

ACCESSION NR: AR4039246

they have not substantiated the great velocity and assumed great loss of mass. Their computation of mass on the basis of atmospheric turbidity is based on a doubtful assumption that there was a uniform distribution of fine particles over the earth's surface. The postulated mechanism of the geomagnetic effect in the form of an analogy with a corpuscular stream obviously is unreal and their assumption of its world-wide character is incorrect and leads to an exaggerated energy estimate. In order to explain the airglow effect the authors have had to make the forced assumption of entry of electrons from the cometary tail into the atmosphere. They fail to give a satisfactory explanation based on the laws of celestial mechanics for their hypothesis of the development of the cometary tail in the immediate vicinity of the earth. Bibliography of 31 titles. I. Zotkin.

DATE ACQ: 12May64 SUB CODE: AS ENCL: 00

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R000412430010-6"

FASTENKO, V., inzh.

Mechanized laying of curbstones. Avt.dor. 23 no.11:27 N'60.
(MIRA 13:11)

(Curbstones)

YESIPENKO, P.; FASTNEKO, V.

Build faster and cheaper. NTO 5 no.1:13-15 Ja '63.
(MIRA 16:5)

1. Predsedatel' soveta nauchno-tekhnicheskogo obshchestva stroitel'no-montazhnogo tresta No.17 Dnepropetrovska (for Yesipenko).
2. Uchenyy sekretar' soveta nauchno-tekhnicheskogo obshchestva stroitel'no-montazhnogo tresta No.17 Dnepropetrovska (for Fastneko).
(Dnepropetrovsk—Construction industry)

KOCHERGIN, P.G. (Kursk); YERMOLAYEV, A.D., (Ul'yanovsk); FASTEUSOVICH, E.L. (Leningrad); MOZZHELIN, A.I.; LAVROV, V.A.; ZIMINA, A.

Discussion of new geography programs. Geog.v shkole 23 no.1: 63-74 Ja-F '60. (MIRA 13:5)

1. 176-ya shkola rabochey molodezhi Moskvy (for Mozzhelin).
2. 7-ya shkola rabochey molodezhi Kalinina (for Lavrov).
(Geography--Study and teaching)

FASTOV, D.V.

FASTOV, D.V., pomoshchnik epidemiologa (selo Kikvidze Balashovskoy oblasti)

Preventive inoculations against diphtheria in Kikvidze District.
Fel'd. i akush. 22 no.8:50 Ag '57. (MIRA 10:12)
(KIKVIDZE DISTRICT (BALASHOV PROVINCE)--DIPHTHERIA--
PREVENTIVE INOCULATION)

FASTOV, N. S.

"Theory of Relaxation Phenomena in Elastic Bodies." Thesis for degree of Cand. Physico-Mathematical Sci. Sub 6 Jun 50, Moscow Mechanics Inst

Summary 71, 4 Sep 52, Dissertations Presented for Degrees in Science and Engineering in Moscow in 1950. From Vechernyaya Moskva, Jan-Dec 1950.

FASTOV, N. S.

PA 164T51

USSR/Physics - Creep
Metallurgy

May 50

"Velocity of Stationary Creep," N. S. Fastov, Inst of Metal Studies and Phys of Metals, Cen Sci Res Inst of Ferrous Metals, Moscow

"Zhur Tekh Fiz" Vol XX, No 5, pp 543-545

Finds velocity v of stationary creep as a function of applied stress, sigma, and absolute temperature T, in various forms. Submitted 23 Apr 49.

[redacted] 164T51

FASTOV, N. S.

USSR/Physics - Relaxation Phenomenon

176T100

11 Apr 50

"Theory of Relaxation Phenomena in Solids," B. N. Finkel'-shteyn, N. S. Fastov, Inst Metal Sci and Phys of Metals, Cen Sci Res Inst of Ferrous Metals

"Dok Ak Nauk SSSR," Vol LXXI, No 5, pp 875-878

Fastov employs gen thermodynamical expressions, analogous to those proposed by Mandel'shtam and M. A. Leontovich in the theory of relaxation phenomena in solids. Submitted 14 Feb 50 By Acad M. A. Leontovich.

PA $176^{T}100$

Walustian B-78524

Fastov N.S.

FINKEL'SHTEYN, B.N., prof., doktor fiz.-mat. nauk; FASTOV, N.S., kand. fiz.-mat. nauk.

Elastic relaxation theory. Probl. metalloved. i fiz. met. no.2:245-255 '51.

(MIRA 11:4)

(Elasticity) (Alloys)

SA A 53 ff

539.374 : 536.7

9751. Contribution to the thermodynamics of plastic deformation. M. S. Zastov. Dokl. Akad. Nauk, SSSR, 78 (No. 2) 251-4 (1951) In Russian.

Kachanov's equation (Abstr. 2606 (1948)) developed for an infinitely slow deformation process is transformed mathematically into an expression for the free energy of a body whose deformation goes on at a finite velocity. It is claimed that equations obtained ultimately for (1) the relationship between the fluidity limit and the maximum elastic deformation on the one sidexnand the velocity of deformation on the other side; and (2) the relationship between stresses, and the amount of deformation and the velocity of plastic deformation, as well as the appearance of the creep curve, qualitatively agree with experimental data. F. Lachman

Inst. Metallography + Physics of Metals, Central Sci-Res. Inst. Ferrous Metallurgy

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

FASTOV, N.S.

USSR/Physics - Thermodynamics Apr 52

"Thermodynamic Theory of Elastic Aftereffect," N. S. Fastov, Inst of Metallurgy and Phys of Metals, Cen Res Inst of Ferrous Metallurgy

"Zhur Eksper i Teoret Fiz" Vol XXII, No 4, pp 487-492

On the basis of thermodynamic concepts, the author presents the theory of elastic aftereffects in solids taking into account thermal variations. Analyzes propagation of longitudinal elastic wave in a relaxing medium. Received 6 Jun 51.

215T86

FASTOV, N. S.

USSR/Physics - Plastic Deformation 21 Apr 52

"Evolution of Heat During Plastic Deformation," N. S. Fastov, Inst of Metal Sci and Phys of Metals, Cen Sci Res Inst of Ferrous Metals

"Dok Ak Nauk SSSR" Vol LXXXIII, No 6, pp 851-854

Determines the amt of heat evolved during plastic deformation and the energy of residual stresses. Sets up the eqs of elasticplastic behavior of a body, and considers the work of external forces during deformation. Submitted by Acad I. P. Bardin 29 Feb 52.

223T92

FASTOV, N. S.

USSR/Metals - Structural Analysis Jun 52

"Influence of the Concentration Stresses on the Diffusion Processes in Solid Solutions," B. Ya. Lyubov, N. S. Fastov, Inst of Metal Studies and Phys of Metals

"Dok Ak Nauk SSSR" Vol LXXXIV, No 5, pp 939-941

Using phenomenological method, develops eq of diffusion which takes into consideration elastic stresses caused by nonuniform distribution of dissolved substance in solid soln. These stresses, decreasing with equalization of concn affect diffusion process, sometimes to such an extent that

223T54

disregarding them may result in considerable discrepancy between calcd and exptl data. Submitted by Acad I. P. Bardin 12 Apr 52.

223T54

[illegible] Elasticity [illegible] part I, OGIZ, [illegible]
[illegible]
[illegible]
[illegible]
[illegible]
to include an extra [illegible]erm depending linearly on the temperature change. R. M. [illegible]

VMF

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R000412430010-6"

FASTOV, N.S.

The effect of plastic deformation on diffusion. Dokl. Akad. Nauk SSSR 85, No.2, 309-12 '52. (MLRA 5:8)
(PA 56 no.671:7970 '53)

Thermodynamics of simple carbides [illegible] [illegible] Energy Comm. NSF [illegible] ... [illegible] ...pose of this work is to devise a method of detg. thermodynamically the amt. of a carbide phase formed [illegible] alloying element. By means of the usual methods of [illegible] thermodynamics, an equation is derived [illegible] M. M is [illegible] alloying element [illegible] chosen for illustration. It is stated that the equation for the case where the concn. of M is too small for carbide formation agrees with exptl. data.

J. W. Faust, Jr.

2356* Calculation of the Energy of Distortion of the Lattice of the Third Type Depending on the Magnitude of Deformation. (Russian.) N. S. Fastov. *Doklady Akademii Nauk SSSR*, v. 92, no. 6, Oct. 21, 1953, p. 1167-1170.
Energy of residual stresses was found to be dependent on magnitude of uniform deformation in tension or compression. Graphs. 3 ref.

Inst. Metals + Phys. of Metals, TsNIIChM.

Surface energy at the boundaries of blocks in plastically deformed metals. N. S. Fastov. *Doklady Akad. Nauk. U.S.S.R.* 93, 655-8 (1953).—If it is assumed that the predominant portion of energy received by the metal in plastic deformation is concd. at the block boundaries and at the slippage planes, it can be shown that the specific surface energy α is $\alpha = wrl/3$, where w is energy of residual stresses per g., r density, and l block size. It amounts to a few hundred ergs. During plastic deformation, a portion of atoms passes from their normal position in the space lattice corresponding to an abs. min. of potential energy to abnormal points corresponding to a relative min. of potential energy distorting the space lattice. On tempering they return to the original position overcoming potential barrier dividing them and generating a matter of 100 cal./mole. The energy of tempering amounts, however, to tens of thousands cal. per mole. It appears, therefore, that the relative vol. of distorted space lattice may reach, with high deformations and at room temp., a value of about 0.01 and, since the min. block dimensions reach 100 at. spaces, the thickness of the surface layer at the block boundaries amounts to 1-2 interat. spaces. The energy of deformed space lattice in a unit vol. and as a function of an external load is $W = \lambda(\sigma^2 - \sigma_1^2)/2E$ where σ is stress, σ_1 yield point, E elastic modulus, λ a const. The av. block edge l is equal to $l = 6\alpha E/(\sigma^2 - \sigma_1^2)$. No exptl. data are presently available for this formula for uniformly stressed conditions.

J. D. Gat

FASTOV, N.S.

USSR/Physics - Metallurgy

Card 1/1 Pub. 22 - 18/48

Authors : Fastov, N. S.

Title : Theory of drop in coercive force at low-temperature tempering of hardened low-carbon steel

Periodical : Dok. AN SSSR 98/3, 391-393, Sep 21, 1954

Abstract : The changes in coercive force occurring in hardened steel during low-temperature tempering as result of redistribution of the carbon concentration were investigated. The effect of stresses on the diffusion in solid solutions is discussed. Processes, which may result in changes of the stresses, are listed. The relation between the changes in stresses, due to redistribution of carbon concentrations and the changes in the deformation occurring during diffusion, is explained. Four USSR references (1938-1954).

Institution : Central Scientific Research Institute of Ferrous Metallurgy, Institute of Metal Research and Physics of Metals

Presented by: Academician G. V. Kurdyumov, June 9, 1954

USSR/Physics - Residual strains

Card 1/1 Pub. 22 - 23/56

Authors : Fastov, N. S.
[redacted]

Title : On the kinetics of residual strain resulting from "self-diffusion" of relaxation stresses.

Periodical : Dok. AN SSSR 99/56, 753-756, Dec 11, 1954

Abstract : A theoretical analysis is presented, and mathematical expressions are given for residual strains in solid bodies subjected to external forces forming shearing stresses in the bodies which, in turn, create the residual strains, until the shearing stresses are uniformly distributed in the bodies (this reaction is called self-diffusion), or the external forces are completely dispelled. The twisting of a round rod, the bending of a prismatic rod, and the shrinkage of a spherical pore are three exemplary cases analyzed. Four USSR references (1946-1953).

Institution : The Institute of Metallurgy and Physics of Metals of TsNII Ch. M. Central Scientific Research Institute of Ferrous Metals

Presented by: Academician G. V. Kurdyumov, August 27, 1954

 TREASURE ISLAND BOOK REVIEW AID 847 - M

FASTOV, N. S., YA. S. UMANSKIY, B. N. FINKEL'SHTEYN, M. YE. BLANTER, S. T. KISHKIN, and S. S. GORELIK.

FIZICHESKIYE OSNOVY METALLOVEDENIYA (Principles of physical metallurgy). Metallurgizdat, 1955. 724 p., diagrs., tables, photos. 10,000 copies printed.

ANALYSIS AND EVALUATION:

This book on physical metallurgy is compiled by a group of prominent Soviet scientists and is based on a very voluminous literature, monographic and periodical, mostly by Soviet writers. It is not a textbook but an outline of present-day acheivement in the understanding of the physical principles of metallography and a survey of physical metallurgy problems as seen by Soviet scientists, Two main problems of theoretical physical metallurgy are emphasized: the theory of phase structure and the theory of phase formation. Presented in addition are the present-day concepts concerning plastic deformation of metals, recovery and recrystallization, and finally a study of the connection between the structure and composition of alloys and their strength.

Translation SL3703

FASTOV, N.S.

Category : USSR/Solid State Physics - Phase transformation of solid bodies E-5

Abs Jour : Ref Zhur - Fizika, No 1, 1957, No 1227

Author : Fastov, N.S.

Title : On the Change in the Coercive Force During Low-Temperature Tempering

Orig Pub : Probl. metalloved. i fiz. metallov, sb. 4, 1955, 219-221

Abstract : Untempered hardened steel is subject to a gradient of "microstresses" -- stresses of the second kind, caused by unevenly stressed plates of martensite. Tempering (at 100 -- 300°) redistributes the concentration of carbon inside these plates, causing a change in the stresses inside the latter. The redistribution in the stresses causes a change in the coercive force, since the latter is proportional to the gradient of the stresses in the micro region. An equation is derived for the connection between the coercive force before and after tempering and for the concentration of carbon in the steel. The calculated results are in agreement with the experimental data.

Card : 1/1

USSR/Solid State Physics - Phase Transformations in Solids, E-5

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 34702

Author: Fastov, N. S., Finkel'shteyn, B. N.

Institution: None

Title: On the Limiting Solubility of Certain Alloying Additives in Steel

Original Periodical: Probl. metalloved. i fiz. metallov, collection 4, 1955, 296-301

Abstract: None

1 of 1

Category : USSR/Solid State Physics - Mechanical Properties of Crystals and Poly-Crystalline Compounds E-9

Abs Jour : Ref Zhur - Fizika, No 1, 1957, No 1314

Author : Fastov, N.S.
Title : Energy of Distorted Crystal Lattice

Orig Pub : Probl. metalloved. i fiz. metallov, sb. 4, 1955, 377-387

Abstract : The problem is raised of determining the changes in the energy of the metal resulting from plastic deformation (strengthening energy) by determining experimentallly the type of dependence of stresses on the strains (plastic elongation diagram). An additional condition is introduced, namely that the strengthening energy must be independent of the macroscopic step-like form of the elongation diagram. For small stresses, it follows from the last requirement that the strengthening energy after removal of the load is proportional to the square of the stress causing the plastic deformation. The results of calculation are compared with the experimental data for Cu, Al, and for an Ag-Au alloy. The average surface energy of the coherent-scattering blocks and of the slippage planes, formed as a result of the plastic deformation, is examined. The surface energy is estimated to be several hundreds

Card : 1/2

Category : USSR/Solid State Physics - Mechanical Properties of Crystals and Poly-Crystalline Compounds E-9

Abs Jour : Ref Zhur - Fizika, No 1, 1957, No 1314

ergs/cm^2. It is shown, that the volume occupied by the lattice distortions of the third kind is 1 -- 2% of the total volume of the metal. Equations are derived for the size of the blocks and for the lattice distortions of the second kind from the external forces causing the plastic deformation.

Card : 2/2

FASTOV, N S.

Category : USSR/Solid State Physics - Morphology of Crystals. Crystallization E-7

Abs Jour : Ref Zhur - Fizika, No 1, 1957, No 1288

Author : Fastov, N.S.
Title : On the Thermodynamics of a Metallic Lattice with Vacancies

Orig Pub : Probl. metalloved. i fiz. metallov. sb. 4, 1955, 388-398

Abstract : A crystalline lattice with vacant sites is considered as a weak solution of "vacancies." The thermodynamic potential of a lattice with vacancies is determined and the possibility of experimentally determining the concentration of the vacancies from the after-effect resulting from preliminary thermal expansion is evaluated. Using approximations that are valid in the thermodynamics of weak solutions, the author calculates the variation of the equilibrium concentration of the vacancies with the stresses. It is shown that the thermodynamic potential of the body diminishes when the vacancies become "dissolved" in it. By assuming the concentration of the vacancies in equilibrium to be constant if the relative displacements of the vacancies and the atoms are in equilibrium, the author reaches the known conclusion that the self-diffusion equilibrium occurs only under uniform hydrostatic pressure. An identity is derived for the thermodynamic potential of an elastically-deformed

Card : 1/2

Category : USSR/Solid State Physics - Morphology of Crystals. Crystallization E-7

Abs Jour : Ref Zhur - Fizika, No 1, 1957, No 1288

body, which becomes also an identity for the thermodynamic potential of liquid for stresses produced by uniform-hydrostatic compression.

Card : 2/2

137-58-1-1590

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 1, p 215. (USSR)

AUTHORS: Fastov, N.S., Finkel'shteyn, B. N.

TITLE: The Thermodynamics of Carbides in Hard Steel (Termodinamika karbidov v tverdoy stali)

PERIODICAL: V sb.: Fiz.-khim. osnovy proiz-va stali. Moscow, AN SSSR, 1957, pp 346-349, Diskus., pp 408-409

ABSTRACT: A theoretical investigation is made of the equilibrium state of the ternary system Fe-C-V, where V is an alloying additive. It is assumed that the steel is a "pure" ternary Fe-C-V system, and that the time of isothermic holding is large enough so that a condition of thermodynamic equilibrium becomes established in the system. The interval in which γ Fe exists was investigated. γ Fe, alloyed V and VC, in which a portion of the V atoms are replaced by Fe, are regarded as weak solutions, making it possible to regard the thermodynamic potential (TP) of the system as equal to the sum of the TP of each phase. If we utilize the condition of minimal TP in the state of equilibrium, and that the sum of all the concentrations in each phase equals unity, it is possible to find an equation determining the relationship between

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137-58-1-1590

The Thermodynamics of Carbides in Hard Steel

the solubility of V in γFe and the C content of the steel. The equation derived describes a family of hyperbolas, which is in good agreement with the experimental data. This same equation may be employed to determine the solubility of other alloying substances, the carbide phase of which has a composition of the type Mc, with M as the alloying additive.

V. R.

1. Steel--Carbides--Thermodynamics

Card 2/2

FASTOV, N.S.

24(0) PHASE I BOOK EXPLOITATION SOV/1180

Vsesoyuznaya konferentsiya po fizike dielektrikov, Dnepropetrovsk, 1956.

Fizika dialektrikov; trudy konferentsii... (The Physics of Dielectrics; Transactions of the All-Union Conference on the Physics of Dielectrics) Moscow, Izd-vo AN SSSR, 1958. 245 p. 3,000 copies printed.

Resp. Ed.: Skanavi, G.I., Doctor of Physical-Mathematical Sciences; Ed.: Filippova, K.V., Candidate of Physical-Mathematical Sciences; Ed. of Publishing House: Starokadomskaya, Ye.L.; Tech. Ed.: Astaf'yeva, G.A.

Sponsoring Agencies: Akademiya nauk SSSR. Fizicheskiy institut, and Dnepropetrovsk. Universitet.

PURPOSE: This book is intended for scientific research workers, professors, industrial engineers and laymen who are interested in the study and use of dielectrics and dielectric materials.

COVERAGE: This volume publishes reports presented at the All-Union Conference on the Physics of Dielectrics, held in Dnepropetrovsk in August 1956, sponsored by the "Physics of Dielectrics" Laboratory of the Fizicheskiy institut

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imeni Lebedeva AN SSSR (Physics Institute imeni Lebedev of the AS USSR), and the Electrophysics Department of the Dnepropetrovskiy gosudarstvennyy universitet (Dnepropetrovsk State University). The present collection presents reports and discussions under the following subject headings: a) the influence of radiation on the properties of dielectrics; b) electro-and photoconductivity of dielectrics; c) methods of measuring dielectric properties; and d) practical uses of dielectrics. Abstracts of reports dealing with dielectric polarization and losses, dielectric disruption, electrets and corresponding materials published in "Izvestiya AN SSSR, seriya fizicheskaya", Nrs 3 and 4, 1958 are included. The editors state that reports submitted for publication, but for some reason not presented at the conference, were not included because of lack of space. References are given at the end of each conference report.

TABLE OF CONTENTS:

ABSTRACTS OF REPORTS READ AT THE CONFERENCE AND PUBLISHED IN THE JOURNAL "IZVESTIYA AN SSSR, SERIYA FIZICHESKAYA", Nos 3 and 4, 1958

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CONFERENCE REPORTS

Card 10/ 17

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R000412430010-6"

APPROVED FOR RELEASE: 03/13/2001 CIA-RDP86-00513R000412430010-6"

The Physics of Dielectrics (Cont.) SOV/1180

Strength of Continuous Compounded Insulation and Its Decrease Under the Influence of High-voltage Industrial Frequency 228

Puchkovskiy, V.V. [Chelyabinskiy institut mekhanizatsii i elektrifikatsii sel'skogo khozyaystva (Chelyabinsk Institute for the Mechanization and Electrification of Agriculture)] Self-drying Moist Dielectrics in an Electric Field of industrial Frequency 235

Discussion (by Yu.V. Koritskiy, I.M. Gol'dman, G.P. Fedoseyev, I.Ye. Balggin and G.N. Voloseyev)

AVAILABLE: Library of Congress

Card 17/17

TM/fal
1-13/59

SOV/137-58-9-19868

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 9, p 253 (USSR)

AUTHOR: Fastov, N.S.

TITLE: On the Thermodynamics of Irreversible Processes in Elastically Deformed Bodies (K termodinamike neobratimykh protsessov v uprogo deformirovannykh telakh)

PERIODICAL: Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-i. in-ta chernoy metallurgii, 1958, Vol 5, pp 550-576

ABSTRACT: The elastic deformation of a solid body is examined; thermodynamic instabilities of shear stresses are taken into consideration. On the basis of free-energy relations in irreversible processes a number of equations are derived in a general form describing the behavior of the free energy as well as the behavior of stress and relaxation tensors in elastically and isothermally deformed bodies. The equations obtained are equations of relaxation kinetics. By means of a general example of an isotropic solid body, it is shown that the stress tensor is a function of the following factors: Temperature and deformation at a given instant of time; the deformation during preceding periods of time, and the time of the shear relaxation and

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SOV/137-58-9-19868

On the Thermodynamics of Irreversible Processes (cont.)

volumetric relaxation. Various cases of approximating the range of relaxation-time spectra in a solid body are analyzed together with conditions permitting employment of equations of relaxation kinetics. In conclusion, the author examines the application of the theory of relaxation processes to the viscous flow of solid bodies and to the propagation of elastic transverse waves in an unlimited layer. Bibliography: 25 references.

L.I.

1. Metals--Thermodynamic properties 2. Metals--Deformation 3. Stress analysis 4. Elasticity--Theory

Card 2/2

SOV/137-58-9-19869

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 9, p 253 (USSR)

AUTHOR: Fastov, N.S.

TITLE: Thermodynamic Relationships in Irreversible Processes (Termodinamicheskiye sootnosheniya dlya neobratimykh protsessov)

PERIODICAL: Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-i. in-ta chernoy metallurgii, 1958, Vol 5, pp 577-582

ABSTRACT: The author establishes the limits within which the basic thermodynamic identities for reversible processes are applicable to irreversible processes. A functional relationship expressing the free energy as a function of temperature and of the tensors of deformation and relaxation was derived, and the rate at which entropy changes was computed for an elastically deformed body. It is shown that if the period of relaxation is significantly shorter than the change-of-state period the form of the thermodynamic equations for the internal and the free energy of irreversible processes coincides with the form of analogous equations for reversible processes. In that instance the unbalanced internal energy is a function of volume and of

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SOV/137-58-9-19869

Thermodynamic Relationships in Irreversible Processes

the unbalanced entropy, and is independent of the relaxation tensors. It is shown that the usual methods for the determination of the change in entropy in irreversible processes are correct only in the event when the change-of-state period of the body being examined is considerably greater than the time of relaxation. Bibliography: 7 references. Ref RZhMet, 1958, Nr 9, abstract 19868.

L.I.

1. Metals--Properties 2. Thermodynamics 3. Stresses 4. Mathematics--Applications

Card 2/2

SOV/124-58-10-11548

Translation from: Referativnyy zhurnal, Mekhanika, 1958, Nr 10, p 121 (USSR)

AUTHOR: Fastov, N. S.

TITLE: A Contribution to the Theory of the Elastic After-effect (K teorii uprugogo posledeystviya)

PERIODICAL: Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-i. in-ta chernoy metallurgii, 1958, Vol 5, pp 583-594

ABSTRACT: Integral equations of the "successive" type with a kernel in the form of an aggregate of exponential kernels are employed to examine the problem of the torsional vibrations of a homogeneous and isotropic round beam, the top end of which is rigidly fixed, while the bottom, at the moment of time t=0, is suddenly subjected to a twisting couple of forces of constant moment. The equation (of motion) of the following appearance

$$\rho\ddot{\phi} = \mu \frac{\partial^2\phi}{\partial z^2} + \sum_{\alpha=1}^{N} B_\alpha \int_0^t e^{\frac{t'-t}{\tau_\alpha}} \frac{d^2\phi}{dz^2}\, dt' ,$$

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SOV/124-58-10-11548

A Contribution to the Theory of the Elastic After-effect

where ρ, μ, B_a, and τ_a are parameters, and ϕ is the angle of deflection of a cross section of the beam, is solved by the operational method. It is observed that in the problem examined, the elastic after-effect is manifested in an asymptotic approximation of the deflection angle of the beam (after extinction of the elastic vibrations) to its position of equilibrium. Bibliography: 10 references.

M. I. Rozovskiy

Card 2/2

SOV/137-58-9-19881

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 9, p 255 (USSR)

AUTHOR: Fastov, N.S.

TITLE: On the Theory of Elastic After-effect (K teorii uprugogo posledeystviya)

PERIODICAL: Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-i. in-ta chernoy metallurgii, 1958, Vol 5, pp 585-594

ABSTRACT: The behavior of an elastic body is examined on a specific example of torsional vibrations induced in a homogeneous, isotropic, round rod subjected to constant external forces after the latter have been rapidly altered. It is shown that an elastic after-effect (EAE) is observed if the relaxation time is considerably greater than the time required for the damping of the elastic oscillations. Taking into account the fact that a number of relaxation processes take place in a solid body, the magnitude of the EAE may be expressed, with a certain degree of approximation, by the following formula:

$\Delta\phi = A z/\mu^2 \sum_{\alpha} B_\alpha \exp(-t/\tau_\alpha)$, where μ is the shear modulus and B_α the constant of a given relaxation process, and z the length

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SOV/137-58-9-19881

On the Theory of Elastic After-effect

of the rod being investigated. $A = 2M/\pi R^4$ (M is the moment produced by the torsion couple and R the radius of the rod). It is pointed out that the appearance of an EAE depends on a number of factors (the temperature, existence of blocks with a mosaic structure, geometric dimensions). Bibliography: 10 references.

L.I.

1. Elasticity--Theory 2. Rods--Stresses 3. Mathematics--Applications

Card 2/2

SOV/137-58-9-19877

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 9, p 254 (USSR)

AUTHOR: Fastov, N.S.

TITLE: The Theory of the Behavior of Macroscopic Pores in a Solid Body (K teorii povedeniya makroskopicheskikh por v tverdom tele)

PERIODICAL: Sb. tr. In-ta metalloved. i fiz. metallov Tsentr. n.-i. in-ta chernoy metallurgii, 1958, Vol 5, pp 595-599

ABSTRACT: Conditions necessary to bring about healing of pores in an isotropic body are analyzed theoretically from the point of view of a relaxation process involving changes occurring in thermodynamically unstable shear stresses. Equations are derived for the rate of change in the radius of a pore located near the surface of a body or at a distance from it. It is shown that the radius of a spherical pore located at some distance from the surface of the body increases or decreases depending on the sign of the expression $2\alpha/R+p$, where α is the coefficient of surface tension, R the radius of the pore, and p the external pressure. When there is no external pressure ($p=0$) the radius is reduced. If the spherical pore is near the surface of the

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SOV/137-58-9-19877

The Theory of the Behavior of Macroscopic Pores in a Solid Body

body, its radius becomes smaller. A study of the behavior of two spherical pores with equal radii indicates that in the absence of external forces the pores tend to approach each other and their radii become smaller in the process.

L.I.

1. Metals--Porosity 2. Porous metals--Theory 3. Mathematics--Applications

Card 2/2

SOV/137-58-8-17720

Translation from: Reverativnyy zhurnal, Metallurgiya, 1958, Nr 8, p 218 (USSR)

AUTHOR: Fastov, N. S.

TITLE: The Effect of Surface Energy on the Field of Elastic Stresses in the Vicinity of Macrodefects in the Structure of Solid Bodies (Vliyaniye poverkhnostnoy energii na pole uprugikh napryazheniy vblizi makrodefektov struktury tverdykh tel)

PERIODICAL: Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-i. in-ta chernoy metallurgii, 1958, Vol 5, pp 600-603

ABSTRACT: Studies were undertaken in order to evaluate the effect of the surface energy on the field of elastic stresses (S) present in the vicinity of structural macrodefects on solid bodies. An analysis of the elastic and surface energy of the body indicates that under marginal conditions of elastic equilibrium it is necessary to take into consideration the additional normal force determined by the curvature of the surface and an additional tangential force determined by the change in the coefficient of surface tension along a given surface. In order to illustrate the role of these additional forces present on the surface of the defects and affecting the S concentration, the author examines a spheroidal pore,

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SOV/137-58-8-17720

The Effect of Surface Energy on the Field of Elastic Stresses (cont.)

with radius R, which is situated in an unlimited isotropic medium and which (at infinity) is subjected to a uniform tensile stress. $S_{\sigma_{xx}}^{o}$.

If no forces are present on the surface of the pore, the maximal tensile stress, $S\sigma_{xx}^{max}$, which is approximately twice as great as the mean tensile S, occurs in a plane perpendicular to the axis of elongation: $\sigma_{xx}^{max}=0.5\,\sigma_{xx}^{o}\,(9-5\nu)/(\sigma-5\nu)$

where ν is the Poisson ratio. However, the additional force which is determined by the surface curvature of the spherical pore and which produces a tangential compressive S, reduces the magnitude of the maximal tensile S's by an amount equivalent to α/R, where α is the free energy of a unit surface. It is pointed out that in actual cases the compressive stresses α/R may considerably exceed the magnitude of practically permissible stresses, $S\,\sigma_{xx}$.

L. G.

1. Solids--Analysis 2. Solids--Stresses 3. Solids--Elasticity 4. Surfaces--Metallurgical effects 5. Surfaces--Energy

Card 2/2

Fastov N. S.

SOV-3-58-9-25/36

AUTHOR: Piguzov, Yu.V., Candidate of Technical Sciences, Moscow Institute of Steel imeni I.V. Stalin

TITLE: Relaxation Phenomena in Pure Metals and Alloys (Relaksatsionnyye yavleniya v chistykh metallakh i splavakh)

PERIODICAL: Vestnik vysshey shkoly, 1958, Nr 9, pp 72-73 (USSR)

ABSTRACT: From 2-4 April 1958, an Intervuz Conference on the "Relaxation Phenomena of Pure Metals and Alloys" took place at the Moskovskiy institut stali (Moscow Institute of Steel). The conference was attended by 196 representatives of 24 higher educational institutions and 31 scientific-research institutes (including 8 institutes of the USSR AS), from 13 cities of the Soviet Union. Doctor K. Mishek of the Prague Institute of Technical Physics and Den Ge San of the Pyongyang State University were also present. S.I. Filippov, Deputy Director of the Institute of Steel, opened the conference. A reviewing report was delivered by B.N. Finkel'shteyn [Finkelstein (Moscow Institute of Steel). V.T. Shmatov (Institute of Physics of the USSR AS in Sverdlovsk) and N.S. Fastov (Tsentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii (TsNIIChM) Central Scientific-Research Institute of Ferrous Metallurgy) reported on "Application of the Thermodynamics of Non-Balanced Conditions."

Card 1/4

AUTHORS: Fastov, N. S., Finkel'stheyn, B. N. 48-22-3-4/30

TITLE: Relaxation Theory of Electric Polarization (Relaksatsionnaya teoriya elektricheskoy polyarizatsii)

PERIODICAL: Izvestiya Akademii Nauk SSSR,Seriya Fizicheskaya, 1958, Vol. 22, Nr 3, pp. 249-251 (USSR)

ABSTRACT: The application of thermodynamics in polarization is based on the assumption that quasi-steady field quartities are concerned. Only under such an assumption may it be assumed that the body is in state of thermodynamic equilibrium during the process of polarization. If, however, the field changes with a finite velocity (e. g. with periodic changes of the field), deviations from the thermodynamic equilibrium take place in the polarized body. The occurrence of one or more processes of relaxation which are determined by corresponding relaxation times, is due to this fact. New independent parameters which characterize the degree of deviation from the thermodynamic equilibrium must be introduced in this case for the thermodynamic description of the behaviour of the body, and ki-

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netic equations must be established. It is known that the fundamental equations of thermodynamics remain effective in the case of smaller deviations from the state equilibrium (Reference 1). The author uses the expression:

$$E_i = 4\pi \frac{\delta F}{\delta D_i}$$

E_i and D_i are components of the voltage vectors of the field and of induction. F - free body-energy with respect to the unit volume. The authors investigated the isothermic polarization-process of the isotropic homogeneous dielectric and developed a corresponding theory. If $D_i \neq 0$, the free energy with isothermic processes will not depend only on D_i, but also on a new variable amount of relaxation for which the authors selected the vector ξ_i. The free energy of such a dielectric which was referred to the unit volume; can be represented in first approximation in form of a square invariant formed of the vectors D_i and ξ_i :

$$F = F_0 + \frac{1}{2} a_1 D_i^2 + a_2 D_j \xi_j + \frac{1}{2} a_3 \xi_j^2$$

(Summation with equal indices), where F_0 denotes the free energy of the dielectric in the absence of the field, a_1, a_2, a_3 - material constants, j - 1,2,3. a_1, a_2, a_3 are essentially positive. It is further shown that the tension of the electric field and of electric induction show a phase shifting. It follows that:

$$D_i(t) = \frac{1}{4\pi} \frac{1 + i\omega\tau}{a + ia_1\omega\tau} E_i(t).$$

Thus $\varepsilon(\omega) = \frac{1}{4\pi} \cdot \frac{a + a_1(\omega\tau)^2}{a^2 + a_1^2(\omega\tau)^2} - \frac{i}{4\pi} \cdot \frac{\frac{a_2^2}{a_3}\omega\tau}{a^2 + a_1^2(\omega\tau)^2}$

is obtained for complex $\varepsilon(\omega)$.

The dielectric losses attain their maximum at the frequency of ω_0:

$$\omega_0 = \frac{1}{\tau}\sqrt{\frac{\varepsilon(\infty)}{\varepsilon(0)}}$$

$$(tg\delta)_{max} = \frac{\Delta_\varepsilon}{2}\sqrt{\frac{\varepsilon(\infty)}{\varepsilon(0)}} = \frac{\varepsilon(\infty) - (0)}{2\sqrt{\varepsilon(0)\varepsilon(\infty)}}$$

is obtained for the maximum absorption.
The theory developed can be extended without difficulty to the anisotropic medium and also in the case that several processes od relaxation take place in the dielectric with polarization.
There are 2 Soviet references.

ASSOCIATION: Institut metallovedeniya i fiziki metallov TsNIIChermet (Institute of Metallography and Physical Metallurgy TsNII Chermet) Moskovskiy institut stali im. I. V. Stalina (Moscow Institute of Steel, imeni I. V. Stalin)

AVAILABLE: Library of Congress

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1. Dielectrics--Polarization 2. Dielectrics--Properties

5.4700
18.9200

67710

AUTHOR: Fastov, N. S.

SOV/126-7-3-6/44

TITLE: Some Results in the Thermodynamics of Solid Solutions

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 7, Nr 3, pp 354-359 (USSR)

ABSTRACT: The usual thermodynamic (more correctly thermostatic) relations are correct for reversible processes and equilibrium states. The state of an elastically deformed solid in the presence of shear stresses $\sigma_{ik} - \sigma_{\ell\ell} \delta_{ik}/3$ (σ_{ik} is the stress tensor and δ_{ik} a unit tensor) is, thermodynamically, a nonequilibrium state. It follows that in the general case the usual thermodynamic relations do not apply to an elastically deformed body. However, at temperatures well below the melting point, the shear stress relaxation times are so large that the elastically stressed state of the body may be looked upon as a quasi-equilibrium state. In this case the thermodynamic relations may be used for an elastically deformed solid but it is necessary to bear in mind that the stressed state of a solid body must be described by six variables, namely, σ_{xx}, σ_{yy}, σ_{zz}, σ_{xy},

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SOV/126-7-3-6/44

Some Results in the Thermodynamics of Solid Solutions

σ_{xz}, σ_{yz} which are the components of the stress tensor (in the case of a fluid only one parameter, namely the pressure, is sufficient). In view of the fact that the elastic equilibrium relaxation times are much smaller than the time for setting up the concentrational equilibrium, the stress tensor components should satisfy the condition $\partial\sigma_{ik}/\partial x_k = 0$. It is assumed that the time for setting up the concentrational equilibrium is much smaller than the shear stress relaxation time and that the stress does not exceed the elastic limit. Expressions are obtained for the chemical potentials of the solvent (μ_1) and the solute (μ_2). For solid solutions, μ_1 and μ_2 are functions of temperature, concentration and the stress tensor σ_{ik}. It is further assumed that the concentration is small. If in addition the stresses are also small, then μ_1 and μ_2 can be expressed as linear functions of $\sigma_{\ell\ell}$ in the form given

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Some Results in the Thermodynamics of Solid Solutions

by Eqs (1) and (1'), where μ_1^o (T,c) and μ_2^o (T,c) are the chemical potentials in the absence of stresses and a and b are functions of temperature and concentration only. The corresponding chemical potentials for fluid solutions are given by Eqs (2) and (2'). If in these equations p is replaced by $\sigma_{\ell\ell}/3$, then one obtains Eqs (3) and (3'), where the symbols are defined in Ref 1 (Landau and Lifshits "Statistical Physics"). These expressions for the chemical potentials are used to estimate:

1) The change in the equilibrium concentration of vacancies on the sites of a crystal lattice (Eq 8);
2) the change in the saturation vapour pressure due to stresses (Eq 11);
3) the change in the concentration of a saturated solid solution (Eq 13).

There are 5 Soviet references.

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SOV/126-7-3-6/44

Some Results in the Thermodynamics of Solid Solutions

ASSOCIATION: Institut metallovedeniya i fiziki metallov TsNIIChM (Institute of Metallography and Physics of Metals TsNIIChM)

SUBMITTED: August 9, 1957

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18.8200

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S/137/61/000/005/038/060
A006/A106

AUTHOR: Fastov, N. S.

TITLE: On the theory of the elastic aftereffect in homogeneous bodies

PERIODICAL: Referativnyy zhurnal. Metallurgiya, no. 5, 1961, 30-31, abstract 5Zh236 (V sb. "Relaksyats. yavleniya v metallakh i splavakh", Moscow, Metallurgizdat, 1960, 169-177)

TEXT: The author presents a theoretical analysis of the elastic aftereffect at a given change of applied external forces for the case of twisting oscillations of a homogeneous isotropic round rod (the load conditions of the rod correspond to the work conditions of a torsion pendulum during the investigation of the internal friction in metal). The problem is reduced to the solution of an equation for the motion of a compact medium. The author uses as stress tensor a general expression considering the totality of relaxation processes (with different relaxation time) caused by elastic deformation. Equations are derived which connect the magnitude of direct and reverse elastic aftereffect with the magnitude and time of action of the load applied and with the time of relaxation and observation. It is shown that an elastic aftereffect will be observed only in

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the case if relaxation processes take place in the body, whose relaxation time may be compared with the observation time, and which simultaneously exceed considerably the attenuation time of elastic oscillations. The equations obtained show that a maximum direct elastic aftereffect must always exceed the maximum reverse elastic aftereffect which should decrease at a shorter time of action of the load. There are 10 references.

A. B.

[Abstracter's note: Complete translation]

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S/126/60/010/002/028/028/XX
E031/E413

AUTHORS: Lyubov, B.Ya. and Fastov, N.S.

TITLE: On the Problem of Diffusion in a Plastically Deforming Medium

18

PERIODICAL: Fizika metallov i metallovedeniye, 1960, Vol.10, No.2, pp.310-312

TEXT: The work of S.A.Dovnar (Ref.1) and Yu.P.Romashkin (Ref.2) contain errors. The authors neglect the variation of the diffusion coefficient D with time in considering the effect of plastic deformation on diffusion. Simmons and Dorn (Ref.3) do not make this error but their method of solution is complicated and difficult to understand. A clearer derivation is presented in this paper. If j is the flow density of the diffusing substance, v the velocity of displacement of the medium and c the concentration, then in a homogeneous medium, in the one-dimensional case, the equation of continuity, the condition of incompressibility and the equation defining j:

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$$\underline{j} = -D(t)\nabla c + \underline{v}c$$

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E031/E413

On the Problem of Diffusion in a Plastically Deforming Medium

lead to the equation

$$\frac{\partial c}{\partial t} = D(t)\frac{\partial^2 c}{\partial x^2} - \frac{\dot{\ell}}{\ell}x\frac{\partial c}{\partial x}$$

($\ell = \ell(t)$ is the thickness of the medium and x the distance of a given point of the material from the surface of the medium). The boundary conditions are that there is no flow across the ends of the medium. With the aid of the transformation (4), the problem is transformed from one with a variable diffusion coefficient and a moving boundary to one with a constant diffusion coefficient and fixed boundaries. The solution is quoted for the case where the initial length ℓ_0 is infinite, Eq.(6). From this, the solution when the initial concentration is $A\delta(x)$ is Eq.(7), ($\delta(x)$ is the Delta function). The case of a concentration with a jump discontinuity at $x = 0$ also follows immediately, Eq.(8). The only point which remains is that of the normalization constant, which is chosen by considering the integral of the concentration

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S/126/60/010/002/028/028/XX
E031/E413

On the Problem of Diffusion in a Plastically Deforming Medium

over the volume of a rectangular parallelopiped, the volume of which does not alter on deformation. The expressions for the concentration given by S.A.Dovnar (Ref.1) and Yu.P.Romashkin (Ref.2) are in error because they do not satisfy the normalization equation (9), given here. There are 4 references: 3 Soviet and 1 English.

ASSOCIATION: Institut metallovedeniya i fiziki metallov TsNIIChM (Institute of Metallurgy and Physics of Metals TsNIIChM)

SUBMITTED: March 28, 1960

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24.4100
~~16(1)~~ 18.8200

67944

SOV/20-130-1-17/69

AUTHOR: Fastov, N. S.

TITLE: Stress Relaxation and Creep as Processes of Viscous Flow

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol 130, Nr 1, pp 64-67 (USSR)

ABSTRACT: The equations of viscous flow in the presence of a spectrum of relaxation times read as follows:

$$\sigma_{ik} - 1/3\, \sigma_{ll}\, \delta_{ik} = 2 \sum_{\alpha} \lambda_{\alpha} \left[(\varepsilon_{ik} - 1/3\, \varepsilon_{ll}\, \delta_{ik}) - \psi_{ik}^{(\alpha)} \right];$$

$$\dot{\psi}_{ik}^{(\alpha)} = \frac{\varepsilon_{ik} - 1/3\, \varepsilon_{ll}\, \delta_{ik} - \psi_{ik}^{(\alpha)}}{\tau_{\alpha}}; \quad \sigma_{ll} = 3K\, \varepsilon_{ll}\,; \quad \psi_{ll}^{(\alpha)} = 0\,.$$

Here $\psi_{ik}^{(\alpha)}$ denotes the relaxation tensor, K the compression modulus, λ_{α} a positive constant which satisfies the condition $\sum_{\alpha} \lambda_{\alpha} = \mu$. The author applies the above equations to stress

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Stress Relaxation and Creep as Processes of Viscous Flow

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relaxation and to the creep of a uniaxially extended homogeneous rod. The load applied to the rod at the initial instant of time is assumed to cause the instantaneous deformation ε_0. Deformation was kept constant during the following periods.

After some operations $\sigma_{xx} = \frac{9K}{3K+\mu} \varepsilon_{xx}(\sum_{\alpha} \lambda_{\alpha} e^{-t/\tau^*_{\alpha}})$ is obtained. Since in all cases $\lambda_{\alpha} \gtrless 0$, stress decreases in a monotonic manner like the sum of the exponents. After sufficiently long intervals the terms of the above equation become negligibly small compared to that term which contains the maximum relaxation time τ_m.

Thus, $\sigma^{(0)}_{xx} - \sigma_{xx} = \sigma^{(0)}_{xx}(\sum_{\alpha} \lambda_{\alpha} - \sum_{\alpha} \lambda_{\alpha} e^{-t/\tau^*_{\alpha}})$ is obtained. After a sufficiently long duration of observation stress relaxation is consequently described by a single exponent (second stage of relaxation). The decrease in the stress $\Delta\sigma_{xx} = \sigma^{(0)}_{xx} - \sigma_{xx}$ during the same interval of time is proportional to the initial

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stress $\sigma_{xx}^{(o)}$. After some further operations

$$\varepsilon_{xx} = \frac{\sigma_{xx}}{9K}\left[\frac{3K}{\sum_{\alpha}\lambda_{\alpha}\tau_{\alpha}} t + \frac{3K}{(\sum_{\alpha}\lambda_{\alpha}\tau_{\alpha})^2}\sum_{\beta}\lambda_{\beta}\tau_{\beta}^2 + \sum_{\alpha=1}^{N-1}\Omega_{\alpha}\, e^{p_{\alpha}t}\right]$$

is obtained, where p_{α} denotes the roots of the function $f(p)$ and Ω_{α} constants. The rate of creep $\dot{\varepsilon}_{xx}$ is proportional to the applied stress σ_{xx}, and with progressing time approaches asymptotically its steady value $(\dot{\varepsilon}_{xx})_{st} = \frac{\sigma_{xx}}{3\sum_{\alpha}\lambda_{\alpha}\tau_{\alpha}}$. If the system is characterized only by one relaxation time, the corresponding region with variable rate of creep disappears. In this case $\dot{\varepsilon}_{xx} = A\sigma_{xx}^m$ for $m > 1$. The computed and the experimental data on the dependence of the rate of creep on the stresses are therefore not in agreement, since in the (loaded) real metal stresses are inhomogeneous due to the defects in the crystal structure. The above-described scheme of the creep in a

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Stress Relaxation and Creep as Processes of Viscous Flow

SOV/20-130-1-17/69

crystal (or polycrystal) holds only if the sample has the corresponding structural defects. In the relaxation of stresses the stress distribution in the sample is also inhomogeneous. The results obtained may be interpreted as follows: In a metal subjected to shear stress viscous-flow processes take place (self-diffusion relaxation) which, under constant deformation, lead to a vanishing of these stresses (i.e., to stress relaxation) and in the case of constant stress, to creep. In the case of viscous flow the atoms (or atom groups) are shifted into other positions by overcoming the potential barriers. There are 1 table and 8 references, 7 of which are Soviet.

ASSOCIATION: Institut metallovedeniya i fiziki metallov Tsentral'nogo nauchno-issledovatel'skogo instituta chernoy metallurgii (Institute of Metallography and Metal Physics of the Central Scientific Research Institute of Ferrous Metallurgy)

PRESENTED: August 17, 1959, by G. V. Kurdyumov, Academician

SUBMITTED: August 7, 1959

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24(8)
S/020/60/130/03/016/065
B014/B014

AUTHOR: Fastov, N. S.

TITLE: Thermodynamics of Irreversible Processes of Plastic Deformation

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol 130, Nr 3, pp 541 - 544 (USSR)

ABSTRACT: The author studies slight elastoplastic deformations and confines himself to pure shearing in investigating the general properties of plastic deformation. Equation (1) leads to the free energy per unit volume for slight deviations from equilibrium. (3) leads to the stress tensor and (4) to the internal energy for a given deformation rate. The stress tensor for relief is given by equation (7), and the internal energy of the plastically deformed body after relief, which is called strengthening energy, is described by equation (8). It follows that in the case of deformations the strengthening energy is accumulated only if deformation is accompanied by relaxation processes such as the cleavage of crystals. Equation (10) describes the ratio between strengthening energy and consumed energy. For purely elastic

Thermodynamics of Irreversible Processes of Plastic Deformation

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deformation it is shown that the strengthening energy and deformation energy are approximately equal. Equation (12) indicates that the strengthening energy decreases in an exponential manner. Furthermore, the author studies the influence exercised by evenly inreasing heating of the body upon this event. It is noted that the results obtained are in agreement with those obtained from experiments on cadmium. In conclusion, the author derives equations (14) and (15) for free energy and for the deviation of the relaxation tensor in the general case of heating and deformation of a body. Stress tensor and entropy are described by equations (16) and (17), respectively. Herefrom it may be seen that strain and entropy in the body depend on the relative change in volume, the temperature change, and also on the preceding deformation and heating. Furthermore, it may be seen from equation (19) that the internal energy is a function of the volume, entropy, and temperature. There are 6 references, 4 of which are Soviet.

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Thermodynamics of Irreversible Processes of Plastic Deformation

S/020/60/130/03/016/065
B014/B014

ASSOCIATION: Institut metallovedeniya i fiziki metallov Tsentral'nogo nauchno-issledovatel'skogo instituta chernoy metallurgii (Institute of Metallography and Metal Physics of the Central Scientific Research Institute of Ferrous Metallurgy)

PRESENTED: June 9, 1959, by G. V. Kurdyumov, Academician

SUBMITTED: June 8, 1959

Card 3/3

FASTOV, N.S.

Thermodynamics of intersticial solid solutions with body-centered, cubic, crystal structures. Fiz. met.i metalloved. 11 no.6:856-863 Je '61. (MIRA 14:6)

1. Institut metallovedeniya i fiziki metallov TSentral'nogo nauchno-issledovatel'skogo instituta chernoy metallurgii imeni I.P. Bardina.

(Crystal lattices)
(Solutions, Solid--Thermal properties)

S/126/61/012/003/015/021
E032/E314

AUTHOR: Fastov, N.S.

TITLE: On the thermodynamics of irreversible processes during elastic deformation

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol. 12, No. 3, pp. 431 - 436

TEXT: The author discusses irreversible processes in the case of finite rates of deformation and uniform heating. The nonequilibrium state of a thermally uniform and uniformly-stressed body is described by the temperature T, the strain tensor ε_{ik} and the set of relaxation tensors $\psi_{ik}^{(\alpha)}$ ($i, k = 1, 2, 3$; $\alpha = 1, 2, \ldots, N$). In addition to the second-rank tensors $\psi_{ik}^{(\alpha)}$, the internal state parameters include also the scalar quantities ξ^{β}. However, the latter are most conveniently looked upon as the second-rank tensors $\psi_{ik}^{(\beta)} \delta_{ik}$ where δ_{ik} is the unit tensor. When T and

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ε_{ik} are constant, the state of the body approaches the equilibrium state and the parameters $\psi_{ik}^{(\alpha)}$ tend to their equilibrium values $\overline{\psi_{ik}^{(\alpha)}}$, which are functions of T and ε_{ik}. If during the deformation and heating the parameters ε_{ll}, $\varphi_{ik}^{(\alpha)}$ and the temperature change $T - T_0$ are small ($\varphi_{ik}^{(\alpha)} = \psi_{ik}^{(\alpha)} - \overline{\psi_{ik}^{(\alpha)}}$), then the free energy per unit volume of an isotropic body is of the form (the present author - Problems in metal science and the physics of metals - No. 5, Metallurgizdat, 1958, p. 550)

$$F^* = F_1(T) - \alpha K \varepsilon_{ll}(T - T_0) + \frac{K}{2}\varepsilon_{ll}^2 + \frac{1}{2}\sum_\alpha A_\alpha \varphi_{ll}^{(\alpha)2} + \sum_\beta B_\beta \left(\varphi_{ik}^{(\beta)} - \frac{1}{3}\varphi_{ll}^{(\beta)}\delta_{ik}\right)^2, \quad (1)$$

where $F_1(T)$ is the free energy in the absence of deformation and in the equilibrium state, K is the bulk modulus, ω is the thermal-expansion coefficient, A_α, B_α are positive constants and T_o is the initial temperature at which, in the absence of external forces and in the equilibrium state, the body may be looked upon as undeformed. It was shown in Ref. 3 that the stress tensor σ_{ik} and the nonequilibrium entropy per unit of volume S^* can be represented by the following integral expressions:

$$\sigma_{ik} = K\varepsilon_{ll}\delta_{ik} - \omega K(T - T_0)\delta_{ik} + \int_{-\infty}^{t}\sum_{\alpha} A_\alpha \exp\left(\frac{t' - t}{\tau_2^{(\alpha)}}\right)[\dot{\varepsilon}_{ll}(t') +$$

$$+ \gamma_\alpha \dot{T}(t')]\delta_{ik}\,dt' + 2\int_{-\infty}^{t}\sum_{\alpha} B_\alpha \exp\left(\frac{t' - t}{\tau_1^{(\alpha)}}\right)\left[\dot{\varepsilon}_{ik}(t') - \frac{1}{3}\dot{\varepsilon}_{ll}(t')\delta_{ik}\right]dt'; \qquad (2)$$

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$$S^* = S_1(T) + \omega K s_{ll} - \int_{-\infty}^{t} \sum_{\alpha} A_\alpha \gamma_\alpha \exp\left(\frac{t'-t}{\tau_2^{(\alpha)}}\right) \left[\dot{s}_{ll}(t') + \gamma_\alpha \dot{T}(t')\right] dt', \quad (3)$$

where $S_1(T)$ is the equilibrium entropy in the absence of deformation, $\tau_1^{(\alpha)}$ and $\tau_2^{(\alpha)}$ are the relaxation times and γ_α are constants defined by

$$\overline{\psi^{(\alpha)}} = \varepsilon_{ll} + \gamma_\alpha (T - T_o) \quad (4) .$$

The heat-transfer equation on the linear approximation is taken in the form

$$T_o \dot{S}^* = \varkappa \Delta T$$

or, bearing in mind Eq. (3),

$$T_0\left(\frac{C_v}{T_0}-\sum_{\alpha} A_\alpha \gamma_\alpha^2\right)\dot{T}+\left(\omega K-\sum_{\alpha} A_\alpha \gamma_\alpha\right)\dot{\varepsilon}_{ll}+$$

$$+\int_{-\infty}^{t}\sum_{\alpha}\frac{A_\alpha \gamma_\alpha}{\tau_2^{(\alpha)}}\exp\left(\frac{t'-t}{\tau_2^{(\alpha)}}\right)\left[\dot{\varepsilon}_{ll}(t')+\gamma_\alpha \dot{T}(t')\right]dt' = \varkappa \Delta T, \qquad (5)$$

where $\varkappa$ is the thermal conductivity and C_v is the equilibrium (static) specific heat ($C_v = T_0 dS_1/dT$). Using Eq. (3) it may be shown that for a thermally-insulated system ($S^* = \text{const.}$)

$$\hat{T}-\hat{T}_0 = -\frac{T_0}{C_v}\omega K\frac{1-\sum\limits_{\alpha} A_\alpha \gamma_\alpha \dfrac{p\tau_2^{(\alpha)}}{1+p\tau_2^{(\alpha)}}}{1-\dfrac{T_0}{C_v}\sum\limits_{\alpha} A_\alpha \gamma_\alpha^2 \dfrac{p\tau_2^{(\alpha)}}{1+p\tau_2^{(\alpha)}}}\hat{\varepsilon}_{ll}. \qquad (7)$$

In order that $T - T_0$ should tend to a finite limit for $\varepsilon_{\ell\ell}$ = const., it is necessary for the roots of the numerator in Eq. (7) to be negative and this is satisfied if the following inequality holds

$$C_v^g = C_v - T_0 \sum_\alpha A_\alpha \gamma_\alpha^2 > 0 \qquad (8)$$

where C_v^g is the specific heat for an infinitely rapid temperature variation ($T \to \infty$). From this it follows that the dynamic specific heat is smaller than the static specific heat since $A_\alpha > 0$. In many cases, the relaxation time $\tau_1^{(\alpha)}$ may be divided into two parts

$$\tau_1^{(\alpha_1)} \gg \Omega ; \quad \tau_1^{(\alpha_2)} \ll \Omega \qquad (9)$$

where Ω is the period of the external force (Ref. 3). Moreover, as far as volume and temperature changes are concerned, the process is quasi-stationary, i.e.

$$\Omega \gg \tau_2^{(\alpha)} \qquad (10).$$

It is then shown, using Eqs. (2) - (4), that the irreversible rate of increase in the entropy is given by

$$\dot{S}_H = \varkappa \frac{(\nabla T)^2}{T^2} + \frac{1}{T}\sum_{\alpha} A_\alpha \tau_2^{(\alpha)} (\dot{\varepsilon}_{ll} + \gamma_\alpha \dot{T})^2 + \frac{2}{T}\eta_1\left(\dot{\varepsilon}_{ik}^2 - \frac{1}{3}\dot{\varepsilon}_{ll}^2\right) + \qquad (17)$$

$$+ \frac{2\eta_k}{T}\left(\varepsilon_{ik}^2 - \frac{1}{3}\varepsilon_{ll}^2\right).$$

where $\eta_1 = \sum_\beta B_\beta \tau_1^{(\beta)}$ and $\eta_5 = \sum_\alpha B_\alpha / \tau_1^{(\alpha)}$.

The term containing η_5 is particularly important at high temperatures. In many cases, each volume element of a solid or liquid is practically adiabatic (e.g. sound propagation) so that when the conditions given by Eqs. (9) and (10) are satisfied, it may be assumed that

$$T - T_o = - \frac{\omega K T_o}{C_v} \varepsilon_{ll} + \eta_3 \frac{T_o}{C_v} \dot{\varepsilon}_{ll} + \frac{\eta_4 T_o}{C_v} \dot{T}$$

and

$$\sigma_{ik} = K^{ad} \varepsilon_{ll} \delta_{ik} + \eta_2^{ad} \dot{\varepsilon}_{ll} \delta_{ik} + 2\mu\left(\varepsilon_{ik} - \frac{1}{3} \varepsilon_{ll} \delta_{ik}\right) +$$
$$+ 2\eta_2 \left(\dot{\varepsilon}_{ik} - \frac{1}{3} \dot{\varepsilon}_{ll} \delta_{ik}\right) - 2\eta_5 \int_{-\infty}^{t} \left[\varepsilon_{ik}(t') - \frac{1}{3} \varepsilon_{ll}(t') \delta_{ik}\right] dt', \qquad (18)$$

where $K^{a\lambda}$ is the adiabatic bulk modulus and $\eta_2^{a\lambda}$ is given by

$$\eta_2^{a\lambda} = \sum_{\alpha} A_\alpha \tau_2^{(\alpha)} \left(1 - \frac{T_0 \omega K}{C_v} \gamma_\alpha \right)^2. \qquad (19)$$

In the case of the quasi-stationary states of a liquid

$$\sigma_{ik} = -p\delta_{ik} + 2\eta_1\left(\dot{e}_{ik} - \frac{1}{3}\dot{e}_{ll}\delta_{ik}\right) + \eta_2\dot{e}_{ll}\delta_{ik} + \eta_3\dot{T}\delta_{ik}, \qquad (20)$$

$$dU^* = -pd\varepsilon_{nn} + TdS^* - \eta_{13}\dot{T}d\varepsilon_{nn} - \eta_{14}\dot{T}\,dT, \qquad (21)$$

where the pressure is defined by

$$p = -K\varepsilon_{ll} + \omega K(T - T_0) \qquad (22)$$

and $\eta_2 = \sum_{\alpha} A_{\alpha} \tau_2^{(\alpha)}$. For adiabatic processes, Eqs. (20) and (21) assume the form

$$\sigma_{ik} = -p\delta_{ik} + \eta_2^{aa} \dot{\varepsilon}_{ll} \delta_{ik} + 2\eta_1 \left(\dot{\varepsilon}_{ik} - \frac{1}{3} \dot{\varepsilon}_{ll} \delta_{ik} \right), \quad (23)$$

$$dU^* = -pd\varepsilon_{nn} + TdS^*. \quad (24)$$

from which it follows that the thermodynamic identity for the nonequilibrium internal energy (24) is identical with the thermodynamic identity for the equilibrium internal energy only in the case of quasi-stationary adiabatic processes. The paper is concluded with the special case of FeNi alloys. According to K.P. Belov (Ref. 12 - Dokl. Ak. nauk SSSR, 1958, 91, 807) and B.G. Livshits (Ref. 13 - Physical properties of metals and alloys, Mashgiz, 1956), in the latter case

$$\left(\frac{\partial \sigma_s}{\partial T}\right)_{\sigma} \Big/ \left(\frac{\partial \sigma_s}{\partial \sigma}\right)_T \approx -4 \cdot 10^8 \text{ dyne/deg.cm}^2 ;$$

$$\omega \approx 10^{-6} \text{ deg.}^{-1}; \quad K \approx 2 \cdot 10^{12} \text{ dyne/cm}^2$$

and hence the value of γ, which is defined by

$$\gamma = \frac{\left(\frac{\partial \bar{\psi}}{\partial T}\right)_{\varepsilon} + \left(\frac{\partial \bar{\psi}}{\partial \sigma}\right)_T \left(\frac{\partial \sigma}{\partial T}\right)_{\varepsilon}}{\left(\frac{\partial \bar{\psi}}{\partial \sigma}\right)_T \left(\frac{\partial \sigma}{\partial \varepsilon}\right)_T} = \frac{\left(\frac{\partial \bar{\psi}}{\partial T}\right)_{\varepsilon}}{K\left(\frac{\partial \bar{\psi}}{\partial \sigma}\right)_T} - \omega, \qquad (25)$$

where

$$\bar{\psi} = \psi_{||}; \ \varepsilon = \varepsilon_{||}; \ \sigma = \sigma_{||}.$$

is found to be

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$$\gamma \approx -2 \cdot 10^{-4} \text{ deg.}^{-1} \qquad (26).$$

The above analysis then leads to the following numerical values

$$\eta_3 = -2 \cdot 10^{-4}\ \eta_2 \text{ (g/cm.sec.deg.) };$$

$$\eta_4 = 4 \cdot 10^{-8}\ \eta_2 \text{ (g/cm.sec.deg.) and}$$

$$\frac{\eta_2^{a\Delta} - \eta_2}{\eta_2} \approx 6 \cdot 10^{-3} .$$

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Moreover,

$$\frac{K^{a\Delta} - K}{K} \approx 1.5 \cdot 10^{-5} .$$

There are 14 Soviet references.

ASSOCIATIONS: Institut metallovedeniya i fizika metallov (Institute of Metal Science and Physics of Metals)
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SUBMITTED: April 22, 1960 (initially)
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AUTHOR: Fastov, N. S.

TITLE: Deformation of a body caused in the stage of steady creep and the transition from microcreep to macrocreep investigated from the point of view of the thermodynamics of irreversible processes

PERIODICAL: Doklady Akademii nauk SSSR, v. 137, no. 2, 1961, 323-326

TEXT: As is well known, a body which is thermodynamically not in equilibrium and is exposed to a load, can be described at constant temperature with the deformation tensor and the relaxation tensor. At sufficiently high temperatures the stress tensor can be written as follows:

$$\sigma_{ik} = K e_{ll} \delta_{ik} + 2 \sum_{\alpha=1}^{N} \lambda_\alpha [(e_{ik} - {}^1/_3 e_{ll} \delta_{ik}) - \psi_{ik}^{(\alpha)}], \qquad (1),$$

where K is the compression modulus, λ_α is a positive constant which

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satisfies the condition $\sum\lambda_{\alpha} = \mu$, μ is the shear modulus, δ_{ik} is the unit tensor and the following expression is valid for the relaxation tensor: $\psi_{ll}^{(\alpha)} = 0$. Now, (1) can be brought into the Boltzmann-Volterra form:

$$\sigma_{ik} = K\varepsilon_{ll}\delta_{ik} + 2\int_{-\infty}^{t}\sum_{\alpha=1}^{N}\lambda_{\alpha}e^{(t'-t)/\tau_{\alpha}}[\dot{\varepsilon}_{ik}(t') - \tfrac{1}{3}\dot{\varepsilon}_{ll}(t')\delta_{ik}]\,dt'. \qquad (4).$$

This is a generalization of the equation for a viscous flow. Furthermore, the creep is described as a viscous flow which takes part in small macroscopic particles of the body in question and the various particles are assumed to slide along each other. During creep elasticly deformed bodies will be deformed plastically which may heal lattice defects. Subsequently this part will again be deformed elastically. During steady creep the volume of the plastically deformed part will remain

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constant and also the change of its distribution of dimension. If the mean rate of creep of the elastically deformed parts is not equal to the rate of creep of the whole sample, then the parts will start sliding along each other and this will lead to a change in dimensions and new lattice defects. Due to the interaction of elastically and plastically deformed parts the thermodynamic state of one body is determined by the thermodynamic state of a single one of its parts, e.g. an elastically deformed part. A short thermodynamic consideration shows that the deformation of a body during steady creep is not a function of the applied load if the deformation is not small. This result has been obtained from purely mathematical considerations and, therefore, is found to be valid for all bodies. The results of investigations done by S. N. Zhurkov (Ref. 4: S. N. Zhurkov, T. P. Sapfirova, Zh.TF, 28, 1719 (1958)) agree well with the theoretical ones. Further, it is shown that the deformation in a body caused by micro-creep is not a function of the load. This has already been established by Chalmers (Ref. 5: B. Chalmers, Proc. Roy. Soc., A, 156, (1936)) on a tin monocrystal. There are 3 figures and 5 references: 4 Soviet-bloc and 1 non-Soviet-bloc.

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Deformation of a body caused in ...

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SUBMITTED: October 24, 1960

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B104/B207

AUTHOR: Fastov, N. S.

TITLE: The characteristics of the thermodynamics of solid solutions of intrusions with cubic volume-centered lattice

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 138, no. 2, 1961, 344-347

TEXT: In the solutions studied, the atoms of the dissolved substance are in the middle of the elementary cube edges or in the middle of the surfaces (Fig. 1). In a deformed lattice, the energies of the atoms of the dissolved substance vary according to the different positions, and the probabilities of the atom positions are different. At a lattice deformation, the energy of the various atom positions changes in a different way which leads to a redistribution of the atoms of the dissolved substance in their positions. This transition of the atoms from one energy position into another occurs in the elementary cubes and is accompanied by a considerable change of the modulus of elasticity and other non-linear effects. The solid solution is then in equilibrium, when it is long enough in a state of constant deformation and temperature. If c_x, c_y and c_z are

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