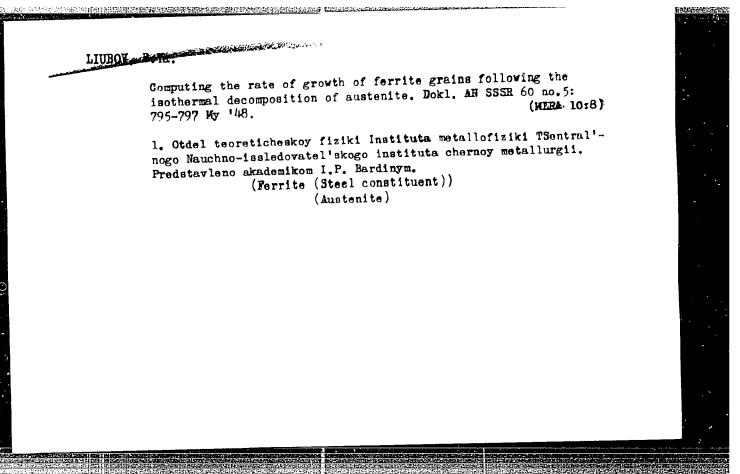
LYUBOV, B. YA.	PA	75T96	
USSR/Physics Heat-Transmission	3		
Heat - Convection  "On V. L. Shevel'kov's Article, 'Calculation of the Temperature Field in an Isotropic Medium in Front of Temperature Field in F. Ya. Lyubov, Inst of	£		
Temperature Field in an inoticpies, Inst of a Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Moving Scurce of Heat', " Ho Ya. Lyubov, Inst of Heat', " Ho Ya. Lyubov, " Ho			
"Thur Tekh Fiziki" Vol IVIII, No 5			
The correct solution of the equation $\frac{\partial t}{\partial \theta} = 2\frac{\partial t}{\partial \nu}$ .  when $\theta > 0$ ; $\nu > \xi(\theta)$ is $\mu = \xi(\theta) = 22\theta \leftrightarrow \frac{\nu}{2}$ .  not $\xi(\theta) = h - \zeta_0 \theta$ as stated by Shevel'kov.	96		



LYUBOV, B.Ya., kand.fiz.-mat.nauk

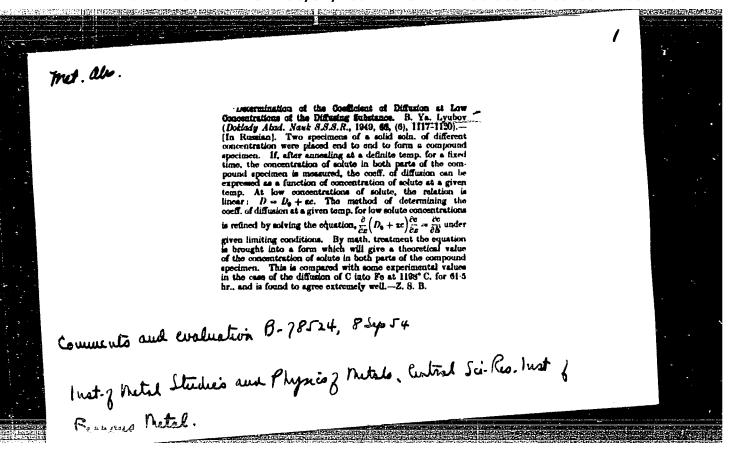
Cafculating the growth rate of a ferrite nucleus during isothermal
dissociation of austenite. Probl.metalloved.i fiz. met. no.[1]:316-321
dissociation of austenite. Probl.metalloved.i fiz. met. no.[1]:316-321
(MIRA 11:4)

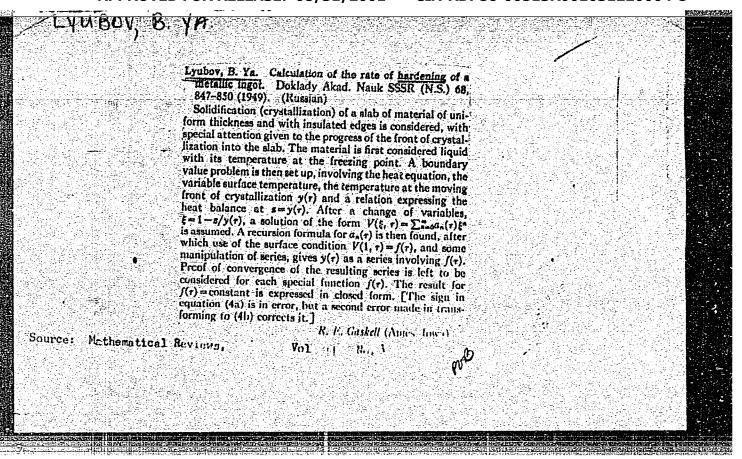
1.Otdel teoreticheskoy fiziki TSentral'nogo nauchno-issledovatel'skogo
instituta chernoy metallurgii.

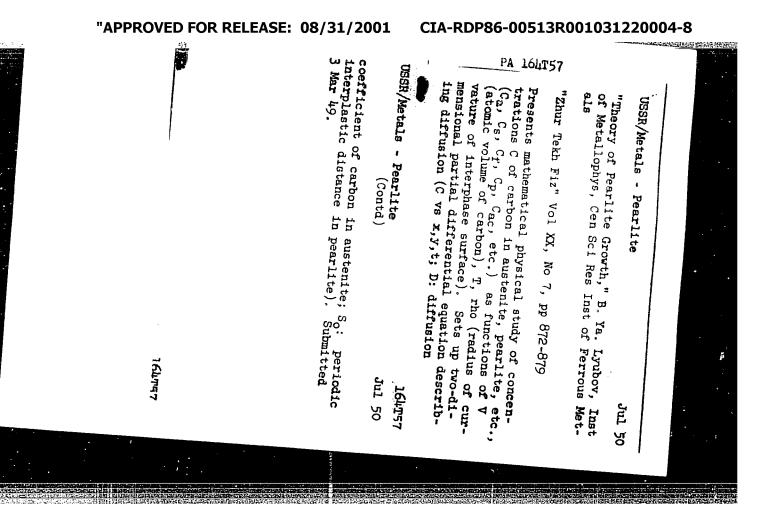
(Ferrite (Steel constituent))
(Metal crystals)

#### "APPROVED FOR RELEASE: 08/31/2001 C

#### CIA-RDP86-00513R001031220004-8

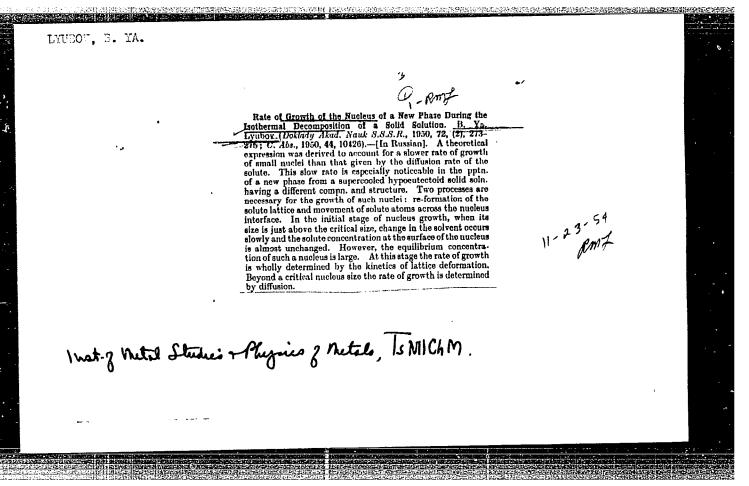






LYUROV, B. YA.	-		
	The influence of the stresses arising in the disintegration of solid solutions on the rate of growth of the nuclei of a new phase. B. Ya. Lyubov. Zhur. Tekh. Fiz. 20, 1344-52 (1950); Chan. Zehr. 1931, II, 490; cf. C.A. 47, 9126g. 10305g.—Calens. are reported which show that stresses 10305g.—Calens. are reported which show that stresses		
	arising from transitions in structure in the system Fe-C arising from transitions in structure in the system Fe-C accelerate the growth of the ferrite grains. It is assumed that the stresses developing in the growth of the nuclei of the new phase lie within the elastic limit. Under the influence of these stresses the max. of the curve showing the rate of growth of the nuclei is raised considerably and displaced to lower temps.  M. G. Moore	11-26-54	
•			
			5 , a.

APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001031220004-8"



IA 172T91

USSR/Physics - Steel

21 Oct 50

"Influence of Concentration Stresses Upon the Speed of Lateral Growth of the Pearlite Grain," L. I. Aleksandrov, B. Ya. Lyubov, Inst of Metal Studies and Phys of Metals, Cen Sci Res Inst of Ferrous Metallurgy

"Dok Ak Nauk" Vol LXXIV, No 6, pp 1081-1084

Math treatment of diffusion eq to clarify comparatively great speeds of decay of sclid soln for temp where speed of normal diffusion is small. Submitted 22 Jul 50 by I. P. Bardin.

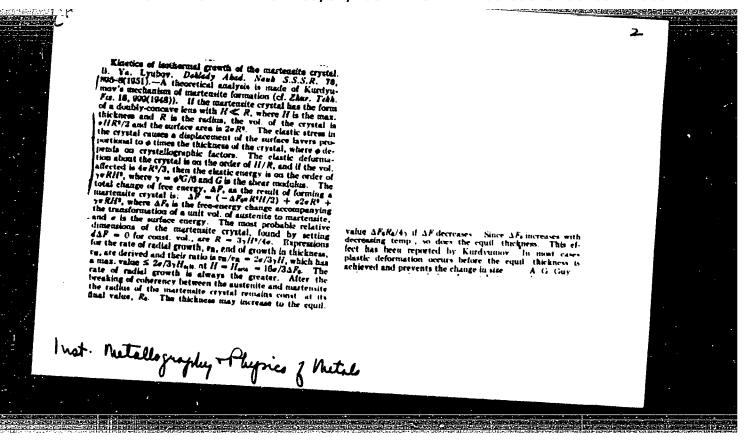
172791

Evaluation B-78945, 15 Syp 54

ALEKSANDROV, L.N.; LYUBOV, B.Ya., kand. fiz.-mat. nauk.

Effect of concentration stresses on the rate of pearlite grain edge growth. Probl. metalloyed. 1 fiz. met. no.2:256-270 '51.

(Steel-Metallography) (Strains and stresses) (MIRA 11:4)



LYUBOV, B.Ya., redaktor; MIEHAYLOVA, V.V., tekhnicheskiy redaktor [Problems of metallography and the physics of metals; third collection] Problemy metallovedeniia i fiziki metallov; tretii sbornik trudov. Moskva, Gos. nauchno-tekhn. izd-vo lit-ry po chernoi i tavetnoi metallurgii, 1952. 384 p. [Hicrofilm] 1. Moscow. TSentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii. (Metallurgy) (Metallography)

APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001031220004-8"

USSR/Metals - Steel, Structural Analysis Apr 52

LYUPOV, B. YA.

"The Field of Stresses Originating During the Decomposition of a Solid Solution Near the Spherical Nucleus of the New Phase," L. N. Aleksandrov, B. Ya. Lyubov, Inst of Metal Studies and Phys, TsNIIChM (Cen Sci Res Inst of Ferrous Metallurgy)

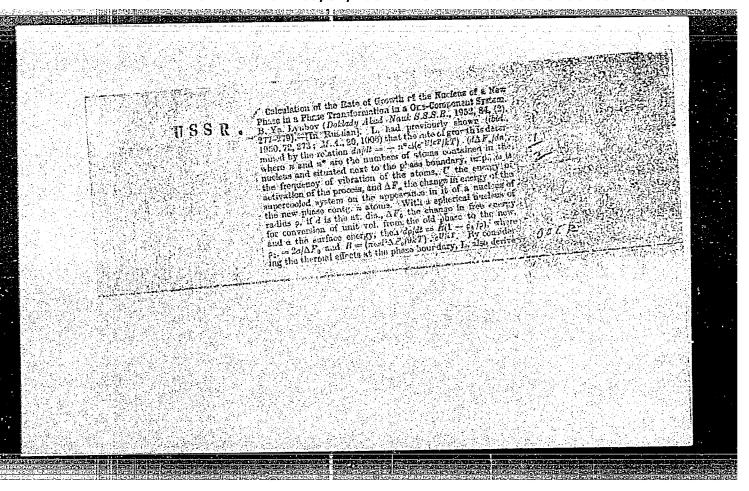
"Dok Ak Nauk SSSR" Vol LXXXIII, No 6, pp 833-835

Analyzes effect of stresses, caused by decompn of solid soln, on growth rate of new-phase nucleus and applies results obtained to calcn of stresses induced in supercooled austenite (T = 993° K) of hypocutectoid concn around sepg ferrite grain. Submitted by Acad I. P. Bardin 29 Feb 52.

223T48

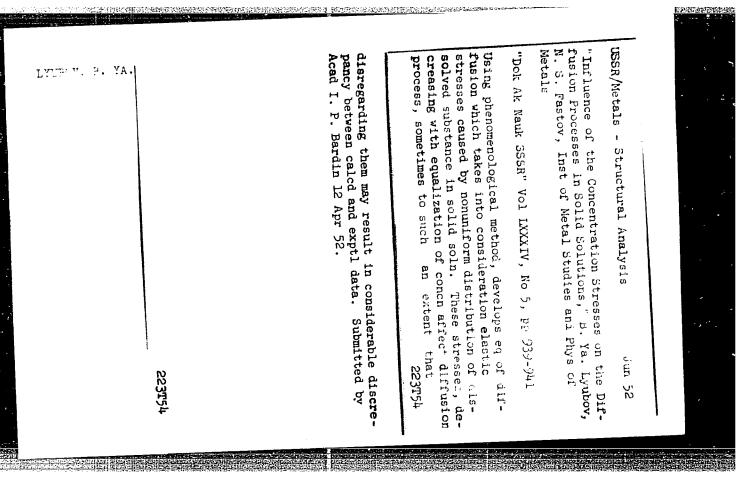
- 1. TYPET, B. Ta.
- 2. USUR (801)
- 4. Diffrusion
- 7. Determination of the diffusion coefficient D = Do ‡ 00%. Down AN SOUR AL no. 1, 1992. Institut Ketallovedeniya i Fiziki Metallov COMITON ed. 20 Feb. 1992
- 9. Monthly List of Russian Accessions, Library of Googress, Mepterber 1962, UNCLASSIFIED.

APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001031220004-8"



#### "APPROVED FOR RELEASE: 08/31/2001

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LYUBOV, B. IA.						Ph 230T62	
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USSN/Physics - Heat Conduction  11 Sep 52  "Initial Heating of Immobile Layer of Spheres by a Current of Hot das," G. P. Ivantsovy, B. Ya. Lyu-bov, Cen Sci Res Inst of Perrous Metallurgy  "Dok Ak Mauk SSSR" Vol 86, No 2, pp 293-296  Discusses soin of the problem concerning the initial heating of the layer of lumpy material by means of a current of hot gases, taking into account the temp drop with respect to thickness of the piece. Sets up the eqs involving radius of spheres, initial temp, temp of gas, velocity of spheres, initial temp, temp of gas, velocity of 235706  the gas, cross section for the gases, etc. solves by means of Laplace transformations. Submitted by Acad I. P. Bardin 8 Jul 52.

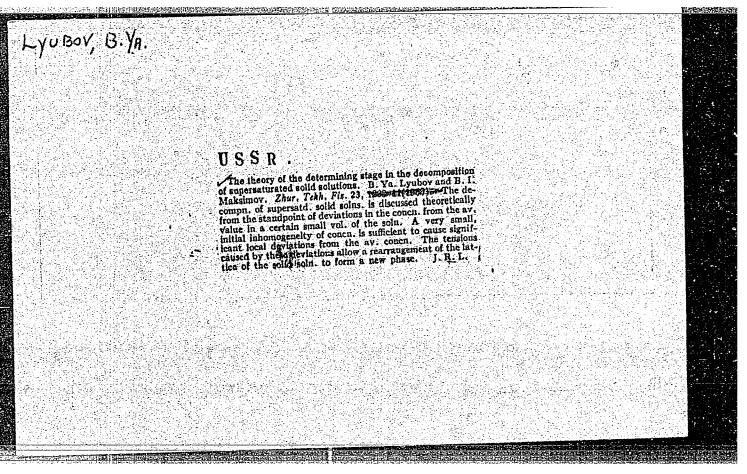
LYUBOV, B. Ya.

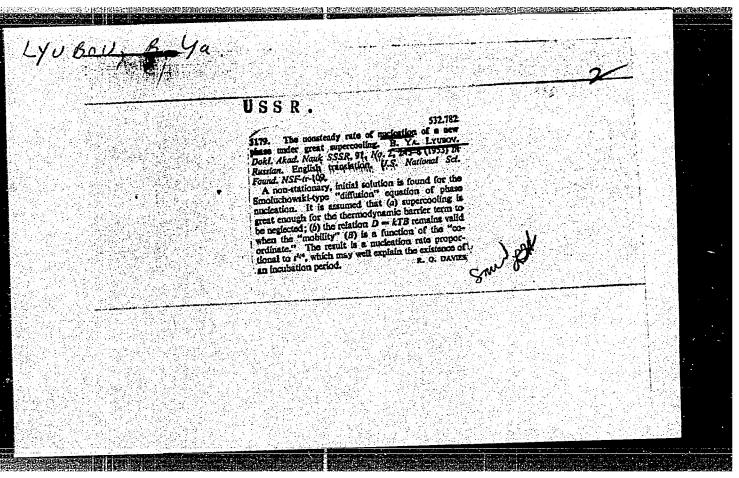
Dissertation: "The Theory of Isothermic Phase Conversions of Metals and Alloys."

Dissertation: "The Theory of Isothermic Phase Conversions of Metals and Alloys."

Dr Phys.-Math Sci. Khar'kov State U, Khar'kov, 1953. (Referativnyy Zhurnal.—Khimiya, Moscow, No 10, May 54)

So: SUM 318, 23 Dec 1954





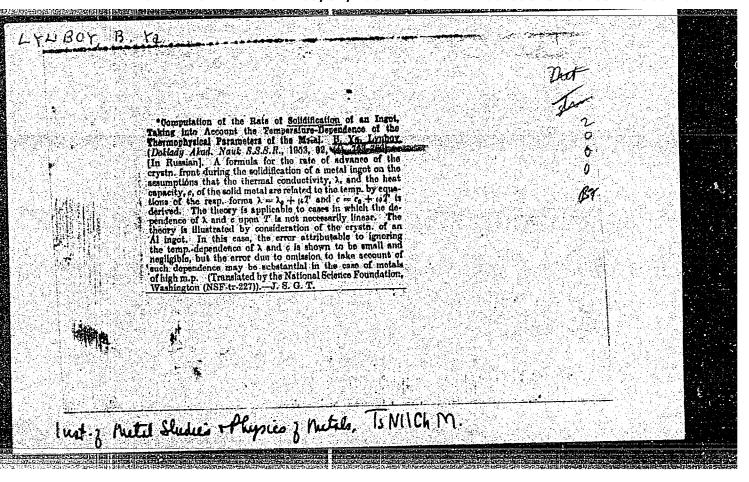
#### "APPROVED FOR RELEASE: 08/31/2001

CIA-RDP86-00513R001031220004-8

LYUBOV. B.Ya.

Metallurgical Abst. Vol. 21 May 1954 Structure The Effect of Plastic Deformation Arising During Decomposition of a Solid Solution on the Rate of Growth of a Nucleus of the New Phase. VI. N. Aleksandrov and B. Ya. Lvulov (Doklady Alnd. Nauk S.S.R.R., 1903, 91, (3), 519-522).—[In Russian]. Math. Equations are developed for the rate of growth of spherical nuclei from supersaturated solid soln, which take into consideration the effect of plastic deformation, and they are applied to isothermal growth of ferrite from austenite. The chief conclusion reached is that the atresses set up by the transformation cause the process to be autocatalytic. 6 ref. (Translated by the U.S. National Science Foundation (NSF-tr-95)).—D. M. P.

Inst. Metal Studies + Physics of Mutals, To NIICHM



APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001031220004-8"

LYUBOV, B. Ya.

(Boris Yakovlevich)

"Theory of Isothermal Phase Transformations in Metals and Alloys," (Dissertations), Academic Degree of Doctor in Physiomathematical Sciences, based on his defense, 27 February 1954, in the Council of Khar'kov State U im. Gor'kiy.

Central Sci Res Inst of Ferrous Metallurgy.

**■**M- 3,054,778, 2 Oct 57

HUME-ROTHERY, William; LYIEOV, B.Ya., redaktor [translator]; SELISSKIY, Ya.P., redaktor [translator].

[Atomic theory for students of metallurgy. Translated from the English] Atomnain teoriia dlia metallurgov. Perevod s angliiskogo i redaktsiia B.IA.Liubova i IA.P.Selisskogo. Moskva, Gos.nauchotekhn.izd-vo lit-ry po chernoi i tsvetnoi metallurgii, 1955. 332 p.

(Atomic theory) (Electrons) (Metals)

LYUBOV, B.Ya., redaktor; BEKKER, O.G., tekhnicheskiy redaktor.

[Problems of physical metallurgy and the physics of metals; fourth collection of papers] Problemy metallovedeniia i fiziki metallov; chetvertyi sbornik trudov. Moskva, Gos.nauchno-tekhn.izd-vo lit-ry po chernoi i tsvetnoi metallurgii, 1955. 6,0 p. (MLRA 8:9)

(Metallurgy)

Walustron B- 97978, 13 Jul 56

USSR/Solid State Physics - Diffusion, Sintering, E-6

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 34750

Author: Borisov, V. T., Lyubov, B. Ya.

Institution: None

Title: On the Theory of the Method of Determining the Diffusion Coefficient from

the Boundaries of the Grains of Metals

Original Periodical: Fiz. metallov i metallovedeniye, 1955, 1, No 2, 289-302

Abstract: Mathematical foundation and a refinement are given for the method of determining the diffusion coefficient from the boundaries of grains of metals, based on the Fisher model (Fisher, I. C., Jr. Appl. Phys., 1951, 22, 74).

1 of 1

- 1 -

LYUBOV, B.YA.

Category: USSR/Solid State Physics - Phase Transformation in E-5

Solid Bodies

Abs Jour : Ref Zhur - Fizike, No 3, 1957, No 6616

: Lyubov, B.Ya. Author

: Theory of the Growth of Centers of a New Fhase in Iscthermal Title

Decomposition of Austenite.

Orig Fub: Tr. Neuch.-tekhn. o-va chernoy metallurgii, 1955, 3, 39-44

Abstract: A theoretical analysis has been made of the growth of centers of a new phase in the isothermal decomposition of supercooled austenite. The new phase (ferrite, cementite or peerlite) differs from the initial one (custonite) both in its structure as well as in its composition. Consequently, the redistribution of the dissolved metter combines in the phase transition with the transition of the solvent from one structural form to enother. The kinetics of the process of the growth of the center are determined by which of the particular components of its simple processes causes a minimum rate of displacement of the boundary between the phases. Thus, for example, a schemetic analysis of the growth of the ferrite center (Dokl AN SSSR, 1952, 84, 277) shows that

: 1/2 Card

> APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001031220004-8"

LYVE Wy Balas USSR/Crystals.

B-5

Abs Jour : Referat Zhur - Khimiya, No 6, 1957, 18306

Author

Title

: B.Ya. Lyubov, B.I. Maksimov. : Theory of Determination Methods of Concentration Depen-

dence of Biffusion Factors in Solii Solutions.

Orig Pub : Probl. metalleved. i fiz. matallov, sb.4: 1955, 543-569

Abstract

: The theory of a new method to determine the dependence of the diffusion factor D on the concentration c is given. A special method to determine D = f(c) by means of radioactive indicators is developed. It is shown by examples that in case of thick layers, the new method yields results close to results yielded by Matano's method, and that the usual methods of determination of D with radioactive indicators yield values of D close to the mean values in the concentration interval in question.

Card 1/1

- 68 -

APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001031220004-8"

KAMENETSKAYA, D.S., kandidat fiziko-matematicheskikh nauk; LYUROV, B.Ya., kandidat fiziko-matematicheskikh nauk; ROSENBERG, V.M., kandidat tekhnicheskikh nauk.

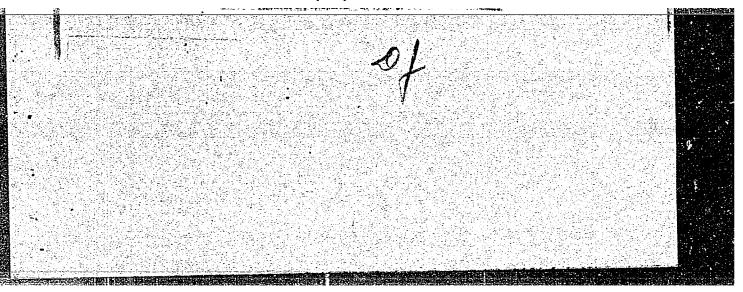
"Metallography." S.S.Shteinberg. Reviewed by D.S.Kamenetskaia, B.IA.Liubov, V.M.Rozenberg. Stal' 15 no.1:95-96 Ja '55. (MLRA 8:5)

1. Organizatsiya VNITOM pri TsNIIChM.
(Metallography) (Physical metallurgy) (Shteinberg, S.S.)

USSE/Physics - Martensite transformations Card 1/1 Pub. 22 - 18/51 Authors Lyubov, B. Ya, and Osipyan, Yu. A. Title On the kinetics of isothermal martensite transformation near absolute zero Dok. AN SSSR 101/5, 853-856, Apr. 11, 1955 Periodical Abstract Experiments with martensite transformations are described. experiments were conducted to determine that the phase transformations of martensite at temperatures near absolute zero do not depend on the temperature, but to the speed of such transformation and that it is a function of the energy of atomic fluctuations. Seven references:

1 British, 2 USA and 4 USSR (1935-1953). Table; graph. Institution : Central Scientific Research Institute of Ferrous Fetals, Institute of Netallography and Physics of Netals Presented by : Academician G. V. Kurdyunov, January 1, 1955

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APPROVED FOR RELEASE: 08/31/2001 CIA-RDP86-00513R001031220004-8"

41:84-66 141(m)/Em (v) T (p(t) ETT IU)(c) U ACC NR: AP6018526 SOURCE CODE: UR/0181/66/008/006/1683/1689

AUTHOR: Lyubov, B. Ya.; Solov'yev, V. A.

ORG: Central Scientific-Research Institute of Ferrous Metallurgy im. I. P. Bardin, Moscow (Tsentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii)

TITLE: Kinetics of disintegration of dislocation cracks on the polygonal walls of edge dislocations

SOURCE: Fizika tverdogo tela, v. 8, no. 6, 1966, 1683-1689

TOPIC TAGS: crystal dislocation phenomenon, crystal defect, crack propagation, metastable state, surface property, relaxation process, brittleness, hardening

ABSTRACT: The authors analyze the decay of metastable dislocation cracks on polygonal walls of edge dislocations, the decay being the result of diffusion over the surface of the crack. It is pointed out in the introduction that formation of dislocations along one side of a crack is energetically favored and that the diffusion on the surface of the crack is the more likely mechanism of disappearance of dislocation cracks at low temperatures. The time evolution of the diffusion of the atoms over the surface of the crack from the base of the crack, which is under compression, into the mouth of the crack, which is under tension, is described and the dislocation distribution produced during such an evolution is calculated. The decrease in volume accompanying the crack disintegration is also calculated as well as the relaxation times characterizing the process. It is concluded that dislocation cracks should

Card 1/2

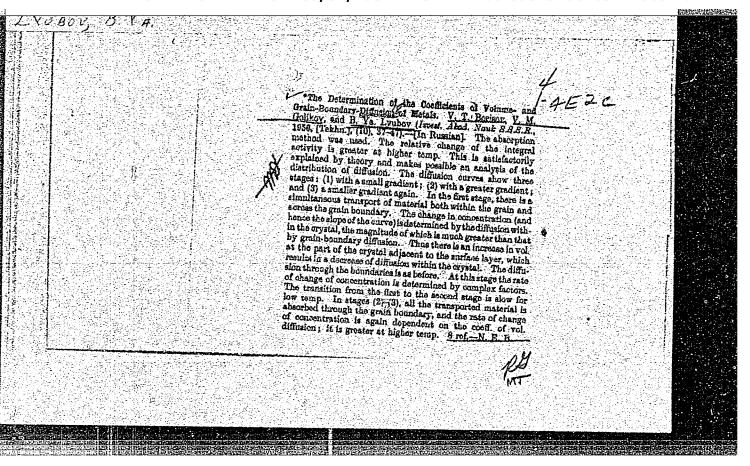
ACC NR: AP6018526

disintegrate as a result of diffusion on the vertical polygonal walls of its dislocations, with a decay time that depends strongly on the number of dislocations forming the crack. This disintegration probability is the cause of the experimental difficulty of observing microcracks. The process counteracts the development of cracks and consequently prevents brittle failure. The effect of this process on hardening produced by heat treatment is briefly mentioned. Orig. art. has: 24 formulas and 2 figures.

SUB CODE: 20/ SUBM DATE: 130ct65/ ORIG REF: 003/ OTH REF: 004

Card 2/2

41034-66\_



LYUBOV, B.Ya.; ROYTBURD, A.L.

Unsteady period in the nucleation of new phase centers during isothermal phase transformations in a single-component system. Dokl. AN SSSR 111 no.3:630-633 N '56.

(MLRA 10:2)

1. Institut metallovedeniya i fiziki metallov TSentral'nogo nauchno-issledovatel'skogo instituta chernoy metallurgii. Predstavleno akademikom G.V. Kurdyumovym.

(Phase rule and equilibrium)

## "APPROVED FOR RELEASE: 08/31/2001

## CIA-RDP86-00513R001031220004-8

Lyuber B YA.

137-1958-2-2486

Translation from Referativnyv zhurnal. Metallurgiva, 1958, Nr 2 p 42 (USSR)

AUTHOR. Lyubov, B. Ya

Physicomathematical Methods for Analyzing the Kinetics of the Solidification and Formation of the Structure of a Metal Ingot (Fiziko--matematicheskiye metody analiza kinetiki zatverdevaniya i formiro-TITLE vaniya struktury metallicheskogo slitka)

PERIODICAL V sb. Fiz -khim osnovy proiz-va stali Moscow. AN SSSR. 1957. pp 739-748 Diskus pp 781-791

An effort was made by means of mathematical analysis to solve the problem of the kinetics of the solidification of an ingot from the point of view of the heat exchange also the problem of the solidi-ABSTRACT fication of an ingot when account is taken of the physicokinetic factors which make it possible to compute the different crystalline structures in the ingot - It was concluded from the calculations that the effect of supercooling the metal in order to advance the front of acicular crystallization was small, that the initially significant supercooling on the crystallization front rapidly diminished and attained values of the order of 2-3°, that the temperature of the molten metal rapidly approached the temperature of the Card 1/2

CIA-RDP86-00513R001031220004-8" APPROVED FOR RELEASE: 08/31/2001

137-1958-2-2486

Physicomathematical Methods for Analyzing the Kinetics (cont.)

crystallization front, and that after the start of crystallization in depth (which led to the formation of a zone of equiaxial crystals in the ingot) the supercooling in the liquid phase was considerably less than on the crystallization front. This theory requires that the mechanisms of heat transfer and crystallization be defined more precisely and that account be taken of the three-dimensionality of the crystallization process

V.N.

1. Ingots—Solidification 2. Ingots—Structural analysis

3. Ingots Mathematical analysis

Card 2/2

137-58-6-13268

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 6, p 300 (USSR)

Maksimova, O.P., Golovchiner, Ya.M., Lyubov, B.Ya., AUTHORS:

Nikonorova, A.I.

Fundamental Trends in Investigations of the Theory of Mar-TITLE:

tensite Transformation (Osnovnyye napravleniya issledovaniy

v oblasti teorii martensitnykh prevrashcheniy)

PERIODICAL: Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-i. in-ta

chernoy metallurgii, Trans. Amer. Soc. Metals, 1957, Nr 49, pp 427-444. Discuss. 1958, Vol 5, pp 147-160

Fundamental problems of the study of laws governing the ABSTRACT:

martensite transformation (MT), the effect of various factors on it, and the control of the process of MT, also means and methods for the investigation of MT are formulated. Biblio-

graphy: 80 references.

L.V.

3. Metals--Trans-1. Martensite--Analysis 2 Martensite--Theory

formations

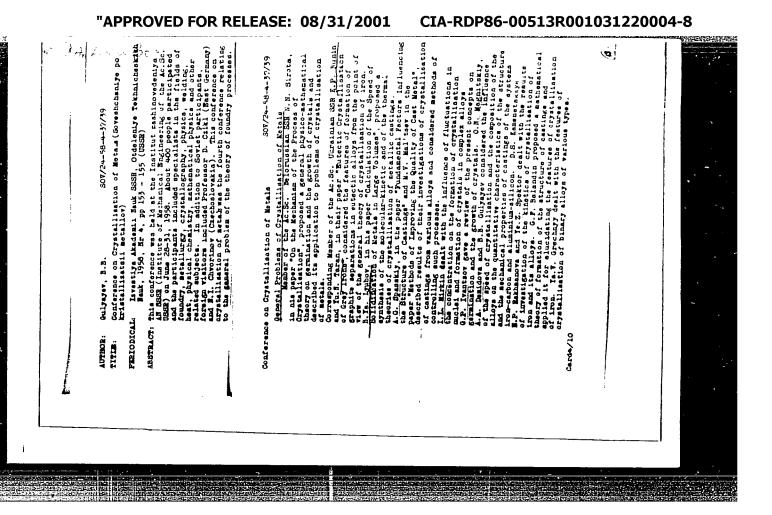
Card 1/1

CIA-RDP86-00513R001031220004-8" APPROVED FOR RELEASE: 08/31/2001

"Calculation of the Temperature Range and Rate of Shift of the Front of a Phase Transformation in Spherical Bodies," with Temkin, J. Ye., page 311.

In book Problems of Physical Metallurgy, Mescow, Metallurgizdat, 1958, 603p. (Its: Shornik trudov, v. 5)

The articles in the book present results of investigations conducted by the issuing body, Inst. of Physical Metallurgy, a part of the Cent. Sci. Ree. Inst. of Ferrous Metallurgy, located in Dnepropetrovsk. The investigations were occuperted with phase transformations in alloys, strengthening and softening processes, diffusion processes (studied with the aid of radicactive isotopes), and certain other questions.



#### CIA-RDP86-00513R001031220004-8 "APPROVED FOR RELEASE: 08/31/2001

SOV/137-58-7-15651

STATE OF THE STATE

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 7, p 248 (USSR)

Lyubov, B. Yar, Roytburd, A. L. AUTHOR:

On the Speed of Nucleation of a New Phase in Single-component TITLE:

Systems (O skorosti zarozhdeniya tsentrov novoy fazy v odnokom-

ponentynkh sistemakh)

PERIODICAL: Sb. tr. In-ta metalloved. i fiz. metallov Tsentr. n.-i. in-t

chernoy metallurgii, 1958, Vol 5, pp 91-123

The nonstationary process of nucleation (N) is analyzed ABSTRACT: theoretically. At a constant temperature the rate of N can be

considered independent of time and calculated according to the formula:  $J_{st} = K_{le} - \Delta \Phi_k/RT - u/RT$  only after the lapse of a certain amount of time from the beginning of the isothermal soaking [time of the nonstationary state (TS)]. On the basis of the solution of the kinetic equation describing the nonstationary N process, an evaluation of TS during phase transformation in single-component systems is made. The deductions of the general theory are applicable to the investigation

of transformations in the solid state, which proceed without changes in the chemical composition of the phases. The TS is Card 1/2

SOV/137-58-7-15651

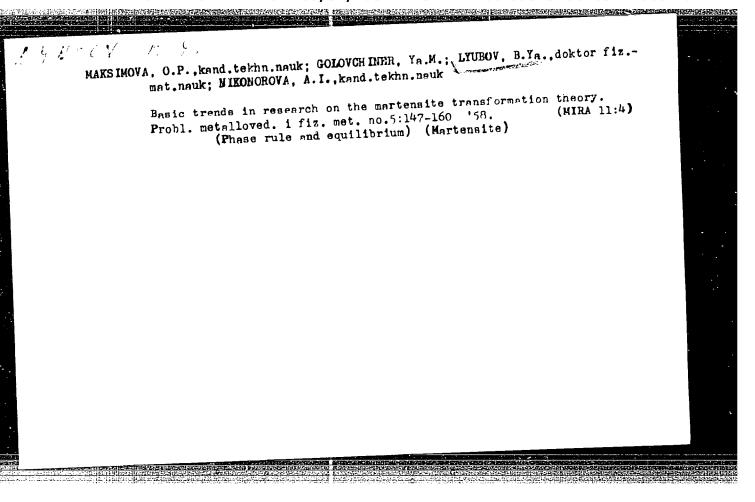
On the Speed of Nucleation of a New Phase (cont.)

 $<10^{-7}-10^{-10}$  sec for processes with a low activation energy (AE) (martensite transformation) but can be considerable (commensurable with the time of complete transformation) in processes with AE close to the AE of self-dif-fusion (normal polymorphic transformations). Therefore the N process with martensite transformation may be regarded as stationary. The application of a stationary expression for the rate of N in the case of normal polymorphic transformation might lead to considerable errors and demands a preliminary evaluation of TS. Bibliography: 36 references.

L. V.

2. Nuclear physics--Applications 1. Alloys--Transformations

Card 2/2



SOV/137-58 11 23356

Translation from: Referativnyy zhurnal. Metallurgiya, 1958, Nr 11, p 216 (USSR)

Lyubov, B. Ya. AUTHOR:

A Theory on the Growth of New-phase Centers During Phase Trans TITLE:

formations in a Single-component System (Teoriya rosta tsentrov novoy fazy pri fazovykh prevrashcheniyakh v odnokomponentnov

sisteme)

PERIODICAL: Sb. tr. In-t metalloved, i fiz. metallov Tsentr. n -1. in-ta chernoy metallurgii, 1958, Vol 5, pp 294-310

A theoretical analysis of the process of growth of new phase centers ABSTRACT:

during phase transformations in a single component system employing the methods of the thermodynamics of unbalanced conditions and the theory of the absolute reaction rates, the author derives a formula for the rate of growth of a new phase center under isothermal conditions as a function of its radius. The growth of a new phase is also examined by taking into consideration the temperature variations on the phase boundaries resulting from the liberation of the latent

heat of fusion. The results of the theory are applied to an analysis

of polymorphous and martensitic transformations. The role of Card 1/2

CIA-RDP86-00513R001031220004-8" **APPROVED FOR RELEASE: 08/31/2001** 

SOV/137-58-11 23356

A Theory on the Growth of New-phase Centers During Phase Transformations (cont.)

quantum effects was investigated with particular emphasis on the tunnel effect during the growth of a martensite crystal at low temperatures. Bibliography: 21 references A. R.

SOV/137-58-9-19809

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 9, p 242 (USSR)

AUTHORS: Lyubov, B.Ya., Temkin, D.Ye.

TITLE:

Calculation of the Temperature Field and the Rate of Displacement of a Phase-transformation Front in Spherical Bodies (Raschet temperaturnogo polya i skorosti peremeshcheniya fronta fazovogo prevrashcheniya v sfericheskikh telakh)

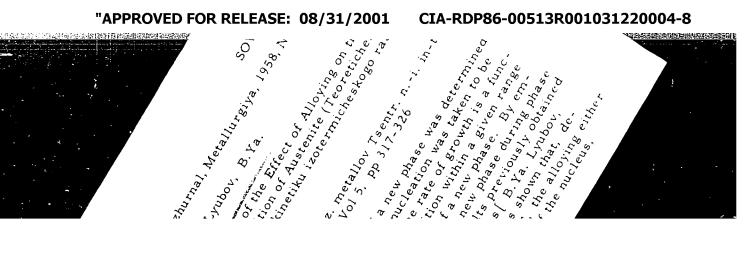
PERIODICAL: Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-i. in-ta chernoy metallurgii, 1958, Vol 5, pp 311-316

ABSTRACT:

Starting with the equations for thermal conductivity the authors determine the temperature field in a solid phase and formulate an expression for the law governing the growth, as a function of time, of the region occupied by a solidifying melt contained within a spherical volume of a liquid phase that is maintained at the temperature of crystallization,  $T_k$ ; at the initial instant the surface of the sphere is cooled below  $T_k$ , while the solid phase is absent entirely. A method which has while the solid phase is employed (RZhFiz, 1956, Nr 4, abbeen developed earlier is employed (RZhFiz, 1956, Nr 4, abstract 10468). Equations for the time of the beginning and the end of the process are derived. 1. Metals—Transformations

Card 1/1

V.R.



SOV/137-58-9-19818

A Theoretical Analysis of the Effect of Alloying (cont.)

providing the diffusion of the alloying element itself does not retard the process. Critical dimensions were established for a nucleus, determined primarily by the diffusion process. The time required for completion of T's with various mechanisms was expressed analytically as a function of temperature. A formula for determination of the nucleation rate of a new phase is given. In the case of nonalloyed austenite, the mechanism of lattice modification gains in importance as the temperature is reduced; at temperatures below 600°C this mechanism becomes a determining factor. At temperatures above 650° the mechanism of diffusion of C is of predominant importance. The process of diffusion of C determines the rate of T in nonalloyed steels and in steels containing alloying elements which noticeably elements that have a small tendency to retard the diffusion of C (Mn, Ni, W), or which tend to accelerate it, the process of modification of the Fe lattice becomes a decisive factor.

V.R. -- Transformations 2. Alloys--Metallurgical effects 3. Metallurgy

Card 2/2

SOV/137-58-9-19818

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 9, p 244 (USSR)

AL'THORS: Aleksandrov, L.N., Lyubov, B.Ya.

TITLE:

A Theoretical Analysis of the Effect of Alloying on the Kinetics of Isothermal Decomposition of Austenite (Teoreticheskiy analiz vliyaniya legirovaniya na kinetiku izotermicheskogo raspada austenita)

PERIODICAL:

Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-1. 1n-ta chernoy metallurgii, 1958, Vol 5, pp 317-326

ABSTRACT:

The rate of growth of nuclei of a new phase was determined as a function of time. The rate of nucleation was taken to be constant at a given temperature. The rate of growth is a function of the mechanism of phase transition within a given range of dimensions of the growing nucleus of a new phase. By employing the equation for the volume of a new phase during phase transformations (T) and by utilizing results previously obtained transformations (T) and by utilizing results previousl

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SOV/137-58-9-19818

A Theoretical Analysis of the Effect of Alloying (cont.)

providing the diffusion of the alloying element itself does not retard the process. Critical dimensions were established for a nucleus, determined primarily by the diffusion process. The time required for completion of T's with various mechanisms was expressed analytically as a function of temperature. A formula for determination of the nucleation rate of a new phase is given. In the case of nonalloyed austenite, the mechanism of lattice modification gains in importance as the temperature is reduced; at temperatures below 600°C this mechanism becomes a determining factor. At temperatures above 650° the mechanism of diffusion of C is of predominant importance. The process of diffusion of C determines the rate of T in nonalloyed steels and in steels containing alloying elements which noticeably inhibit the diffusion process (Cr, Mo). In the case of steels alloyed with elements that have a small tendency to retard the diffusion of C (Mn, Ni, W). or which tend to accelerate it, the process of modification of the Fe lattice becomes a decisive factor. V.R.

1. Anstenite--Transformations 2. Alloys--Metallurgical effects 3. Metallurgy -- heory

Card 2/2

LYMBON B. SA

ATTHOR: Shvarto

Shvartoman, L. A., Dector of Decidal Sciences. 30-1-13/3)

TITLE:

The Practice of the Application of Isotopes for Technical Purposes (Iz grantiki princhaniya izotopov v tekhnike).

PERICDICAL:

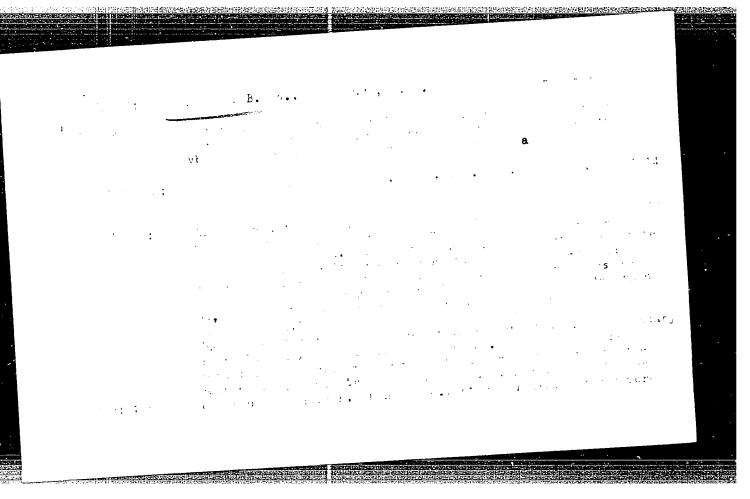
Vestnik AN 355R, 1950, 701. 20, Fr 1, 72. 79-83 (7351)

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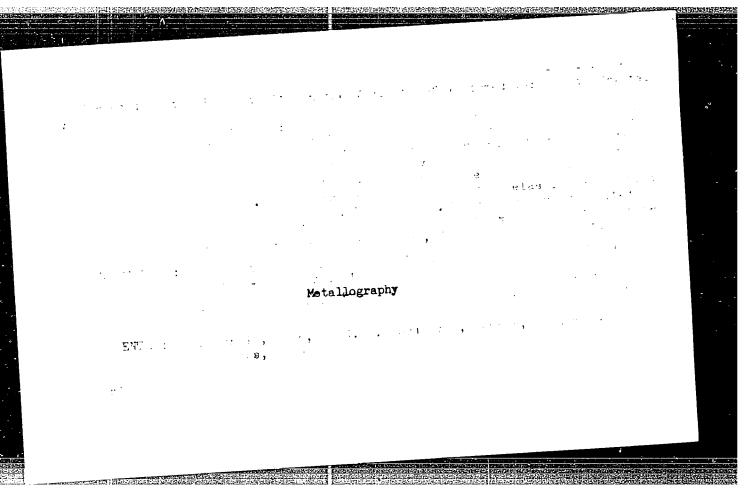
ABJTRACT:

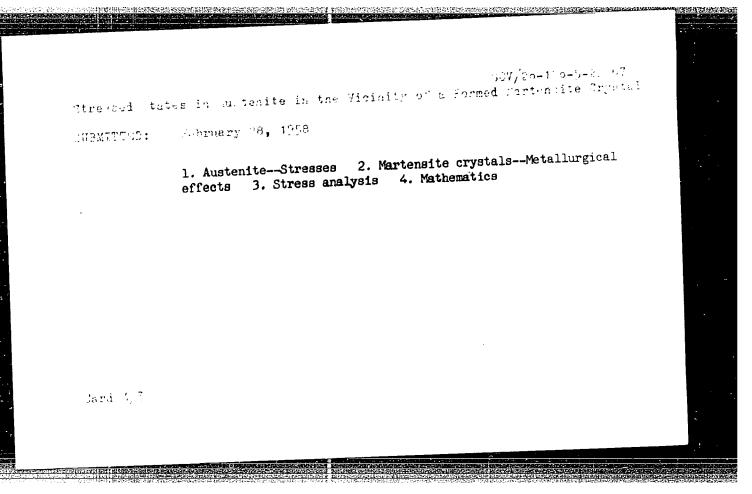
The majority of report, delivered at the Paris Conference in 1957 dealt with problems of metalluray. The Folish authors T. Malikevich and R. Vuzatovskiy used the radioactive isotupes Fe59 for the explanation of the distribution of non-metallic inclusions in a steel block, which get into the liquid metal during casting from the refractory materials. For this juryose iron oxide which was enriched by Fe59 was introduced into the raw clay from which the bricks for the lining of the casting device were made. After casting the ingots and blocks were autoradiographed, and besides the radicactive intensity of radiation of the metal w s measured. These experiments were also carried out with various refractories in order to determine their influence. The Soviet metal experts V. T. Borisov, V. M. Golikov, B. Ya. Lyahov, and G. V. Shcherbedinskiy in their rerort dealt with problems of diffusion in real metals, which have a polyprystalline structure. A. A. Zhukhovitskiy, M. Ye. Yanitskaya, and A. D. Jotskov reported on the results of the

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PHASE I BOOK EXPLOITATION

SOV/2125

Tsentral'nyy nauchno-issledovatel'skiy institut chernoy metallurgii. Institut Metallovedeniya i fiziki metallov

Problemy metallovedeniya i fiziki metallov (Problems in Physical Metallurgy and Metallophysics) Moscow, Metallurgizdat, 1959.

540 p. (Series: Its: Sbornik trudov, 6) Errata slip inserted. 3,600 copies printed.

Additional Sponsoring Agency: USSR. Gosudarstvennaya planova komissiya.

Ed. of Publishing House: Ye.N. Berlin; Tech. Ed.: P.G. Islent'yeva; Editorial Board: D.S. Kamenetskaya, B.Ya. Lyubov (Resp. Ed.), Ye.Z. Spektor, L.M. Utevskiy, L.A. Shvartsman, and V.I. Malkin.

PURPOSE: This book is intended for metallurgists, metallurgical engineers, and specialists in the physics of metals.

COVERAGE: The papers in this collection present the results of investigations conducted between 1954 and 1956. Subjects

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Problems in Physical Metallurgy (Cont.)

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covered include crystallization of metals, physical methods of influencing the processes of crystallization, problems in the physical chemistry of metallurgical processes, development of new methods and equipment for investigating metals, and production control. References follow each article.

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### CRYSTALLIZATION OF METALS PART I.

Dukhin, A.I., Candidate of Physical and Mathematical Sciences. Crystallization of Metals and Alloys in Small Volumes

Dukhin, A.I., and V.Ye. Neymark, Candidate of Physical and Mathematical Sciences. Effect of Boron and Titanium on the

The results of measuring the supercooling of steels lead to Supercooling of Steel the conclusion that the energy of nucleation in type-Kh18N9 austenitic steel is much greater than in type-Kh27 ferritic steel. This explains the difficulty of refining the grain of ingots of Kh18N9 steel by means of additions of titanium and boron, as well as the ease of refining the gain of Kh27

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S07/2125 Problems in Physical Metallurgy (Cont.) steel with the aid of seed crystals. It was shown that modifying additions of titanium and boron diminish the capacity of Kh23N18 steel for significant supercooling. Titanium and boron, at concentrations which produce minimum supercooling of the melt, refine the dendritic structure at rapid rates of solidification. Neymark, V.Ye., and A.I. Dukhin. Effect of Modifying Agents on the Structure, Skin Deformation, and Solidification Rate of Steel 39 Skin defects were revealed in ingots of four types of steel (St. 3, Kh27, Kh23N18, and Kh18N9) by the vacuum-crystalli-Ingots zation method. It was found that modifying agents (titanium, zirconium, and boron) reduce skin deformation and accelerate the skin-solifidication rate of these steels in varying degrees. The results obtained suggest that it would be advisable to investigate the possibility of using modifying agents for lessening skin deformation and increasing the skin-solidification rate in the continuous casting of steel. Card 3/18

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Problems in Physical Metallurgy (Cont.)

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Kamenetskaya, D.S., Candidate of Physical and Mathematical Sciences; E.P. Rakhmanova; Ye.Z. Spektor; and V.I. Shiryayev. The Mechanism of the Effect of Aluminum on the Formation of Crystallization Centers in Liquid Iron

Liquid primary iron (electrolytic and direct-reduction) containing no active undissolved impurities or surface-active dissolved impurities can easily be supercooled 260-270° C, below the melting point. Nonactivated particles of Al203 have little effect on the development of crystallization centers in iron. But the start of the crystallization process in iron containing particles of Al<sub>2</sub>0<sub>3</sub> has an activating effect on the particles and results in a decrease in supercooling capacity. The introduction of small quantities of aluminum into iron sharply reduces the supercooling capacity. The small degree of supercooling in such cases is in accord with the fact that additions of aluminum to steel act to refine the grain. In view of the results of this investigation and others, this effect may be explained by the fact that small additions of aluminum decrease the energy of nucleation in liquid iron. Because of the surface activity of aluminum, nucleation can take place spontaneously with but slight supercooling, as a result of which a fine-grained cast structure is obtained.

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SOV/2125 Problems in Physical Metallurgy (Cont.) Malkin, V.I., Candidate of Technical Sciences. Mechanism of the 76 Growth of Crystalls From the Liquid Phase Lyubov, B.Ya., Doctor of Physical and Mathematical Sciences, and D.Ye Temkin. On the Theory of Crystallization in Large Volumes ∂# Leont'yev, V.I. Effect of Ultrasonic Waves on the Crystallization For effective passage of ultrasonic waves through molten metal it is necessary to establish a definite limit of specific of Ingots ultrasonic power. The time necessary for action of the waves on the molten metal must exceed a certain minimum, but at the same time need not be as great as that required for complete solidification. Better results are obtained with the use of wider ingot molds and slower cooling. Ultrasonic waves induce intensive crystallization in all directions from numerous nuclei, the formation of which is aided by the action of the waves. Card 5/18

SOV/2125 Problems in Physical Metallurgy (Cont.) Gurevich, Ya.B., Candidate of Technical Sciences; V.I. Leont'yev; and I.I. Teumin, Candidate of Physical and Mathematical Sciences. Effect of Elastic Vibrations During Crystallization on the Structure, Mechanical Properties, and Deformability of Kh27 117 The application of elastic vibrations during crystallization results in a marked refinement of the grain. The linear and Kh25N2O Steel dimensions of the grains are 3-5 times smaller than those of ordinary grains. Columnar crystals are almost entirely lacking. In addition, nonmetallic inclusions are relatively small and uniformly distributed. The mechanical properties of both types of steel are improved. Neymark, V.Ye. Application of the Vacuum-Crystallization Method for Producing Hollow High-alloy Steel Ingots for Rolling Into 137 This method is recommended for the production of high-Tubes quality thin-walled ingots (blanks). In cases where the blanks are long and thich-walled, or short and thin-walled, the centrifugal-casting method is preferred. The vacuumcrystallization method is still in the experimental stage, Card 6/18

SOV/2125 Problems in Physical Metallurgy (Cont.) but is already being used at several Soviet machine-building plants for producing hollow cylindrical blanks from

nonferrous metals and alloys.

Yemyashev, A.V.; A.M. Zubko, Candidate of Physical and Mathematical Sciences; and V.Ye. Neymark. On the Effect of Vacuum Melting and Teeming on Metal Properties and Ingot Quality

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Zelenov, A.N., and D.S. Kamenetskaya. Effect of Inert Gas Pressure in the Furnace on Gas Content in the Metal The content of nitrogen and hydrogen in metal melted in an atmosphere of argon at a pressure of 1-450 mm. Hg has little relationship to the pressure of the argon and is considerably lower than in the original charge. The inert gas must be purified of oxygen if a pressure is used at which the partial pressure of oxygen would exceed 0.01 mg. Hg. The same applies to nitrogen contained in the inert gas, provided the nitrogen reacts with the metal,

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SOV/2125 Problems in Physical Metallurgy (Cont.) Gorbatenko, A.K., and D.S. Kamenetskaya. On the Shape of 191 Equilibrium Curves of Binary Alloys PART II. PHYSICAL CHEMISTRY OF METALLURGICAL PROCESSES Tomilin, I.A., Candidate of Technical Sciences, and L.A. Shvarts-man, Doctor of Chemical Sciences. Effect of Silica, Calcium Oxide, and Sodium Oxide on the Distribution of Sulfur and 199 Phosphorus in Iron and Ferruginous Slag It was found that the heat of transfer of sulfur from iron to slag in the system FeO-SiO2, saturated with silica, is decreased by the addition of CaO to the slag. At a concentration of about 20 percent CaO the heat of reaction amounts to some 13,000 cal./g. atom, which coincides with the heat of transfer of sulfur from iron to ferruginous slag. Further, on increasing the content of CaO in the slag, a certain increase in entropy takes place. An overall result of these processes is a reduction in the value of the coefficients of sulfur distribution in comparison with acid slag not containing CaO. The introduction of Na2O into the slag causes the same phenomenon to take place, but in a greater degree. These Card 8/18

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facts may be explained by the specific interaction of ions in the acid fusion. The free energy of solution of solid iron sulfide in ferruginous and ferruginous-silicate slags was calculated. It was shown that the heat of transfer of calculated. It was shown that the heat of transfer of phosphorus from iron to acid slag does not differ from the corresponding figure in the case of ferruginous slag. The coefficients of diffusion of phosphorus, however, are considerably less in the first case than in the second. This can siderably less in the first case than in the second. This can be explained by the presence of a "structure" of silicate polymers in the acid slag. Additions of CaO and Na2O to acid polymers in the acid slag. Additions of dephosphorization, and slag increase the heat of reaction of dephosphorization, and at the same time the values of the coefficients of distribution rise.

Kozhevnikov, I.Yu., Candidate of Technical Sciences, and L.A. Shvartsman. Effect of Oxides of Alkali Earth Metals on the Equilibrium of the Dephosphorization Reaction of Iron

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zation in the temperature range of the viticods by zation in the temperature range this relationship can be within a narrow temperature range this relationship can be described by a simple exponential law. Determinations were also made of the energy of activation of the rate of also made of the energy of activation crystallization. The high value of the energy of activation		
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for slag consisting of 23 percent CaO, 18 percent Al <sub>2</sub> O <sub>3</sub> , and 59 percent SiO <sub>2</sub> (66,000 k cal./mol) as compared with that for slag consisting of 23 percent CaO, 32 percent Al <sub>2</sub> O <sub>3</sub> , and slag consisting of 23 percent CaO, 32 percent Al <sub>2</sub> O <sub>3</sub> , and 45 percent SiO <sub>2</sub> indicates the presence of cationic aluminum	
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Shvartsman, L.A., A.I. Osipov,, V.I. Alekseyev, V.F. Surov, M.L. Sazonov, M.T. Bul'skiy, S.A. Telesov, A.M. Skrebtsov, A.M. Ofengenden, L.G. Gol'dshteyn, and F.F. Sviridenko. An Investigation of the Kinetics of Scrap Melting in the Scrap-Ore Process

A method for determining the speed of melting scrap in

A method for determining the speed of melting scrap in an open-hearth furnace in the scrap-ore process was developed on the basis of this investigation. The method is based on "isotopic dilution" using radioactive cobalt. It was shown that the melting speed depends on the duration of the pig iron pouring process and carbon content in the

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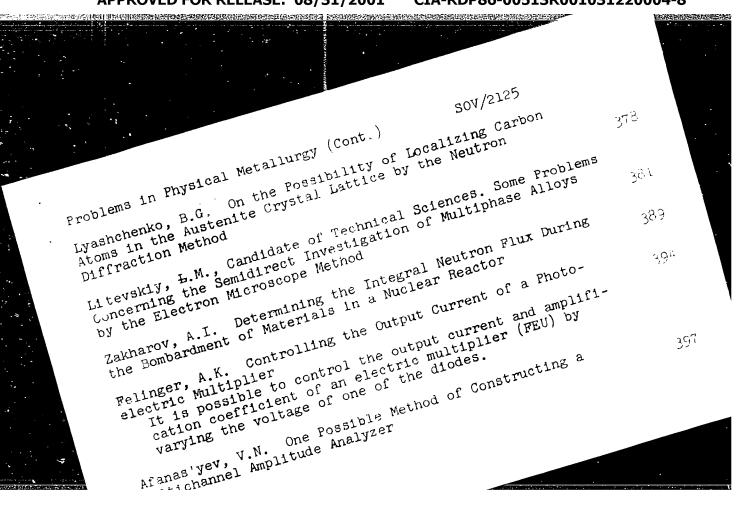
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bath.

SUV/2125 Problems in Physical Metallurgy (Cont.) metallic portion of the charge. The speed of sulfur absorption during this period is 17-25 percent per hour, during preheating 8-11 percent, and during final melting 3-7.5 percent. Percentage is based on the sulfur content in the metal. PART III. METHODS AND EQUIPMENT Perkas, M.D., Candidate of Technical Sciences. Determination the Depth of Decarburized and Carburized Layers by the X-ray Determination of 36.3 The maximum carbon content in the specimen was found to be not of the surface but at some depth (0.1-0.2 mm.) from Method Zubko, A.M., Candidate of Physical and Mathematical Sciences, and Ye.Z. Spektor. A Quantitative Method for Determining the 372 Graphitization of Coke in the Blast Furnace card 13/18

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Problems in Physical Metallurgy (Cont.)  Pliskin, Yu.S. Method of Designing Installations for Levitation Melting of Metals.  Methods of levitation melting of metals are compared, and a simple method of designing an inductor sufficiently accurate for practical purposes is proposed.  Teumin, I.I. Principles of Designing Magnetostrictive Vibrators  Basic principles of designing magnitostrictive vibration for untrasonic industrial equipment are presented. Special attention is given to the analysis of operating conditions in machining crystallizing metals and alloys  Latyshev, V.K., and A.K. Felinger. Logarithmic Electron Converter for Type MF-4 Microphotometer  Tatochenko, L.K., Yu-V. Moysh, V.V. Lyndin, and B.S. Tokmakov. Magnetic Particle Inspection Method Used in Metallurgy  Card 15/18			
Methods of levitation melting of metals are compared, and a simple method of designing an inductor sufficiently accurate for practical purposes is proposed.  Teumin, I.I. Principles of Designing Magnetostrictive Vibrators  Basic principles of designing magnitostrictive vibration for untrasonic industrial equipment are presented. Special attention is given to the analysis of operating conditions in machining crystallizing metals and alloys  Latyshev, V.K., and A.K. Felinger. Logarithmic Electron Converter for Type MF-4 Microphotometer  Tatochenko, L.K., Yu-V. Moysh, V.V. Lyndin, and B.S. Tokmakov. Magnetic Particle Inspection Method Used in Metallurgy  460	Problems in Physical Metallurgy (Cont.) SOV/2125		
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Zakharov, A.I. Proportional Neutron Counters Utilizing Boron Trifluoride The author states that, ordinarily, gas obtained from the composition of a solt by heating is used in proportional neutron counters. However, he further states, BF3 obtained from glass containers is also effective.  Kornev, Yu.V., Candidate of Physical and Mathematical Sciences. A Simple Electronic Magnetic Spectrometer for Identifying Radioactive Isotopes A simple portable design of a beta-spectrometer based on focusing electrons by means of a transverse uniform magnetic field is described.  Tatochenko, L.K., and V.V. Lyndin. Instrument for Rapid Determination of the Curie Point The instrument described is successfully being used at the TsNIIChM for investigating properties of ferromegnetic alloys.  Card 16/18	
Radioactive Isotopes  A simple portable design of a beta-spectrometer based on focusing electrons by means of a transverse uniform magnetic field is described.  Tatochenko, L.K., and V.V. Lyndin. Instrument for Rapid Determination of the Curie Point The instrument described is successfully being used at the TsNIIChM for investigating properties of ferromegnetic alloys.	
The instrument described is successfully being used at the TsNIIChM for investigating properties of ferromegnetic alloys.	
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It was found that a substantial increase in plasticity results from the addition of 0.1-0.2] percent. Al and 0.2-0.3 percent Ba-Al alloy. Addition of Titanium greatly reduces the plasticity.

Tokmakov, V.S. Experience Gained in the Use of Gamma-ray Flaw-detection Method in Metallurgy Experience gained in the use of radioactive isotopes for the purpose of flaw detection has shown that it is possible

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to use this method in checking castings and welded structures.

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s/137/62/000/006/089/163 A160/A101

AUTHORS:

Lyubov, B. Ya., Temkin, D. Ye.

TITLE:

The theory of crystallization in large volumes

FERI # FEAL: Referativnyy zhurnal, Metallurgiya, no. 5, 1962, 4, abstract 6125 ("Sb. tr. In-t metalloved. i fiz. metallov Tsentr. n.-i. in-ta chernoy metallurgii", v. 6, 1997, 84 - 99)

A calculation was made of the solidification rate of a metal ingot with consideration of undercooling. Crystallization processes for two boundary cases were considered: for a case of total intermixing and for a case of heat extrange in the melt by heat conductivity. It is shown that the undercooling at the front of the crystallization quickly decreases as it proceeds and soon diminishes to a minimum after the beginning of the process. From an analysis of the equations obtained it is concluded that the overheat gradually abates during the solidification process of the ingot and that the remaining liquid proves to he undercooled at the given moment. Due to this fact, new centers of crystallimation may arise. The results of the work permit the explanation of the pre-

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he theory of crystallization in large volumes	3/137/62/000/006/089/163 A160/A101	
care of three zones in the ingot: the zone of a systais, the columnar zone, and the central zone of		
	n, valyenko	
Abstracter's note: Complete translation]		
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SOV/126-8-2-10/26

AUTHORS: Aleksandrov, L.N. and Lyubov, B.Ya.

TITLE: Contribution on the Influence of Alloying on the

Kinetics of the Pearlite Transformation

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 8, Nr 2,

pp 216 - 224 (USSR)

ABSTRACT: Considerable differences of opinion exist (R.I. Entin

et al - Refs 1-4) on the reasons for the influence of alloying elements on the kinetics of the pearlite trans-

formation in austenite. This transformation, the

authors point out, is important not only in eutectoidal

but also in hyper- and hypo-cutectoidal steels since the excess ferrite (or cementite) liberated in the early stages of the transformation leads to the attainment of the cutectoidal state. To elucidate the influence of alloying elements the relation between the rate of

formation of centres of the new phase, the lateral rate of growth of the pearlite grain, the alloying element concentration and the transformation temperature were

studied. The authors use available information (Ya. S.

Card1/4 Umanskiy et al - Refs 6-8) to discuss these relations.

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SOV/126-8-2-10/26 Contribution on the Influence of Alloying on the Kinetics of the Pearlite Transformation

They consider the movement of the austenite/pearlite boundary, ignoring its curvature, obtaining an equation from which the rate of growth of a pearlite grain in the eutectoidal transformation of both unalloyed and alloyed steel; the equation, unlike previous ones (Refs 4,9) has no constants determined from rates found experimentally. As a first approximation, the authors assume that the change of activation energy for the  $\gamma \rightarrow \alpha$  iron transformation on alloying corresponds to the change of that of the self-diffusion. From their equation the authors conclude that alloying can reduce the rate of rearrangement of the iron lattice to such an extent that it becomes rate-controlling. To calculate the rate of growth of pearlite grains depending on diffusion of carbon in alloyed austenite, the authors use their previous (Ref 12) results, allowing for the considerable influence

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of concentrating strains on diffusion. Calculated values of pearlite-transformation rate are close to or considerably higher than experimental for unalloyed or chromium steel, respectively. A form of the diffusion equation is solved by the authors in their previous manner (Ref 12) to give relations for pearlite-growth rate in the formation of ferrite-carbide mixture where this is limited by diffusional redistribution of the alloying element in austenite. They conclude that this could not be the ratecontrolling factor for chromium, nickel, manganese and some other alloying elements with a high activation energy of diffusion, but could be for elements such as molybdenum. The authors then deduce kinetic equations for the pearlite transformation for control by iron-lattice rearrangement, by carbon diffusion and alloying element diffusion. They calculate kinetic curves for 50% transformation of austenite in unalloyed (Figure 1) and alloyed (0.4% C, 8.5% Cr) steel and consider a steel with 0.5% Cr and 0.4% C; then compare

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Contribution on the Influence of Alloying on the Kinetics of the Pearlite Transformation

calculated and experimental results. With over 2.5% Cr, the pearlite transformation rate is governed by the polymorphic transformation. Their results show that the views of Frye, Stansbury McElroy (Ref 9) that the rearrangement mechanism is rate controlling in eutectoidal unalloyed steel are incorrect. There are 2 figures and 18 references, of which 14 are Soviet and 4 English.

ASSOCIATION: Mordovskiy gosudarstvennyy universitet (Mordovskiy State University)

Institut metalloedeniya i fiziki metallov TsNIIChM (Institute of Metallurgy and Metal Physics of TsNIIChM)

SUBMITTED: June 14, 1958

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PHASE I BOOK EXPLOITATION

sov/4344

Soveshchaniye po teorii liteynykh protsessov, 4th

- Kristallizatsiya metallov; trudy soveshchaniya (Crystallization of Metals; Transactions of the Fourth Conference on the Theory of Casting Processes)
  Moscow, izd-vo AN SSSR, 1960. 325 p. 3,200 copies printed.
- Sponsoring Agency: Akademiya nauk SSSR. Institut mashinovedeniya. Komissiya po tekhnologii mashinostroyeniya.
- Resp. Ed.: B. B. Gulyayev, Doctor of Technical Sciences, Professor; Ed. of Publishing House: V. S. Rzheznikov; Tech. Ed.: S. G. Tikhomirova.
- FURPOSE: This book is intended for metallurgists and scientific workers. It may also be useful to technical personnel at foundries.
- COVERAGE: The book contains the transactions of the Fourth Conference (1958) on the Theory of Casting Processes. [The previous 3 conferences dealt with hydrodynamics of molten metals (1955), solidification of metals (1956), and shrinkage processes in castings (1957)]. General problems in the crystallization of metals, including the crystallization of constructional steels, Card 148

SOV/4344 Crystallization of Metals (Cont.) alloy steels with special properties, cast iron, and of nonferrous alloys, are discussed. Recognition is given to D. K. Chernov and N. T. Gudtsov and their students, B. B. Gulyayev and A. G. Spasskiy, for their contributions to the understanding of the basic problems involved in the theory of crystallization of ferrous and nonferrous metals and alloys. Academician A. V. Shubnikov is also mentioned in connection with his work on the planning of research on crystal formation. References accompany several of the articles. TABLE OF CONTENTS: 3 Foreword Gulyayev, B. B. Crystallization of Metals I. GENERAL PROBLEMS IN THE CRYSTALLIZATION OF METALS Calculation of the Rate of Crystallization of Metal Lyubov, B. Ya. 35 in Large Volumes 43 Mirkin, I. L. Crystallization of Complex Alloys Card 2/8

32291R

18.7500 1555, 1418, 1045 0/126/00/010/002/027/020/IX

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

TITLE: On the Problem of Diffusion in a Plastically

Deformed Medium

PERICDICAL: Fizika metallov i metallovedeniye, 1963, Vol. 10, No. 2, pp. 310 - 312

TEXT: The work of S.A. Dovnar (Ref. 1) and Yu.P. Romashkin (Ref. 2) is said to contain errors. Moreover, these workers did not take into account the possible variation of the diffusion coefficient D with time. Simmons and Dorn (Ref. 5) have obtained a diffusion equation which is not subject to the latter limitation, although their method is unnecessarily involved and difficult to understand. The present authors report a clearer derivation of the diffusion equation for a plastically deforming medium and indicate the method whereby this equation can be solved. Let  $\hat{j}$  be the flow density of the diffusing substance,  $\hat{v}$  the velocity of displacement of the medium at a given point and  $\hat{c}$  the concentration. The expression for  $\hat{j}$  is

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$$j = -D(t)^{1/c} + vc$$
.

The continuity equation and the fact that the medium is incompressible lead to the following equation for the one-dimensional case

$$\frac{\partial c}{\partial t} = D(t) \frac{\partial^2 c}{\partial x^2} = v_1 \frac{\partial c}{\partial x} \tag{1}$$

In the case of a homogeneous medium

$$\mathbf{v}_{\mathbf{x}} = \frac{\mathbf{j}}{\mathbf{x}} \mathbf{x} \tag{2}$$

where is the thickness of the specimen, which is a function of time, and

Some of the specimen the surface of the specimen or some other fixed plane.

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Combining Eqs. (1) and (2) one obtains

$$\frac{\partial r}{\partial t} = D(t) \frac{\partial^2 r}{\partial x^2} = \frac{i}{L} x \frac{\partial c}{\partial x} \tag{3}$$

The boundary conditions employed with Eq. (3) are

$$\frac{\partial c}{\partial x} = 0 \frac{\text{wh.co}}{\text{npin } x} = 0; \quad \frac{\partial c}{\partial y} = 0 \frac{\text{npin } x}{\text{npin } x} = I(t)$$
(51)

Using the substitution

$$\vdots \qquad \frac{l_0}{l(t)} x_1 \not \longrightarrow \int_0^t \frac{l_0'}{l^2(t')} D(t') dt'. \tag{l_2}$$

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On the Problem of ....

where 'o is the thickness of the specimen at the initial instant of time, Eqs. (3) and (3') can be transformed to read

$$\frac{\partial c}{\partial z} = \frac{\partial c}{\partial \overline{z}^2}$$
 (5)

$$\frac{\partial c}{\partial \xi} = 0 \text{ npn } \xi = 0; \quad \frac{\partial c}{\partial \xi} = 0 \text{ npn } \xi = t_0.$$

$$(\xi^{\pm}) = 0.$$

When  $\frac{1}{2} = \frac{1}{2}$ , the solution of this equation can be shown to be (Myunts - Ref. 4)

$$\varepsilon(\hat{z}, z) = \frac{1}{1-\pi} \int_{-\pi}^{\pi} c_0(\hat{z} - 2\pi) |\hat{z}| e^{-z^2} z d, \qquad (6)$$

where  $c_0(x) = c_0(\xi)$  is the concentration at the initial instant of time. In the case where a thin layer of the diffusing  $\mathcal{K}$ 

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substance is deposited on the surface of the specimen  $C_0(x) = A\delta(x)$  and  $\delta(x)$  is the delta function, Eq. (3) leads to the following expression

$$c = \frac{A}{\sqrt{\frac{1}{\pi \pi}}} = \frac{A}{\sqrt{\frac{f}{\pi \sqrt{D(t')}e^{-2\pi t_1 t_1}}dt'}} = \exp \left\{ -\frac{x^2}{4e^{2\pi (t)}\sqrt{D(t')}e^{-2\pi (t')}dt'} \right\}, \tag{7}$$

where

$$\varepsilon = \ln \frac{\cdot}{\cdot}$$
.

As has been pointed out above, Eq. (7) was obtained by Simmons (Ref. 5) by a very much more complicated method. With an initial step change in the concentration, as is the case with thick layers ( $c_0 = c_1$  when -1 < x < 0,  $c_0 = c_2$  when  $0 \le x \le 1$ ), Eq. (6) yields Card 5/8

(3).

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 $c(i, z) = \frac{c_1 + c_2}{2} + \frac{c_3 - c_1}{2} \operatorname{erf}\left\{\frac{i}{2}\right\} = \frac{x}{2}$   $+ \frac{c_2}{2} + \frac{c_2 - c_1}{2} \operatorname{erf}\left\{-\frac{x}{2}\right\} = \frac{x}{2}$ 

 $\frac{c_1 + c_2}{2} = \frac{c_2 - c_1}{2} \operatorname{erf} \left\{ \frac{x}{2e^{x(t)}} \sqrt{\int_{-\infty}^{t} \frac{x}{D(t') e^{-2x(t')} dt'}} \right\}$   $\operatorname{erf} \{x\} = \frac{2}{1 - \pi} \int_{-\pi}^{t} e^{-x^2} dt'$ 

The solution given by Eq. (3) is not normalisable with respect to  $\mathbf{x}$ , i.e.

c(::, t)dz ≠ const.

for all instants of time, as should be the case when the thickness of an incompressible material is altered. On the Card 6/8

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other hand—the volume integral of the concentration—evaluated for a rectangular parallelipiped with unit cross-section at—t = 0—and constant volume should be equal to a constant—i e.

$$\iint_{O} \int_{S} c dx dy dz = S(t) \int_{O}^{\infty} c (x + t) dx = A$$

and since  $S = \ell_0/\ell = e^{-\epsilon}$  , the normalisation condition becomes

$$\int_{0}^{\infty} c(x, t) dx = \frac{A}{S(t)} = Ae^{\varepsilon(t)}$$
 (9)

The expressions for the concentration given by Dovnar and Romashkin (Refs. 1, 2) are in error because they do not

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(Abstractor's note this is an abridged translation) There are 4 references: 3 Soviet and 1 non-Soviet

ASSOCIATION

Institut metallovedeniya i fiziki metallov TsNIIChM (Institute of Metallurgy and Physics

of Metals TsNIIChM)

SUBMITTED

March 28 1960

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# "APPROVED FOR RELEASE: 08/31/2001 CIA-

CIA-RDP86-00513R001031220004-8

18.7500 authors:

Lyubov, B. Ya., Roytburd, A.L.

68985 S/020/60/131/02/024/071

BO13/BO11

TITLE:

Energy Relations in Martensite Transformation

PERIODICAL:

Doklady Akademii nauk SSSR, 1960, Vol 131, Nr 2, pp 303-305 (USSR)

ABSTRACT:

The authors derive the energy relations mentioned in the title under the following simplified premises: The pure shear k along the habit plane (gabitusnaya ploskost?) zx is selected as the deformation with an invariant plane. The presence of a net of dislocations on the interface allows to neglect the deformations within the martensite crystal. The forces acting upon the martensite crystal from the deformed matrix, compensate with the forces of the surface tension on the interface between the phases. These premises are bound to influence the numerical results of computation to a certain degree. This can, however, be taken into the bargain, because the investigation under review aims at determining only certain general rules. Therefore, the anisotropy of the elastic properties of the material is also neglected with a view to simplifying calculations. The stressed state and the energy of the deformations occurring with the formation of an isolated martensite crystal, can be solved by solving the plane problem of the theory of elasticity. This solution holds for the region situated outside the elliptic hole (at the edge of which the dislocations  $u = ky + \alpha x$ ;  $v = \alpha y$  are given). Here, x and y denote

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Energy Relations in Martensite Transformation

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the coordinates of the point at the edge of the opening, u and v the components of the shift toward the x- and y-axis respectively, k the shear, and  $\alpha$  the dilatation parameter. By using function-theoretical methods one finds the following relation for the specific

energy of elastic deformations:  $E_0 = \mu \left(1 + \frac{1}{\lambda}\right) \frac{k^2 + \alpha^2}{2} = \frac{b}{a} +$ 

+  $\mu(1+\frac{1}{\mathcal{H}})\frac{\alpha^2}{2}$   $\frac{a}{b}$  +  $\mu(1-\frac{1}{\mathcal{H}})\alpha^2$ . Here,  $\mu$  denotes the shear modulus, a and b the semimajor and semiminor axis of the ellipse (which constitutes the cross section of the martensite crystal) and  $\mathcal{H}=3\sim4\nu$  holds.  $\nu$  denotes Poisson's ratio. The free energy of the system changes with the formation of a martensite crystal which is coherent with the matrix, by  $\Delta F = -(\Delta F \pi - C)ab + Aa^2 + Bb^2 + \sigma s$ . Here,  $\Delta F$ 

denotes the change in the "chemical" energy in the transition of a unit volume of the old phase into the new modification, and  $\sigma$  denotes the surface tension. The authors then determine a relation for the energetically optimum dimensions of the martensite crystal. With increasing growth of the crystal the ratio b/a decreases and tends toward a certain limit. If dilatation does not change  $(\alpha=0)$ , the relation  $b^2/a$  = const holds for the growth of the crystal, i.e.,

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the curvature of the elliptic surface of the crystal and of its growing edge remains constant. From the standpoint of thermodynamics the growth of the crystal is of interest only under a certain condition which is given here. There are 3 figures and 7 references, 1 of which is Soviet.

ASSOCIATION: Institut metallovedeniya i fiziki metallov Tsentral'nogo nauchno-

issledovatel'skogo instituta chernoy metallurgii (Institute of Metallurgy and Metal Physics of the Central Scientific Research

Institute of Ferrous Metallurgy)

PRESENTED: October 19, 1959, by G.V. Kurdyumov, Academician

SUBMITTED: October 15, 1959

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#### CIA-RDP86-00513R001031220004-8 "APPROVED FOR RELEASE: 08/31/2001

AUTHORS:

Lyubov, B. Ya., Roytburd, A. L.

5/020/60/131/04/025/073 B013/B007

TITLE:

Temperature Conditions on the Surface of a Growing Martensite

Crystal

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol 131, Nr 4, pp 809-812 (USSR)

TEXT: The authors of the present paper made the attempt of estimating the temperature conditions at various sites of the crystal surface in consideration of its shape. The solution of the problem of thermodynamic growth of the martensite crystal furnishes the true value of the moving force of this process. Mention is made of various earlier papers which are based only on qualitative considerations, whereas the solution of the afore-mentioned problem requires a quantitative investigation of the relations between heat emission and heat conduction from the growing surface. The shape of the crystal, which is usually not taken into account, is of great importance to such investigations. The martensite crystal may be described as an elliptic cylinder with a small ratio b/a of the semiaxes of the cross section. From the minimum condition holding for the energy of distortions of the crystal it follows for the radius of curvature of the crystal edge that  $Q = b^2/a = (A/B)a + 2\sigma/B$ . In this case it

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Temperature Conditions on the Surface of a Growing S/020/60/131
Martensite Crystal S013/B007

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holds that  $A = \mu(1 + (1/x))\pi\alpha^2/2$ ;  $B = \mu(1 + (1/x))\pi(k^2 + \alpha^2)/2$ ; x = 3 - 4 r;  $\alpha$  and k denote the coefficient of linear expansion and the shear modulus of macroscopic deformation in the conversion of martensite,  $\mu$  and r - the torsion modulus and Poisson's ratio of the austenite die,  $\sigma$  - surface tension at the interface between austenite and martensite. As soon as the crystal dimensions exceed a certain critical size, the rate of growth in the longitudinal direction is determined by the rate of shift of those dislocations which form the interface between the crystal and the surrounding die. In this direction the crystal grows with the constant rate r, so that r = r = r = r = r + r = r = r = r + r = r

constant velocity.  $\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2} = \frac{1}{\chi} \frac{\partial T}{\partial t}$  holds for the temperature field round the

crystal, where  $\chi$  denotes thermal diffusivity. The solution of this equation obtained for the corresponding conditions is written down. This solution can be used also in the case of a time-variable temperature field.  $\varrho$  is approximate-

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Temperature Conditions on the Surface of a Growing Martensite Crystal

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ly constant and equal to  $2\sigma/B$  in the first stage of the process with t  $\ll 2\sigma/Av$ . With  $q/c \approx 100^{\circ}$  it holds that  $T_{surface} \approx 13^{\circ}$ , i.e., the temperature of the

crystal edge differs but little from the temperature of the surrounding medium. The thickness, b, of the crystal is related to the rate of its growth along

the x-axis by the equation  $b = \sqrt{\frac{A}{B} v^2 t^2 + \frac{2\sigma}{B} vt} = \sqrt{\varrho vt}$ . In the initial period

of growth the temperature prevailing on the plane crystal faces also differs but little from the temperature of the surrounding medium. t  $\gg 2\sigma/Av$  holds for the further growth of the crystal. With  $\beta V t \approx 3$  the process is adiabatic. The time necessary for attaining the steady state (which, in the case of a plane face, corresponds to the occurrence of adiabatic conditions) is inversely proportional to the rate of growth. In the initial stages, the growth of the crystal is an isothermal process, but when the martensite plate is formed, the conditions prevailing on its surface become more and more adiabatic. These adiabatic conditions are attained more rapidly on the blunted edge of the crystal than on its plane faces. There are 3 figures and 8 references, 3 of which are Soviet.

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Temperature Conditions on the Surface of a Growing Martensite Crystal

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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:

November 30, 1959, by G. V. Kurdyumov, Academician

SUBMITTED:

Card 4/4

November 18, 1959

IVANTSOV, G.P.; LYUBOV, B.Ya.; POLYAK, B.T.; ROYTBURD, A.L.

Calculation of the crystallization of a metallic ingot with various types of heat flow through its surface. Inzh.-fiz. zhur. no.3:41-47 Mr '60. (MIRA 13:10)

1. Institut chernoy metallurgii, Moskva. (Crystallization)

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\$/058/62/000/005/070/119 A061/A101

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AUTHORS:

Lyubov, B. Ya., Temkin, D. Ye.

TITLE:

Distribution of soluble impurities in crystallization

PERIODICAL: Referativnyy zhurnal, Fizika. no. 5, 1962, 10, abstract 5E84 (V sb. "Rost kristallov. T. 3", Moscow, AN SSSR, 1961, 59 - 67. Discuss.,

214 - 218)

The distribution of a soluble impurity in solid phase on crystal-TEXT: lization from a melt has been determined. The following assumptions are made in solving the problem: 1) the problem is one-dimensional (plane front of crystallization moving according to a certain law y(t); 2) the impurity is unlimitedly soluble both in the melt and in the solid phase; 3) the law y(t) is postulated; 4) near the liquid-solid interface, equilibrium is established almost instantaneously; 5) convection is absent, and mass transfer takes place only by molecular diffusion. A general method of solving the problem is presented, together with the boundary conditions and the fundamental integral equation representing the solution. An approximate solution of this equation is given for two courses

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Distribution of soluble impurities in crystallization

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of y(t), i.e., crystallization taking place at a constant rate, and crystallization by the law y(t)  $\sim \sqrt{D_2 t}$ , where  $D_2$  is the coefficient of impurity diffusion in the melt. The two solutions are of a like nature, since the impurity concentration grows from initially solidified portions to those solidifying later. The conditions, under which the impurity distribution is bound to be sharply non-uniform, are analyzed.

K. Gurov

[Abstracter's note: Complete translation]

Card 2/2