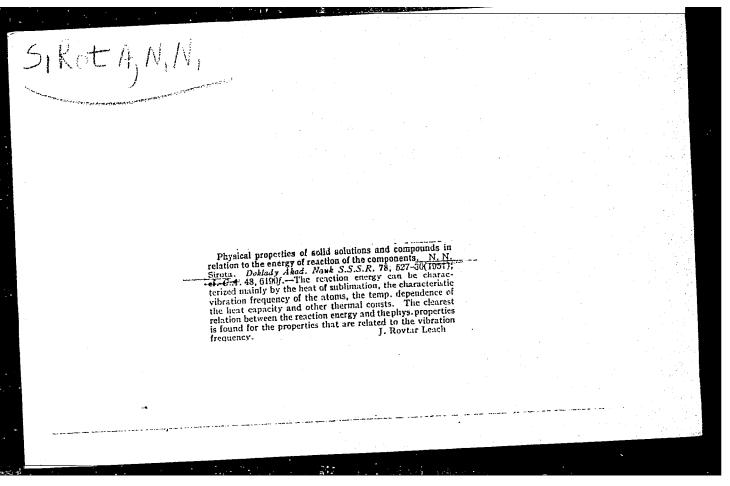SIROTA, N. N.

"Effect of Temperature on the Stability of an Undercooled Phase," Doklady Akademii Nauk SSSR 74 (1950) No 5, pp 971/974.

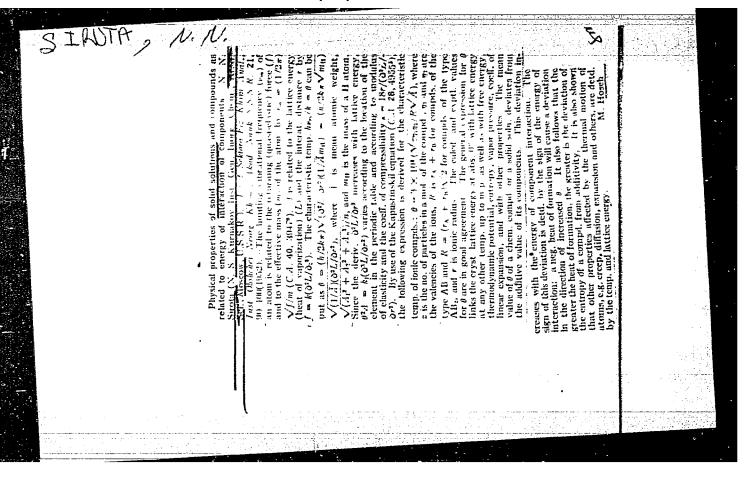Translation B-79119, 22 Sep 54

SIROTA, N. N.

"On the Two Types of S-Shaped Curves Showing Stability of Undercooled Phases,"
Doklady Akademii Nauk SSSR 74 (1950) No 6, pp 1105/1108.

Translation B-79119, 22 Sep 54

SiROt A, N, N,

Physical properties of solid solutions and compounds in relation to the energy of reaction of the components, N. N. Sirota. Doklady Akad. Nauk S.S.S.R. 78, 527-30(1951); C.A. 48, 6100f.—The reaction energy can be characterized mainly by the heat of sublimation, the characteristic vibration frequency of the atoms, the temp. dependence of the heat capacity and other thermal consts. The clearest relation between the reaction energy and the phys. properties is found for the properties that are related to the vibration frequency.   J. Rovtar Leach

SIRUTA, N. N.

Physical properties of solid solutions and compounds as related to energy of interaction of components. N. N. Siruta (N. S. Kurnakov Inst. Gen. Inorg. Chem., Moscow, USSR). *Izd. Sborn. Nauk. Rabot. Inst.*, 21, 90-100 (1952). — The bonding vibrational frequency (v_m) of an atom is related to the restoring (quasi-elastic) force (f) and to the effective mass (m) of the atom by $v_m = (1/2\pi) \sqrt{f/m}$ ($C.A.$ 40, 3047²), f is related to the lattice energy (heat of vaporization) (L) and the interat. distance r by $f = k(\partial^2 L/\partial r^2)$. The characteristic temp. $h v_m/k = \theta$ can be put as $\theta = (h/2k\pi) \sqrt{f/(1/\bar{A}m_H)} = (n/2k\pi \sqrt{mu})$ $\sqrt{(1/\bar{A})(\partial^2 L/\partial r^2)}$, where i is mean atomic weight, $\sqrt{(f_1^2 + f_2^2 + f_3^2)/n}$, and m_H is the mass of a H atom. Since the deriv. $\partial^2 L/\partial r^2$ increases with lattice energy, $\partial^2 L = k_2(\partial^2 L/\partial r^2)$ varies according to the location of the element in the periodic table and according to modulus of elasticity and the coeff. of compressibility $\kappa \sim 18r/(\partial^2 L/\partial r^2)$. By use of the Kapustinskii equation ($C.A.$ 28, 4936¹), the following expression is derived for the characteristic temp. of ionic compds.: $\theta \sim 1 \times 10^6 (\sqrt{z_A z_B/R\sqrt{A}})$, where z is the no. of particles in a mol of the compd., n and n_r are the valencies of the ions, R is $r_A + r_B$ (or compds. of the type AB) and $R = (r_A + r_B) \times 2$ for compds. of the type AB_2, and r is ionic radius. The calcd. and exptl. values for θ are in good agreement. The general expression for θ links the cryst. lattice energy at abs. 0° with lattice energy at any other temp. up to m.p. as well as with free energy, thermodynamic potential, entropy, vapor pressure, coeff. of linear expansion, and with other properties. The mean value of θ of a chem. compd. or a solid soln. deviates from the additive value of its components. This deviation increases with the energy of component interaction. The sign of this deviation is detd. by the sign of the energy of interaction; a neg. heat of formation will cause a deviation of θ in the direction of increased θ. It also follows that the greater the heat of formation, the greater is the deviation of θ from additivity. It is also shown that other properties affected by the thermal motion of atoms, e.g. creep, diffusion, expansion and others, are detd. by the temp. and lattice energy.

M. Hoseh

SIROTA, N.N.

Development of processes of nonvariant isothermic conversion in
time. Izv.Sekt.fiz.-khim.anal. 23:70-89 '53.   (MLRA 7:1)

1. Institut obshchey i neorganicheskoy khimii im. N.S.Kurnakova
Akademii nauk SSSR.
     (Steel--Metallurgy) (Crystallization)
                              (Phase rule and equilibrium)

137-58-4-8346

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 4, p 291 (USSR)

AUTHOR: Sirota, N.N.

TITLE: The Physicochemical Nature of Highly Coercive Alloys (Fiziko-
           khimicheskaya priroda vysokokoertsitivnykh splavov)

PERIODICAL: Tr. Nauchno-tekhn. o-va chernoy metallurgii, 1955, Vol 6,
               pp 152-203

ABSTRACT: The physical theories of the processes of magnetization and
           H_C are analyzed. The maximum H_C of an isolated single-domain
           ferromagnetic particle (IFP), and the effect of nonmagnetic or
           weakly magnetic foreign inclusions in ferromagnetic material
           upon its H_C are examined. The major types of highly coercive
           alloys are dealt with, and the factors in the physical chemistry
           defining their structure and magnetic retentivity are examined.
           Theoretical analysis leads to the conclusion that high H_C values
           may be due: a) to high values of the reduced constant of aniso-
           tropy of the IFP, b) to the shape of these IFPs and the textures
           due to their positioning (high H_C values being attainable with
           IFC having their long axes in the direction of magnetization);
Card 1/2   c) to a heterogeneous structure due to the presence of a signifi-

137-58-4-8346

The Physicochemical Nature of Highly Coercive Alloys

, cant amount of nonmagnetic or weakly magnetic inclusions in the ferromagnetic phase; d) to high structural stresses due to the mechanism of transformation. As a rule, alloys of high H_C are found in a metastable condition, characterized by incompleteness of the transformation processes, high dispersion of the component phases, high stresses at the phase boundaries, etc. Clarification of the conditions for obtaining high H_C in alloys is a most important question in the theory of metallic alloys, and one of general significance.
Bibliography: 94 references.

1. Alloys--Magnetic properties--Theory   2. Ferromagnetic materials--Magnetic properties

L. P.

Card 2/2

Sirota, N. N.

Sopostavlenie Modulia Iunga s Drugimi Mekhanicheskimi Kharakteristikami Aliuminevykh Splavov pri Razlichnykh Temperaturakh. G. S. Dzamimyn, M. V. Zakharov, and N. N. Sirota. AN SSSR Otd. Tekh. Nauk Izv., Feb., 1957, pp. 120-122. In Russian. Comparison of Young's modulus with mechanical characteristics of aluminum alloys by varying temperatures.

MT

SOV/137-58-11-21953

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 11, p 17 (USSR)

AUTHORS: Urazov, G. G. , Sirota, N. N.

TITLE: Physicochemical Analysis as a Branch of General and Inorganic
             Chemistry and Physics of Condensed Systems (Fiziko-khimicheskiy
             analiz kak otdel obshchey i neorganicheskoy khimii i fiziki konden-
             sirovannykh sistem)

PERIODICAL: Sb. nauchn. tr. Mosk. in-t tsvetn. met. i zolota, Nauchno-tekhn.
             o-vo tsvetn. metallurgii, 1957, Nr 30, pp 3-36

ABSTRACT: A detailed historical review of the origins of a new branch of
             science, viz. , physicochemical analysis (FCA), founded by N. S.
             Kurnakov. One of the conditions for further successful development
             of FCA is perfection of the experimental techniques in physical
             chemistry - the development of dependable and accurate instruments
             for measuring various properties of substances. The problems in
             FCA requiring solution singled out by the authors are the following:
             theory of liquid and solid solutions, daltonide and berthollide phases,
             phase diagrams of dielectrics, semiconductors, and heat-resistant
             superalloys, and the FCA of the rare elements.   I. K.
Card 1/1

Translation from: Referativnyy zhurnal. Metallurgiya, 1958, Nr 11, p 197 (USSR)   SOV/137-58-11-23219

AUTHOR: Sirota, N. N.

TITLE: Elastic and Thermal Constants of Solids in Relation to the Atomic Interaction Energy (Uprugiye i termicheskiye konstanty tverdykh tel v svyazi s energiyey mezhatomnogo vzaimodeystviya)

PERIODICAL: Sb. nauchn. tr. Mosk. in-t tsvetn. met. i zolota. Nauchno-tekhn. o-vo tsvetn. metallurgii, 1957, Nr 30, pp 138-150

ABSTRACT: The relationship between the temperature coefficient of thermal expansion α, compressibility χ, specific heat C, and the lattice energy was investigated. The following equation was adopted for the energy of the atomic interaction: $U^1 = (-A/V^m) + (B/V^n)$, where V is the volume of the crystal. It is shown that this equation satisfies the relationship $C = 2\alpha/\chi n$. To investigate the temperature dependence of C the oscillatory frequency-distribution function is approximated by the following expression: $dZ/d\nu = A \nu^p \exp(-\alpha \nu^n)$, where ν is the frequency and $dZ/d\nu$ is the frequency density. The following characteristic temperature is introduced: $\theta = h\nu_0/k$ where ν_0 is the frequency at which the function $Z(\nu)$ attains its maximum.

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Elastic and Thermal Constants of Solids (cont.)   SOV/137-58-11-23219

Formulae were derived for C as a function of T/θ. With the aid of the ratio between a and C and of the temperature dependence of C obtained it is shown that with $T = \theta$ $a = 8RV_0/9mU_0$, where U_0 and V_0 are the bond energy and the volume at absolute zero, respectively. On this basis a conclusion is drawn that   can serve as a measure of energy of the atomic bond in the lattice. In cases where Lindeman's equation $a T_{melt} = const$ is justified, T_{melt} is proportional to the bond energy.

M. K.

Card 2/2

SOV/137-58-11-23301

Translation from: Referativnyy zhurnal. Metallurgiya, 1958, Nr 11, p 208 (USSR)

AUTHORS: Sirota, N. N., Chizhevskaya, S. N.

TITLE: Characteristic Temperatures of Mg_2Si, Mg_2Sn, and Si (Kharakteri-
sticheskiye temperatury Mg_2Si, Mg_2Sn i Si)

PERIODICAL: Sb. nauchn. tr. Mosk. in-t tsvetn. met. i zolota, Nauchn.-tekhn.
o-vo tsvetn. metallurgii, 1957, Nr 30, pp 175-191

ABSTRACT: The characteristic temperatures θ, the rates of propogation of
longitudinal (ld) ultra sonic waves V_{ld}, the modulus of elasticity E,
and the microhardness of Si, Mg_2Si, and Mg_2Sn were determined
experimentally. The compounds were obtained by the direct smelting
of the components in a resistance furnace. θ was determined by
X-ray diffraction from the ratio of the intensities of one line at two
different temperatures. V_{ld} and E were measured on an ultrasonic
flaw detector UZD-7N. Microhardness was determined with a PMT-3
apparatus. For Si: $a \cdot 10^6 = 4.58$, $\theta = 758°K$, $V_{ld} \cdot 10^{-5} = 4.82$ cm/sec,
$E = 5910$ kg/mm^2; for Mg_2Si: 14.8, 398°K, 5.32, and 5430 respectively;
for Mg_2Sn: 22, 206°K, 2.63, and 3940. θ calculated by means of the
Card 1/2   coefficient of linear expansion agree well with the experimental values,

Characteristic Temperatures of Mg_2Si, Mg_2Sn, and Si   SOV/137-58-11-23301

whereas those calculated by Lindemann's formula give incorrect values.

G. L.

Card 2/2

SOV/137-58-11-23383
Translation from: Referativnyy zhurnal. Metallurgiya, 1958, Nr 11, p 220 (USSR)

AUTHORS: Sirota, N. N., Belyayevskiy, V. I., Shmatova, G. P.

TITLE: A Study of the Physical Properties of Solid Solutions and of Processes of Aging in Al-Mg-Si Alloys Containing 99% Al (Izucheniye fizi-cheskikh svoystv tverdykh rastvorov i protsessa stareniya splavov Al-Mg-Si, soderzhashchikh 99% Al)

PERIODICAL: Sb. nauchn. tr. Mosk. in-t tsvetn. met. i zolota, Nauchno-tekhn. o-vo tsvetn. metallurgii, 1957, Nr 30, pp 223-234

ABSTRACT: It is shown that the hardness, the modulus of elasticity, and the electrical resistivity of alloys (quenched as well as aged) of the ternary Al-Mg-Si system along a section of the phase diagram corres-ponding to a constant Al content (99%) exhibit minimum values when the composition of the alloys corresponds to a quasi-binary section of $Al-Mg_2Si$ (0.6 at. %Mg). It is concluded that the change in proper-ties of the quenched alloys is caused by the presence of a short-range order which is most discernible in the vicinity of the quasi-binary section of $Al-Mg_2Si$. The increase in hardness occurring on both sides of the quasi-binary section after aging is attributable to an

Card 1/2

A Study of the Physical Properties of Solid Solutions (cont.)   SOV/137-58-11-23383

increase in supersaturation, and the reduction of electrical resistivity in the vicinity of the quasi-binary section to a decrease in the number of segregations and an increase in their size to a point when they are larger than the free path of conduction electrons.

A. K.

Card 2/2

SOV/137-58-11-23716

Translation from: Referativnyy zhurnal. Metallurgiya, 1958, Nr 11, p 263 (USSR)

AUTHORS: Sirota, N. N., Bychkov, Yu. F.

TITLE: Measuring the Longitudinal Modulus of Elasticity at High Temperatures in a Vacuum (Izmereniye prodol'nogo modulya uprugosti pri vysokikh temperaturakh v vakuume)

PERIODICAL: Sb. nauchn. tr, Mosk. in-t tsvetn. met. i zolota, Nauchno-tekhn. o-vo tsvetn. metallurgii, 1957, Nr 30, pp 254-267

ABSTRACT: An apparatus is described for measuring the modulus of normal elasticity E in a vacuum at temperatures up to 1000°C. The magnitude of the E of a material was calculated according to the measured values of the natural frequencies of the transverse oscillations of a cylindrical specimen (S). The general arrangement of the apparatus is given. The electric oscillations are transferred from a 3G-2A sonic-frequency generator to a piezoelectric transducer which transforms them into mechanical oscillations of the same frequency. The horizontally sus-pended S is connected to the oscillating needle of the transducer by means of a suspension wire. The natural oscillations excited in the S are picked up by a detector, consisting of a second piezoelectric

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SOV/137-58-11-23716

Measuring the Longitudinal Modulus of Elasticity at High Temperatures (cont.)

adapter with the S suspended from its needle. Adapters with Rochelle salt crystals are used as the transducer and the receiver. The transducers are mounted in a special quartz apparatus which makes it possible to reproduce the measurements of natural frequencies in a vacuum and which is placed in a dismountable electric resistance furnace. The temperature of the S is measured by a Pt/Pt-Rh thermo-couple introduced into the quartz apparatus through a Mo-glass probe into which the thermocouple is welded. The apparatus is evacuated to 10^{-4} mm Hg. The total error of measurements constitutes ~3%. An analysis of the effect of the size of S on the magnitude of E is given, also the experimental results obtained with an alloy of Fe with 16% Ni.

L. G.

Card 2/2

SOV/137-59-1-1352

AUTHORS: Sirota, N. N., Ginzburg, F. N.

TITLE: A Study of the Physical Properties of Bi-Sb Alloys
           (Izucheniye fizicheskikh svoystv splavov vismuta s sur moy)

ABSTRACT: Physical properties (thermoelectric power, electrical resistivity,
          hardness, microhardness, and modulus of elasticity) of 19 Bi-Sb
          alloys were studied. The composition of the alloys varied from 0 to
          100% in increments of 5 atom.%. Rod-shaped specimens 4 mm in di-
          ameter obtained by casting in a graphite mold were annealed at a
          temperature of 240° C for a period of 2 weeks. The shape of the
          hardness and microhardness curves is typical of systems which form
          a continuous series of solid solutions. The maxima of these curves
          correspond to an alloy containing 80% Sb and 20% Bi. A well-defined
          maximum corresponding to an alloy with a composition of 15% Sb and
          85% Bi is observed in curves representing the electrical resistivity
          and the thermoelectric power as functions of the concentration of

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SOV/137-59-1-1352

A Study of the Physical Properties of Bi-Sb Alloys

the constituents. A slight deviation from additive behavior was observed in the curve "modulus-of-elasticity vs. concentration". In alloys containing 20-30% Sb a certain maximum is observed which coincides with the maxima on the curves of electrical resistivity and thermoelectric power.

V.G.

Card 2/2

AUTHORS: Sirota, N.N., Samsonov, G.V., Strel'nikova, N.S.

TITLE: Electrical Properties of Some Metalloid Compounds and Solid Solutions Thereof (Elektricheskiye svoystva nekotorykh metal-lopodobnykh soyedineniy i ikh tverdykh rastvorov)

PERIODICAL: Sb. nauchn. tr. Mosk. in-t tsvetn. met. i zolota, nauchno-tekhn. o-vo tsvetn. metallurgii, 1957, Nr 30, pp 368-374

ABSTRACT: The results of measurement of the electrical resistivity and thermoelectromotive force of a number of carbides, sili-cides, borides, nitrides, and certain binary alloys thereof, all in a Cu-containing vapor, and of preliminary determination of the magnetic susceptibility of a number of two-component alloys of these compounds are presented. The specimens for investi-gation are made by hot extrusion. The electronic structure of the objects of investigation is used as the basis for discussion of certain results of the work. 1. Intermetallic compounds--Electrical properties 2. Alloys--Electrical properties

R.A.

Card 1/1

20-5-14/54

Sirota, N. N.

AUTHOR: Sirota, N. N., Member of the AN Belorussian SSR

TITLE: On the Dependence Upon Temperature of the Heat Capacity
             of Solids (O temperaturnoy zavisimosti teployemkosti
             tverdykh tel).

PERIODICAL: Doklady Akademii Nauk SSSR, 1957, Vol. 115, Nr 5,
             pp. 901-903 (USSR)

ABSTRACT: At first the results of various previous works dealing
             with the same subject are mentioned. The present paper
             shows a possibility for the computation of the dependence
             on temperature of the heat capacity of the solids on the
             assumption of a nearly Gauss-like distribution of the
             frequencies. In the case of the method adopted here for
             the computation of the temperature dependence of the heat
             capacity, the author confines himself to the case of the
             isotropic solid body. For the distribution of the frequencies
             assumed here

             $$dz/d\nu = A \nu^p e^{-\alpha \nu^n}$$

             may approximatingly be written down. The author, however,
             describes the curve of the distribution of the frequencies

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20-5-14/54

On the Dependence Upon Temperature of the Heat Capacity of
Solids.

on the spectrum of the oscillations by the approximated
equation

$$dz/d\nu = A \, \nu^{p} \, e^{-\alpha\nu}$$

and this approximation apparently causes no great error.
Herefrom results

$$z = 3N = \int_{0}^{\infty} A \, y^{p} e^{-\alpha\nu} \, d\nu = A \, \Gamma \, (p+1)/\alpha^{p+1}$$

and further $A = 3N\alpha^{p+1}/ \Gamma (p+1)$. The relation $\nu_{0} = p/\alpha$ is
here true for the frequency ν_{0} corresponding to the
maximum of the distribution curve. $\theta = h \, \nu_{0}/k = hp/k\alpha$
is then true for the characteristic temperature. Next,

CARD 2/3

20-5-14/54

On the Dependence Upon Temperature of the Heat Capacity of
Solids

expressions for the total energy of the oscillations
(i.e. for the internal energy of the solids) and for the
temperature dependence of the heat capacity of an isotropic
solid are given. These formulae are then specialized for
the case p = 2. The experimental data on the temperature
dependence of the heat capacity of various solids are well
described by the here derived expression. The simplicity
of the law obtained here for the modification of the heat
capacity of the solids as a function of temperature offers
far-reaching possibilities for the application of this
theorem to different thermodynamical and other physical
computations. There are 2 figures and 8 references, 4 of
which are Slavic.

SUBMITTED: March 25, 1957

AVAILABLE: Library of Congress

CARD   3/3

SIROTA, N.N.; DANIL'KEVICH, M.I.; SIROTA, A.G.; SHIMANSKAYA, V.P.

Electrets made from high polymers. Dokl.AN BSSR 2 no.10:413-
415 N '58.   (Electrets)   (MIRA 12:8)

SIROTA, N.N.

Heat conductivity of solid bodies. Dokl. AN BSSR 2 no.11:453-456
D '58.   (MIRA 12:8)

        (Heat—Conduction)

SOV/24-58-4-37/39

AUTHOR: Gulyayev, B.B.

TITLE: Conference on Crystallisation of Metals (Soveshchaniye po
            kristallizatsii metallov)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh
            Nauk, 1958, Nr 4, pp 153 - 155 (USSR)

ABSTRACT: This conference was held at the Institut mashinovedeniya
            AN SSSR (Institute of Mechanical Engineering of the Ac.Sc.
            USSR) on June 28-31, 1958. About 400 people participated
            and the participants included specialists in the fields of
            foundry metallurgy, crystallography, physics, welding,
            heat, physical chemistry, mathematical physics and other
            related subjects. In addition to Soviet participants,
            foreign visitors included Professor D. Czikl (East Germany)
            and M.I. Chvorinov (Czechoslovakia). This conference on
            crystallisation of metals was the fourth conference relating
            to the general problem of the theory of foundry processes.

            Crystallisation of Non-ferrous Metals. N.N. Belousov and
            B.B. Gulyayev - in their paper "Investigation of the
            Crystallisation and the Properties of Non-ferrous Metals
            Under Conditions of Applying Pressure", presented results
            of experiments on producing castings which crystallise
            under pressure from all sides and piston pressure within
            a wide range of specific loads. The results of the
            investigation provide material for improving existing
            methods of applying pressure to influence the crystallis-
            ation of alloys. The influence of the condition of crystall-
            isation on the casting and mechanical properties of
            aluminium alloys, at normal and at elevated temperatures,
            were discussed in the papers of investigations of the
            A.Ya. Semenov. The results of investigations of the
            conditions of crystallisation of aluminium alloys during
            continuous casting were presented in the paper of
            Ye.B. Makharov. N.L. Pokrovskiy and D.Ye. Ovsiyenko
            dealt with the features of crystallisation of various

Card8/10   non-ferrous alloys and the physico-chemical phenomena
            accompanying this process.
            Crystallisation of Metals in the Welding Bath. The
            following papers were read: B.A. Movchan - "Investigation
            of the Features of the Microscopic Chemical Non-uniformity
            in Alloys"; G.L. Petrov - "Crystallisation and Chemical
            Non-uniformity in Weld Joints"; M.Kh. Shorshorov and
            V.B. Sedykh - "Influence of Non-uniformities of
            Crystallisation in the Weld Bath on the Formation of Hot
            Cracks".
            Crystallisation of Metals in an Ultrasonics Field. The
            following papers were read: Ye.I. Lakhtin and
            B.N. Smirnenko - "Crystallisation of Metals and Alloys
            in an Ultrasonics Field"; I.I. Teumin - "Influence of
            Elastic Oscillations on the Processes of Crystallisation
            and the technological properties of Alloys"; L.L. Silin
            and A.A. Terekhin - "Effect of Ultrasonics on Crystallising

Card9/10   Metal in the Weld Bath".

SOV/137-58-12-25017

Translation from: Referativnyy zhurnal. Metallurgiya, 1958, Nr 12, p 142 (USSR)

AUTHOR: Sirota, N. N.

TITLE: On the Temperature Relationship of Thermodynamic Functions of
            Solid Substances (O temperaturnoy zavisimosti termodinamicheskikh
            funktsiy tverdykh tel)

PERIODICAL: Sb. nauchn. tr. Fiz.-tekhn. in-t AN BSSR, 1958, Nr 4, 225-228

ABSTRACT: Instead of the generally accepted description of the spectrum of the
          normal oscillations of a solid introduced by Debye in his specific-heat
          theory the author employs the density of the distribution of frequencies
          described by the following equation: $dr/d = A \, P \exp(-a \, n)$ where ν
          is the frequency, A is the normalizing factor, exponents p and n are
          constants characteristic of the given solid, and a is related to a
          certain characteristic temperature (~ 3 times smaller than Debye's).
          Formulae for the internal energy, free energy, entropy, and
          specific heat of a solid were obtained.   V. D.

Card 1/1

SIROTA, N.N.; BERGER, L.I.

Thermal conductivity of indium and gallium arsenides and indium selenide and telluride. Inzh.-fiz.zhur. no.11:117-120 N '58.   (MIRA 12:1)

1. Fiziko-tekhnicheskiy institut AN BSSR, g. Minsk, i Institut tsvetnykh metallov i zolota imeni M.I. Kalinina, g. Moskva.
    (Heat--Conduction) (Indium compounds) (Gallium compounds)

SIROTA, N.N.; PASHINTSEV, Yu.I.

Determining the characteristic temperature and coefficients
of linear expansion for indium and gallium arsenides [with
summary in English]. Inzh.-fiz.zhur. no.12:38-42   ' 58.
(MIRA 11:12)

1. Fiziko-tekhnicheskiy institut AN BSSR, g. Minsk, Moskov-
skiy institut tsvetnykh metallov i zolota imeni M.I. Kalinina,
g. Moskva.
(Indium arsenide) (Gallium arsenide)

AUTHORS: Sirota, N. N., Shibayeva, A. V.   S/170/59/002/10/009/020
                                                       B115/B007

TITLE: The Occurrence of Dislocations in Single Crystals of Silicon

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, 1959, Vol 2, Nr 10,
              pp 57-61 (USSR)

ABSTRACT: In the present paper an experiment is described, which was
              undertaken with a view of determining the orientation and, at
              the same time, also the occurrence, the character, and the
              density of dislocations in a silicon single crystal by means of
              the etching method. As etching agent, aqueous solutions of
              KOH and NaOH with a concentration of from 20 to 40% were used.
              The production of the samples is described. At every section
              the orientation of crystallographic directions was determined
              by means of the "epigram" (diffraction pattern) method with an
              accuracy of up to 1°. Microphotographs of the surfaces of
              silicon after etching in a 40% aqueous NaOH-solution with dif-
              ferent duration of the etching process and at different angles
              α formed by the (111) plane with the section (Fig 1) as well
              as a microphotograph and an "epigram" of a thin section of the
              silicon surface after etching for 25 minutes in a 30% aqueous
              NaOH-solution (Fig 2) are given. The microphotographs of the

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The Occurrence of Dislocations in Single
Crystals of Silicon

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silicon surfaces after etching in a mixture of hydrofluoric
acid and nitric acid (1:2) are also given (Fig 3). The shape
and the appearance of the etch patterns are due to dislocations
and depend on the crystallographic orientation of the micro-
section plane. There are 3 figures and 3 references, 1 of
which is Soviet.

ASSOCIATION: Belorusskiy gosudarstvennyy universitet im. V. I. Lenina,
g. Minsk (Belorussian State University imeni V. I. Lenin,
City of Minsk)

Card 2/2

24,5200

68769

AUTHORS: Berger, L. I.,   Sirota, N. N.   S/170/59/002/11/016/024
                                                      B014/B014

TITLE: Some Properties of the Alloys of the $InAs$ - In_2Se_3 System

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, 1959, Vol 2, Nr 11, pp 102-105 (USSR)

ABSTRACT: In this article the authors study the heat conductivity and the
              linear expansion coefficient of a number of alloys of the quasi-
              binary section of the $In-As-Se$ system. The production of these
              alloys and the device used to determine their heat conductivity
              within the temperature range $80°K - 300°K$ were described in an
              earlier paper by the authors (Ref 1). It is shown that heat con-
              ductivity decreases considerably with increasing content of
              In_2Se_3 (Fig 1). The device used to determine the linear expansion
              coefficient was described in the article mentioned in reference 2.
              The results contained in the diagram of figure 2 show an increase
              in the linear expansion coefficient with rising content of In_2Se_3.
              Table 1 lists the coefficients of heat conductivity and expansion
              for the various temperatures. It may be seen that with rising
              temperature the linear expansion coefficient of pure $InAs$ in-
              creases much faster than that of alloys or pure In_2Se_3. In study-

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68769

Some Properties of the Alloys of the InAs – In_2Se_3 S/170/59/002/11/016/024
System   B014/B014

ing the relationship between thermal conductivity and expansion at $300^{\circ}K$ the authors found the same relation between the square of the expansion coefficient and the reciprocal value of heat con- ductivity as V. P. Zhuze (Ref 2). Additional experiments performed in the temperature range 100 - $300^{\circ}K$ furnished the same result. The corresponding values are summarized in table 2. The authors thank N. A. Goryunova and S. I. Radautsan for the samples obtained from them and for their interest displayed in the present paper. There are 3 figures, 2 tables, and 5 references, 3 of which are Soviet.

ASSOCIATION: Institut tsvetnykh metallov i zolota im. M. I. Kalinina, g. Moskva (Institute of Nonferrous Metals and Gold imeni M. I. Kalinin, City of Moscow). Otdel fiziki tverdogo tela i poluprovodnikov AN BSSR, g.Minsk (Branch of Solid State Physics and Semiconductors of the AS BSSR, City of Minsk)

Card 2/2

PASHINTSEV, Yu.I.; SIROTA, N.N.

Temperature relationship between characteristic temperatures
and coefficients of linear expansion of aluminum, gallium, and
indium arsenides. Dokl.AN BSSR 3 no.2:38-40   F '59.
(MIRA 12:5)

(Arsenides)

MOLODTSOVA, L.V.; SIROTA, N.N.

Electric conductivity and magnetic properties of magnesium-manganese ferrites containing 43 and 45% Fe_2O_3. Dokl. AN BSSR 3 no.8:336-337 Ag '59.

(MIRA 12:11)

(Ferrates—Electric properties)

GOLOLOBOV, Ye.M.; SIROTA, N.N.

Characteristic temperature and coefficient of linear expansion of germanium. Dokl.AN BSSR 3 no.9:368-369 S '59. (MIRA 13:2)

(Germanium)   (Expansion of solids)

MOLODTSOVA, L.V.; SIROTA, N.N.

Pulse response of magnesium-manganese ferrite cores containing 43 per cent Fe_2O_3. Dokl.AN BSSR 3 no.11:440-441 N '59.   (MIRA 13:4)

(Ferrates--Electric properties)

SOV/170-59-5-14/18

.24(6,8)

AUTHORS:

TITLE:

Sirota, N.N., Berger, L.I.

Coefficients of Linear Expansion of Indium and Gallium Arsenides and Indium Telluride, and Their Relation to Heat Conductivity (Koeffitsiyenty lineynogo rasshireniya arsenidov indiya i galliya i tellurida indiya i ikh svyaz' s teploprovodnost'yu)

PERIODICAL:

ABSTRACT:

The authors determined the values of linear expansion coefficients for InAs, In_2Te_3 and GaAs and plotted them versus temperatures in Figure 2. The measurement were performed with a quartz dilatometer in the temperature range from 100 to 600°C. The character of the temperature dependence of the coefficient value for indium telluride differs somewhat from that observed with arsenides, which is explained by a difference in the types of crystalline lattice. The results obtained made it possible to confirm an assumption expressed by Ya.I. Frenkel' [Ref 5], V.P.Zhuze [Ref 6] and T.A. Kontorova [Ref 7] on the relation between the coefficient of linear expansion α and coefficient of heat conductivity $\varkappa$. Figure 3 represents this relation which can be analytically expressed as follows:

$$\frac{1}{\varkappa} \sim \alpha^2$$

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SOV/170-59-5-14/18

Coefficients of Linear Expansion of Indium and Gallium Arsenides and Indium
Telluride, and Their Relation to Heat Conductivity

which relation was proposed previously by V.P. Zhuze. The authors
express their gratitude to N.A. Goryunova, B.T. Kolom'yets and
T.A. Kontorova for their interest in the present investigation.
There are 2 graphs, 1 diagram and 8 references Soviet.

ASSOCIATIONS: Institut tsvetnykh metallov i zolota imeni Kalinina (Institute
of Nonferrous Metals and Gold imeni Kalinin), Moscow;
Otdel fiziki tverdogo tela i poluprovodnikov AN BSSR (Section
of Physics of Solids and Semiconductors of the AS Belorussian
SSR), Minsk.

Card 2/2

24(3, 6)

AUTHORS: Sirota, N.N., Molodtsova, L.V.

TITLE: Investigation of Magnesium-Manganese Ferrites Containing 40% Fe_2O_3

PERIODICAL: Inzhenerno-fizicheskiy zhurnal, 1959, Nr 6, pp 116-120 (USSR)

ABSTRACT: In view of considerable technical importance of magnesium-manganese
             ferrites and insufficient studies of their properties, the authors
             undertook this attempt to investigate the changes in their magnetic
             characteristics due to changes in the MgO/MnO ratio under constant
             Fe_2O_3 content. Magnesium oxide, commercial iron oxide and manganese
             carbonate were used as initial materials whose relative concentration
             in various ferrites investigated is given in Table 1. Changes in
             specific electric resistance, coercive force, maximum and residual
             induction in dependence on the composition of the specimens are
             shown in Figure 1; changes in the values of Curie point, coefficient
             of the square shape of hysteresis loops, initial permeability and
             the area of hysteresis loops in dependence on composition are shown
             in Figure 2, and changes of induction in dependence on temperature
             in a field of 8 oersted are shown in Figure 3. Of considerable

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SOV/170-59-6-19/20

Investigation of Magnesium-Manganese Ferrites Containing 40% Fe_2O_3

interest is a peak in the curve of hysteresis loop areas at 20% concentration of MnO in Figure 2. Various shapes of hysteresis loops are shown in Figure 4. The authors thank A.I. Gur'yanova for assistance in preparing the specimens.
There are 4 graphs, 2 tables and 8 American references.

ASSOCIATION: Institut tsvetnykh metallov i zolota im. M.I. Kalinina (Institute of Non-Ferrous Metals and Gold imeni M.I. Kalinin), Moscow; Otdel fiziki tverdogo tela i poluprovodnikov AN BSSR (Department of Physics of Solids and Semiconductors of the AS Belorussian SSR), Minsk.

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SOV/126-7-6-12/24

AUTHORS: Sirota, N.N., Lekhtblau, Ye.A. and Smolyarenko, E.M.

TITLE: Influence of Ultrasonic Action in the Crystallization Process on the Structure and Properties of Aluminium Silicon Alloys

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 7, Nr 6, pp 879-884 (USSR)

ABSTRACT: Experiments were carried out on the ultrasonic apparatus of the Scientific Research Technological Institute (Fig 1). It consisted of a generator, a 3 kW amplifier and a magnetostriction transformer and rectifier. Twelve Al-Si alloys were made for the experiments with the following silicon contents: 2.5; 5; 7.5; 10; 11; 11.6; 12; 12.5; 15; 17.5; 20 wt.%. The alloys were heated to 250°C above the melting point and were cast into a mould which had been pre-heated to 400°C and dressed with chalk. Control runs have shown that dressing with chalk has no influence on the crystallization process and the structure of the ingot but it does prevent sticking to the mould walls. Ultrasonic waves were applied up to the point of casting. The frequency of oscillation was 18 to 18.5 khertz, changing during the crystallization process due to an

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SOV/126-7-6-12/24

Influence of Ultrasonic Action in the Crystallization Process on the Structure and Properties of Aluminium Silicon Alloys

increase in the quantity of the solid phase and to the change in the acoustic parameters of the system. The power supply to the emitter was 1.0 to 1.5 kW. As the alloys changed to the heterogeneous pasty state at the end of the crystallization process, the ultrasonic waves were as a rule discontinued. After perfecting the method a series of experiments with alloys of the Al-Si system was carried out. Six ingots were cast from each alloy, three being exposed to ultrasonic waves and three for reference purposes. From these ingots, specimens were made for tensile, impact and hardness testing and also for macro and micro-sections. It was noticed that alloys with low Si content (up to 7.5%) did not swell up under the action of ultrasonic waves until the ingot had completely solidified. The surface of the exposed ingots was smooth and even, whereas the surface of the reference specimens was rough. In Fig 2 the macrostructure of an Al-Si alloy containing 2.5% Si is shown (a - non-exposed and b - exposed specimens). In Fig 3 the macrostructure Card 2/4 of an Al-Si alloy containing 11.6% Si is shown (a - non-

SOV/126-7-6-12/24

Influence of Ultrasonic Action in the Crystallization Process on the Structure and Properties of Aluminium Silicon Alloys

exposed and b - exposed specimens). In Fig 4 the macrostructure of an Al-Si alloy containing 15% Si is shown (a - non-exposed and b - exposed specimens). In Fig 5 the influence of exposure on the change in ultimate tensile stress of Al-Si alloys with change in composition is shown (exposed specimen - upper curve). In Fig 6 the change in impact strength of Al-Si alloys with change in composition is shown (exposed specimen - upper curve, non-exposed specimen - lower curve). The authors arrive at the following conclusions:
1) As a result of the action of ultrasonic waves on the crystallization of Al-Si alloys, within the range 2.5 and 20% Si, a sharp refinement of the primary grain and microstructure takes place.
2) The ultimate tensile stress of exposed ingots increases on the average by 11% and the percentage elongation by 75%.
3) A general increase in hardness and impact strength of the alloys is achieved.

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SOV/126-7-6-12/24

Influence of Ultrasonic Action in the Crystallization Process on
the Structure and Properties of Aluminium Silicon Alloys

There are 6 figures, 1 table and 3 references, 1 of
which is Soviet and 2 German.

ASSOCIATION: Moskovskiy institut tsvetnykh metallov i zolota imeni
M. I. Kalinina (Moscow Institute of Non-ferrous Metals
and Gold imeni M. I. Kalinin)

SUBMITTED: December 7, 1957 (Initially)
July 29, 1958   (After revision)

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5 (4).
AUTHORS: Sirota, N. N., Academician, AS BSSR,   SOV/20-127-3-37/71
             Pashintsev, Yu. I.

TITLE: Dynamic Displacements of Atoms and the Linear Expansion
             Coefficient of Aluminum-, Gallium-, and Indium Arsenides

ABSTRACT: In continuation of observations made by Sirota (Ref 1) the
             connection between root mean square atomic displacements in the
             crystal lattice of the semiconductor compounds mentioned above
             and the linear expansion coefficient is investigated. For the
             determination of the characteristic temperature and the linear
             expansion coefficient the data of the X-ray structural analysis
             of the compounds mentioned were used. Table 1 shows the data
             obtained from X-ray pictures, the centers of temperature inter-
             vals for which the characteristic temperature θ was calculated,
             the logarithm of the ratio of the peaks of the blackening lines

             $\left(\ln \dfrac{I_{T_1}}{I_{T_2}} \right)$ determined from the microphotogram, root mean square of

             the dynamic displacement $\overline{u_T^2}$, the linear expansion coefficient α

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Dynamic Displacements of Atoms and the Linear Expansion SOV/20-127-3-37/71
Coefficient of Aluminum-, Gallium-, and Indium Arsenides

and its square. From the theory of the thermal dissipation of
X-rays by Debye-Waller, the connection of line intensity at
various temperatures (T_1 and T_2) is given by the expression

$$\ln \frac{I_{T_1}}{I_{T_2}} = 16\pi^2 \left(\overline{u^2_{T_2}} - \overline{u^2_{T_1}} \right) \frac{\sin^2 \vartheta}{\lambda^2} \quad (1),$$

and the dependence of $\overline{u^2_T}$
on the characteristic temperature

$$\overline{u^2_T} = \frac{3h^2 T}{4\pi^2 mk\theta^2} \left[\phi(x) + \frac{x}{4} \right] \quad (2)$$

with $\phi(x)$-Debye function, m - average mass of the atom $x = \frac{h\nu_g}{kT}$
and ν_g limit frequency of the atoms. From the relation (2), to
which attention had already been drawn by Ioffe (Ref 7), it may
be seen that with an increase of $\overline{u^2_T}$ the characteristic temperature θ
and thus also the threshold frequency decreases. Figure 1 shows
the dependence of $\overline{u^2}$ on T. The greatest $\overline{u^2}$ was found in the case
of indium arsenide, the smallest in that of AlAs. With increasing
temperature, $\overline{u^2}$ in the case of all compounds increases according

Card 2/3   to a similar law. Figure 2 shows the dependence of

Dynamic Displacements of Atoms and the Linear Expansion   SOV/20-127-3-37/71
Coefficient of Aluminum-, Gallium-, and Indium Arsenides

$\overline{u^2}$ on α^2. The values are on a straight line passing through the origin of coordinates. Thus, there is direct proportionality for the investigated compounds within the temperature interval of $200-650^\circ$. There are 2 figures, 1 table, and 7 references, 6 of which are Soviet.

ASSOCIATION: Gosudarstvennyy nauchno-issledovatel'skiy i proyektnyy institut
              redkometallicheskoy promyshlennosti (State Scientific Research
 and Planning Institute for the Rare Metals Industry)

SUBMITTED: May 5, 1959

Card 3/3

SIROTA, N. N.

PHASE I BOOK EXPLOITATION   SOV/4893

Vsesoyuznoye soveshchaniye po fizike, fiziko-khimicheskim svoystvam
    ferritov i fizicheskim osnovam ikh primeneniya. 3d, Minsk, 1959

Ferrity; fizicheskiye i fiziko-khimicheskiye svoystva. Doklady
    (Ferrites; Physical and Physicochemical Properties. Reports)
    Minsk, Izd-vo AN BSSR, 1960. 655 p. Errata slip inserted.
    4,000 copies printed.

Sponsoring Agencies: Nauchnyy sovet po magnetizmu AN SSSR. Otdel
    fiziki tverdogo tela i poluprovodnikov AN BSSR.

Editorial Board: Resp. Ed.: N. N. Sirota, Academician of the
    Academy of Sciences BSSR; K. P. Belov, Professor; Ye. I. Kondor-
    skiy, Professor; K. M. Polivanov; Professor; R. V. Telesnin, Pro-
    fessor; G. A. Smolenskiy, Professor; N. N. Shol'ts, Candidate of
    Physical and Mathematical Sciences; E. M. Smolyarenko; and
    L. A. Bashkirov; Ed. of Publishing House: S. Kholyavskiy; Tech.
    Ed.: I. Volokhanovich.

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SOV/4893

Ferrites (Cont.)

PURPOSE: This book is intended for physicists, physical chemists, radio electronics engineers, and technical personnel engaged in the production and use of ferromagnetic materials. It may also be used by students in advanced courses in radio electronics, physics, and physical chemistry.

COVERAGE: The book contains reports presented at the Third All-Union Conference on Ferrites held in Minsk, Belorussian SSR. The reports deal with magnetic transformations, electrical and galvanomagnetic properties of ferrites, studies of the growth of ferrite single crystals, problems in the chemical and physicochemical analysis of ferrites, studies of ferrites having rectangular hysteresis loops and multicomponent ferrite systems exhibiting spontaneous rectangularity, problems in magnetic attraction, highly coercive ferrites, magnetic spectroscopy, ferromagnetic resonance, magneto-optics, physical principles of using ferrite components in electrical circuits, anisotropy of electrical and magnetic properties, etc. The Committee on Magnetism, AS USSR (S. V. Vonsovskiy, Chairman) organized the conference. References accompany individual articles.

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Ferrites (Cont.)

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pendence of the Magnetic Permeability of Nickel-Magnesium-
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perature Magnetic Hysteresis in Nickel-Zinc Ferrites   249

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Kovtun, Ye. F., and A. S. Mil'ner.   Magnetic Anomalies of
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27374
S/194/61/000/003/040/046
D201/306

:8 32 5TD

AUTHORS: Sirota, N.N., Lekhtblau, Ye.A. and Smolyarenko, E.M.

TITLE: Crystallization of alloys in an ultrasonic field

PERIODICAL: Referativnyy zhurnal. Avtomatika i radioelektronika,
                 no. 3, 1961, 20, abstract 3 E144 (V sb. Kristalli-
                 zatsiya metallov, M., AN SSSR, 1960, 268-271)

TEXT: An investigation has been made into the effect of ultra-
sonic oscillations at a frequency of 19 Kc/s on the process of
crystallization. The alloys Al-Si, Al-Cu, Al-Mg were heated to
about 50-100°C above their melting point and then poured into a
casting mould heated to 400°C. The mould was then screwed onto the
concentrator. The analysis of the samples thus obtained has shown
that the sedimentation shell concentrated in the upper portion of
the ingot under the effect of ultrasound and was evenly distributed
throughout its volume without ultrasound. By comparing the macro-
graphs it was determined that sound makes the structure of the ingot

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Crystallization of alloys...

27374
S/194/61/C)0/003/040/046
D201/D306

finer. The mechanical tests with samples show an increase in strength by 10-15%. The effect of ultrasound results in dispersion and in a uniform distribution of impurities and consequently in even formation of crystals. It also increases the probability of spontaneous generation of crystallization centers. 3 figures. 11 references. /Abstracter's note: Complete translation/

Card 2/2

SIROTA, N.N.; OLEKHNOVICH, N.M.; SHELEG, A.U.

Distribution of electron density in silicon.   Dokl.AN BSSR 4 no.4:
144-147 Ap '60.   (MIRA 13:10)

1. Otdel fiziki tverdogo tela i poluprovodnikov AN BSSR.
                        (Silicon)

80067

24.7100

AUTHORS: Sirota, N. N., Academician of the   S/020/60/132/01/042/064
            AS BSSR, Olekhnovich, N. M.,   B004/B007
            Sheleg, A. U.

TITLE: The Determination of the Distribution of Electron Density in
            Crystals

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol 132, Nr 1, pp 160 - 163
            (USSR)

TEXT: The electron density distribution ρ and its value at a certain point
$(x, y, z,)$ is determined by summation of a three-dimensional Fourier series
(1). The number of terms in this series is limited by the number of experi-
mentally determinable reflections. The authors mention the methods which were
suggested for the purpose of further increasing the precision of the determi-
nation of electron density (extrapolation of the f-curve, introduction of a
temperature coefficient), and point out the errors arising in this connection.
They then explain their method, which makes use of the value of the atomic
scattering factor, which may be determined by means of CuKα radiation as well
as by less hard radiations. The authors divide the value of the scattering
factor into two parts with a density distribution $\rho_1(\vec{r})$ and $\rho_2(\vec{r})$, where $\rho_1(\vec{r})$
corresponds to the density of the electrons near the atom and is described by

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The Determination of the Distribution of
Electron Density in Crystals

S/020/60/132/01/042/064
B004/B007

the Gauss function $\rho_1(\vec{r}) = A \exp(-\alpha r^2) \cdot \rho_2(\vec{r})$, on the other hand, corresponds
to the electron density of the outer electrons, which, in the case of high
reflection indices, cause only a slight change in the course of the f-curve.
Figure 1 shows the course of the f_1-curve and the f_2-curve for diamond, where

$f - f_1 = f_2$. f_2 corresponds to the unknown density ρ_2 of the outer electrons,
which may thus be determined from the difference. For the electron density in
an arbitrary point of the crystal, $\rho(\vec{r}) = \rho_1(\vec{r}) + \rho_2(\vec{r})$. This equation is ex-
panded into a series (6). Figure 2 shows the results obtained by calculating
the electron density for diamond in the direction [111] according to the
method suggested and by means of a temperature factor at 7500°K and 20°C.
Figure 3 shows the calculation for the points 0, 0, 0; 1/8, 1/8, 1/8 and 1/2,
1/2, 1/2 according to both methods between 0 and 15000°K. There are 3 figures,
and 18 references, 7 of which are Soviet.

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80067

The Determination of the Distribution of
Electron Density in Crystals

S/02C/60/132/01/042/064
B004/B007

ASSOCIATION: Otdel fiziki tverdogo tela i poluprovodnikov Akademii nauk BSSR
(Department of the Physics of Solids and Semiconductors of the
Belorussian Academy of Sciences)

SUBMITTED: January 5, 1960

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S/020/60/134/006/026/031
B004/B054

AUTHORS: Sirota, N. N., Academician of the AS BSSR and Tonoyan, A.A.

TITLE: Visualization of Dislocations and Some Forms of Etch
               Patterns on Single Crystals of Silicon

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 134, No. 6,
               pp. 1397-1398

TEXT: The authors thoroughly studied the etch patterns produced on sili-
con samples by dislocation and other disturbances (Ref. 1). The samples
were cut out of single crystals in the (111) plane. The orientation of
the crystals was carried out by means of an apparatus described by
I. Ye. Voytsekhovich. The mechanical polishing was followed by a chemical
polishing with a mixture of concentrated hydrofluoric, nitric, and acetic
acids at 30 - 35°C (for 2-3 min), and then by etching in a dilute acid
solution (for 1.5 - 2 min). The etch patterns are described, and their
microphotographs are shown in Figs. 1, 2: right- and left-handed spirals
which, externally, often change into triangular terraces; spirals with
new spirals becoming visible at both ends in planes perpendicular to each
other; superposed terraces; and (in KOH) polygons with sides parallel to
Card 1/2

Visualization of Dislocations and Some Forms   S/020/60/134/006/026/031
of Etch Patterns on Single Crystals of Silicon B004/B054

one another. Measurements showed a decrease in microhardness near the etch-
ing furrows (Table 1). There are 2 figures, 1 table, and 5 references:
2 Soviet, 1 US, 1 British, and 1 Japanese.

ASSOCIATION: Otdel fiziki tverdogo tela i poluprovodnikov Akademii nauk
                BSSR
                (Branch of Solid State Physics and Semiconductors of the
                Academy of Sciences BSSR)

SUBMITTED: June 17, 1960

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86843

S/020/60/135/005/034/043
B004/B075

$9.4300 (3203, 1043, 1143)$

AUTHORS: Sirota, N. N., Academician of the AS BSSR and Sheleg, A. U.

TITLE: Distribution of the Electron Density in Germanium

PERIODICAL: Doklady Akademii nauk SSSR, 1960, Vol. 135, No. 5, pp. 1176-1178

TEXT: The author systematically investigated the distribution of electron density in semiconductors. The present paper gives some results of the determination of the atomic scattering factor f as a function of $\sum_i h_i^2$ and of the distribution of electron density in germanium. The investigation was carried out with n-type germanium monocrystals pulverized up to 5-8μ (resistivity 60 ohm·cm). The X-ray pictures were taken in Cu K_α radiation at room temperature by means of a УРС-50 И (URS-50I) recorder. A 20-μ thick nickel foil served as a filter. The reflection intensity I_{hkl} was calculated on the strength of the peak areas of the ЭПП-09 (EPP-09)-type recording electronic potentiometer. To find out the absolute

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86843

Distribution of the Electron Density in   S/020/60/135/005/034/043
Germanium V   B004/B075

values, the I_{hkl} of Ge was compared with the 220- and 311-lines of Si and
NaCl, which served as standards. The absorption coefficient of Ge was de-
termined from the reduction of the intensity of the primary beam during its
passage through 50-200 μ thick lamellas. Results are given in Figs. 1, 2,
4. On the level of electron density of 1.5 el/A^3, a Ge-ion diameter of
0.5 A is obtained, and on the level of 0.05 el/A^3, one of 2 A. For a com-
parison, the corresponding values for diamond (0.20 - 0.25 and 1.25 A) and
silicon (0.4 and 1.75 A) are given. Yu. N. Shuvalov is mentioned. There
are 4 figures and 6 references: 3 Soviet and 3 German.

ASSOCIATION: Otdel fiziki tverdogo tela i poluprovodnikov Akademii nauk
                BSSR (Department of Solid-state Physics and Semiconductor
                Physics of the Academy of Sciences BSSR)

SUBMITTED: September 10, 1960

Card 2/4

S/058/62/000/008/070/134
A061/A101

AUTHOR: Sirota, N. N.

TITLE: On some basic problems of the theory of crystal origin and growth

PERIODICAL: Referativnyy zhurnal, Fizika, no. 8, 1962, 7, abstract 8E59
               (In collection: "Rost kristallov. T. 3", Moscow, AN SSSR, 1961,
               211 - 213. Discuss., 214 - 218)

TEXT: Deficiencies in modern conceptions of crystal origin and growth
are considered. It is noted that many theories of crystallization do not take
into account, among other factors, the probability of nucleation as depending
on the composition, the ordering degree of initial and nascent phases, and the
probabilities of concentration fluctuation. The role of dislocations in the
surface layer of the growing crystal also requires a careful analysis.

[Abstracter's note: Complete translation]

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AKULOV, N.S., akademik; GINZBURG, A.S., doktor tekhn.nauk, prof.;
KOSTERIN, S.I., doktor tekhn.nauk, prof.; LYKOV, A.V.,
akademik; POMERANTSEV, A.A., doktor fiziko-materaticheskikh
nauk, prof.; SIROTA, N.N., akademik; SHEVEL'KOV, V.L., doktor
tekhn.nauk, prof.

Aleksandr Savvich Predvoditelev; on his 70th birthday. Inz.-fiz.
zhur. 4 no.12:106-108 D '61.   (MIRA 14:11)

1. Akademiya nauk BSSR (for Akulov, Lykov, Sirota).
            (Predvoditelev, Aleksandr Savvich, 1891-)

89737

24.7700   1143, 1043, 1150

S/020/61/136/003/025/027
B004/B056

AUTHORS: Sirota, N. N., Academician of the AS BSSR, and Olekhnovich,
             N. M.

TITLE: Electron Density Distribution in Indium Arsenide

PERIODICAL: Doklady Akademii nauk SSSR, 1961, Vol. 136, No. 3,
             pp. 660-662

TEXT: It was the purpose of this work to clarify the factors to which the
specific physical properties of arsenides $A^{III}B^{V}$ with sphalerite structure
are due. This concerns the semiconductor properties, the markedly high
carrier mobility, and the great width of the forbidden band. The study
was carried out on a crystalline InAs (the synthesis is described in Ref.1),
which was ground to fine powder (6 - 8μ). X-ray diffraction patterns were
made at room temperature, and Cu Kα-radiation by means of a УPC-50-И
(URS-50-I) apparatus. From the experimental data obtained, the following
was calculated: The square of the structural amplitude F^2 and the atomic
scattering factors f_{In} and f_{As}. Herefrom, the distribution of the electron

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Electron Density Distribution in Indium   S/020/61/136/003/025/027
Arsenide   B004/B056

density was obtained. Fig. 3 shows the distribution in the unit cell of
InAs in the plane (110). Fig. 4 shows the same in the plane (110) and the
direction [111] and [113]. The results obtained are discussed. Special
attention is drawn to the "bridge" of the electron density, which takes
its course in the direction [111] in the interval 1/2 1/2 1/2 - 3/4 3/4 3/4,
attains a value of 0.20 electron/A^3 at 5/8 5/8 5/8, and drops at the point
3/4 3/4 3/4 to 0.03 eletron/A^3. This "bridge" does not exist in germanium.
The "bridge" between the coordinates 000 and 1/4 1/4 1/4 in the direction
[111] was observed also in germanium, silicon, and diamond. The data
obtained will contribute towards clarifying the interatomic interaction
in InAs. There are 4 figures and 5 references: 4 Soviet and 1 German.

ASSOCIATION: Otdel fiziki tverdogo tela i poluprovodnikov Akademii nauk
             BSSR (Department of Solid-state Physics and Semiconductors
             of the Academy of Sciences BSSR)

SUBMITTED: September 16, 1960

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$9,4300$ (also $1043, 1143, 1150$)

AUTHORS: Sirota, N. N., Academician AS BSSR, and Olekhnovich, N. M.

TITLE: Electron Density Distribution in Gallium Arsenide

PERIODICAL: Doklady Akademii nauk SSSR, 1961, Vol. 136, No. 4,
              pp. 879-881

TEXT: The specimens used for the experiment were purified by zone melting.
X-ray pictures were taken by CuKα radiation at room temperature and
recorded by a УРС-50 (URS-50) recorder and a Geiger-Müller counter. The
line intensity was calculated from data recorded by the automatic
potentiometer ЭПП-09 (EPP-09). The amplitude squares (F^2) were calculated
for three types of lines: (F_1^2), (F_2^2), and (F_3^2). The atomic scattering
factors f for gallium and arsenic ions were calculated for given F^2 (Fig.1).
Fig. 2 shows the logarithm of the atomic scattering factors as a function
of Σh_i^2. If $\Sigma h_i^2 > 12$ for arsenic and $\Sigma h_i^2 > 10$ for gallium ions, ln f
is a linear function of Σh_i^2. Fig. 4 shows the electron density

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Electron Density Distribution in Gallium
Arsenide

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B028/B060

distribution among the ions Ga-As-Ga in the direction $[111]$ (Fig. 4a), and
among GaAs ions in the direction $[11\bar{3}]$ (Fig. 4b) in the (110) plane. In the
plane (110) between neighboring Ga ions and As ions in the direction
$[111]$, one finds "bridges" with increased electron density with a
minimum value of 0.49 el/A^3 between the points 000 and 1/4 1/4 1/4.
Similar "bridges" are observed in SiO_2, Ge, and InAs crystals. In GaAs and
InAs, electron density almost vanishes in the direction $[111]$ near the
points 3/4 3/4 3/4. In addition there are no "bridges" in GaAs in the
direction $[11\bar{3}]$, but an electron density minimum (groove) similar to
those found in Ge and Si crystals. For an electron density level of
0.5 el/A^3, the ionic radius of Ga is 0.8 A, and that of As, 1.65 A. In the
direction $[11\bar{3}]$, it is only 1.3 A for As. For an electron-density level
of 0.25 el/A^3, Ga had an ionic radius of 1.3 A, while As had one of
1.45 A. The following values were obtained for InAs: for 0.5 el/A^3:
In = 0.9 A; As = 1.2-1.1 A; for 0.25 el/A^3: In = 1.5 A; As = 1.35 A.
There are 4 figures and 3 Soviet references.

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Electron Density Distribution in Gallium
Arsenide

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B028/B060

ASSOCIATION: Otdel fiziki tverdogo tela i poluprovodnikov Akademii nauk
BSSR (Department of Solid-state Physics and Semiconductors,
Academy of Sciences BSSR)

SUBMITTED: September 19, 1960

Legend to Fig. 1: $F^2 = f\Sigma h_i^2$ for GaAs (a); atomic scattering factors (σ)
for As ions (I) and gallium ions (II) in GaAs.

Legend to Fig. 2: $\ln f = g\Sigma h_i^2$ in GaAs for As ions (o-o-o) and Ga ions
(x-x-x).
Legend to Fig. 4: electron density distribution in the directions $[111]$ (a)
and $[11\bar{3}]$ (σ) in the (110) plane of a GaAs unit cell; 1) el/A.

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_:, 7000 · 1043, 1136, 1160

RS: Sirota, N. N., Academician AS BSSR, and Gololobov, Ye. M.

E: Atomic scattering factors and electron density distribution
in gallium antimonide

DICAL: Doklady Akademii nauk SSSR, v. 138, no. 1, 1961, 162-164

T: The present work is the first of a series of studies conducted on
the density distribution in antimonides of 3rd-group elements of
periodic system.   Due to the fact that the electron density distribu-
of gallium antimonide is of interest for the interatomic bond problem
conductors of type $A^{III}B^V$, this compound was chosen as the first for
mental purposes.   At the Institut redkikh metallov (Institute of
Metals) GaSb was obtained by zone melting. crushed in an agate dish,
ded in toluene, and the fraction with a particle size ranging from
was subsequently subjected to examination.   The X-ray pictures
by means of a УРС-50И (URS-50I) apparatus with K_α radiation of
The constant of the unit cell (a = 6.087 A), found as the result of

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B101/B231

... scattering factors and electron...

examination, agreed fairly well with previous publications. The curves
.. structural amplitude squares (Fig. 1a), referring to the formula
.. were constructed on the basis of the absolute reflection intensities
...ens with even indices, the sum of which can be divided by four, of the
.. reflections with odd indices as well as of those with even indices,
.. total of which is indivisible by 4. The same procedure was applied for
..mputation of the atomic scattering factors of the Sb and Ga ions
.. 1). The logarithms of the atomic scattering factors are - beginning

$\sum\limits_{i=1}^{2} h_i^2 > 8$ - positioned on straight lines (Fig. 2). A deviation occurs
.. 4, which is indicative of a non-Gaussian distribution of the electron
..ty. The values of f_{Sb} and f_{Ga} were used to calculate electron density

.. 3). The results obtained showed that on the electron-density level
.. lectron per 1 A^3" the ionic radius of Ga is about 0.5 A and that of
.. 0.8 A, whereas for the level 0.5 el/A^3 these values are 0.75 and
.. respectively. This reveals the relative characters of the concepts of
.. radius and packing density. The point to be stressed is that near
.. middle of the distance (5/8 5/8 5/8) the electron density between the

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B101/B231

Atomic scattering factors and electron...

Ga and Sb ions in the directions [111] and [113] in the (110) plane almost vanishes. Fig. 4 represents the electron density distribution in the (110) plane of the GaSb unit cell. Attention is drawn to the "bridges" of increased electron density between adjacent Ga and Sb ions. The authors believe that the results of the present work will offer a better insight into the character of interatomic interaction with regard to the physical properties of GaSb. There are 4 figures and 5 references: 4 Soviet-bloc and 1 non-Soviet-bloc.

ASSOCIATION: Otdel fiziki tverdogo tela i poluprovodnikov Akademii nauk BSSR (Division of Solid State Physics and Semiconductors of Academy of Sciences, BSSR).

SUBMITTED: December 12, 1960

Card 3/7

SIROTA, N.N., akademik, red.; KHOLYAVSKIY, S., red. izd-va; VOLOKHANOVICH,I.
tekhn. red.

[Crystallization and phase transitions]Kristallizatsiia i fazo-
vye perekhody. Minsk, Izd-vo Akad. nauk BSSR, 1962. 444 p.
                                                  (MIRA 16:2)

1. Akademiya nauk Belorusskoy SSR (for Sirota).
               (Crystals--Growth)

L 18449-63   EWP(q)/EWT(1)/EWT(m)/BDS   AFFTC/ASD/ESD-3/IJP(C)   JW/JD
                                          S/2912/62/000/000/0011/0058
ACCESSION NR: AT3001892   7/
                                                                 5-9
AUTHOR: Sirota, N. N.

TITLE: Current status and problems of the theory of crystallization.

SOURCE: Kristallizatsiya i fazovy*ye perekhody*.Minsk, Izd-vo AN BSSR, 1962,
11-58

TOPIC TAGS: crystal, crystallization, growing, kinetics, thermodynamics,
nucleus, crystallization nucleus, surface energy, phase, boundary, electrocrys-
tallization, diffusion, heat transfer, mass transfer, lattice, phase diagram,
metastable, metastability, eutectic, eutectoid, autocatalytic, phase transformation

ABSTRACT: This state-of-the-art survey paper embraces both the fundamental
problems of crystallization and its many direct or indirect links with many techno-
logical and industrial processes, phenomena of nature around us, and the biosci-
ences. The paper does not touch upon certain special fields of crystallization,
such as in the process of zone melting, continuous casting, etc. Literature
sources are cited extensively. (I) The kinetics of crystallization processes. The
development, during the 1920's and 30's, of an understanding of the laws governing
the crystallization process with time, is broken down into the investigation of the

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kinetics of isothermal crystallization, investigations of topochemical and chemical
reactions, and others. The theory of the kinetics of crystallization has achieved
significant progress to date, but is still far from perfect. In current theory,
phase transformation is regarded as proceeding rigorously in isothermal conditions
and, with few exceptions, without consideration of the change in composition of the
initial and the resulting phases, volumetric changes, autocatalysis effects, the
mutual screening action of the growing crystals, the gradual exhaustion of impuri-
ties, the fractioning of the initial phase into mutually isolated regions, etc. (II).
Elementary processes of the inception and growth of crystallization nuclei. The
surface energy along the phase boundary. Basic reference is made to the classical
work of Kossel and Stranski. In the USSR, great attention has been focused on the
surface tension. V. K. Semenchenko and his students work actively on a solution.
The works of Ya. I. Frenkel', A. G. Samoylovich, and S. N. Zadumkin, the latter
through his investigations via the solution of the Thomas-Fermi equation, are
attracting considerable interest. However, it must be noted that neither from the
theoretical nor from the experimental side have any substantial break-throughs
been scored in the estimation of the surface tension on the phase boundaries in
solids. In this respect the recent efforts of A. A. Gorskiy are to be welcomed.
The most difficult problem in this sector appears to be that of the determination
of the surface energy on the boundary between liquid-solid and solid-solid phases.

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Elementary crystallization processes. Existing concepts on the elementary pro-
cesses of crystallization are based on D. B. Gibbs' and M. Vollmer's classical con-
cepts. Further developments, including those of Kossel and Stranski, developed
more fully by Stranski and Kaishew, relative to the energy of the bonding of atoms
or ions on the surface of a growing crystal, are cited. The fluctuation theory and
its experimental verification are set forth. The development of the theory of dis-
locational spiral growth or dissolution of layers of crystals is traced from its be-
ginning in 1945 at the hand of G. G. Lemleyn. Among the most important results of
this direction of investigation are the quantitative examination of the rate of growth
of a two-dimensional layer on a surface, the estimation of the normal rates of
growth of faces in dislocational, nucleus-free, spiral growth, and the partial elimi-
nation of the contradiction between experimental and theoretical values of super-
saturation required for normal growth. Contrary to the results of the Stranski-
Kaishew theory the author believes that the actual mechanism of growth of crystals
is a result of the presence of an amorphized, mobile, surface layer in the growing
crystal and is comparatively similar to the mechanism of growth of a drop. In
contrast to the growth of a liquid drop, there occurs in the growth of a crystal a
partial disordering of the surface layer, which is eliminated as the thickness in-
creases. Here it is not excluded that the formation of two-dimensional nuclei in a
number of cases can occur as a secondary process which does not exert as great a

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limiting effect as would appear from the Stranski-Kaishew theory. The author presented these concepts at the First All-Union Crystallization Conference and has meanwhile found experimental confirmations therefor. Electrocrystallization (EC). The literature touching on the subject is cited, and it is concluded that the processes of EC, fundamentally, are described by the same expressions as are other crystallization processes and that the study of EC processes benefits from the advances of the general theory of crystallization. Nonstationary crystallization processes: Influence of diffusion and heat transfer. The process of crystallization is basically regarded to be a nonuniform process, even though in many cases it may be stationary or nonstationary. The literature adduced pertains to the consideration of the heat-transfer process during crystallization, which occurs because of the rejection of the heat of crystallization and, at times, even during the process of change of composition by diffusion. (III) . P. D. Dankov's principle of dimensional and orientational correspondence. This principle (ZhFKh, v. 20, 1946, 853) demonstrates convincingly that the effect of insoluble impurities and stranger base layers can be understood on the basis of the conceptions of the mechanism of spontaneous nucleation and the statistical-kinetic character of their growth. The development of this thought, including the formation of Widmanstätten structures, is traced through the literature. Topochemical oxidation and reduction processes are also characterized by the presence of a crystallographic affinity

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along the phase boundary. The impact of the Dankov principle and theory on the
understanding of these processes is traced. (IV). The effect of elastic deforma-
tion and pressure on the crystallization process: Primacy in this field is attri-
buted to P. D. Dankov also. The complex history of this particular sector is de-
veloped. Attention is directed to recent works, in connection with the problem of
martensite transformation, on the consideration of the elastic energy during the
appearance of crystals of a new phase and the determination of the change of
thermodynamic potential related thereto. (V). Crystallization processes in multi-
component systems. The literature pertaining to the investigation of processes in
which a new phase of a different composition than the initial one appears is sur-
veyed. In this sector it appears that no more than a statement of the problems of
the theory of crystallization of solid solutions (mixed crystals) and of the crystalli-
zation of multicomponent systems is at hand. (VI). The theory of the formation of
metastable phases. The development of this theory and that of the boundaries of
metastability is traced. The results of the quantitative examination of the problem
of the causes and conditions of the formation of metastable phases have permitted
the solution of a number of important scientific and practical problems and, in
particular, a study of the conditions that govern the existence of metastable phase
diagrams and the factors that determine the thermodynamic and kinetic conditions
of the formation of metastable phases and, lastly, an examination, from these

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points of view, of the phenomenon of "recovery," that is, the appearance of meta-
stable phases during dispersion hardening. Among the important problems in
this sector cited is the problem of the causes of the change in composition of the
precipitating phases during anneal of quench-hardened steel, the isothermal aus-
tenite transformation, and other experimental facts concerning the changes in
composition of carbide during the anneal of quenched special and carbon steels.
The theory of eutectic and eutectoid crystallization: Special attention is focused on
the formation of a shielding layer of initial phase which affects the process of
diffusion of the crystalline matter of the new phase. In many instances, the exist-
ence of such a shielding layer appears to be a limiting factor for the mechanism
and kinetics of the process. The literature on the effect of inclusions on the pro-
cess of crystallization or phase transformation, such as that of graphite in steel
and of sulfides and others that affect the process of transformation of supercooled
austenite, is mentioned. Effect of stresses on the processes of crystallization:
Autocatalytic processes. The literature on the autocatalytic processes, in which
the precipitation of a new phase along certain crystallographic planes and directions
produces stresses which, in return, stimulate an acceleration of the precipitation
along the same directions, is briefly surveyed. Conclusions: The author is not
certain whether the development of the science of crystallization in recent years
has brought forth more answers to existing problems or more new problems that

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call for answers. Among the most important problems of the moment are: (1) The surface energy along the phase boundaries between solid and liquid, solid and solid, and liquid and liquid. (2) The effect of the structure of the liquid and the initial phase on the rate of inception and growth of nuclei of the new phase. (3) The appearance of microscopic and macroscopic defects in the process of crystalliza- tion; the effect of defects on the progress of the crystallization. (4) A synthesis of the phenomenological, molecular-kinetic, and dislocational theories into a unitary theory of crystallization. (5) The elaboration and application of the methods of thermodynamics and the statistics of irreversible processes to problems of the formation and growth of new-phase nuclei. (6) The development of a phenomeno- logical and molecular-kinetic theory of crystallization in two- and multi-compon- ent systems. Improved utilization of phase diagrams in the solution of problems of the mechanism and kinetics of the process of crystallization. Development and application of the method of physico-chemical analysis (study of the phase diagram) in the investigation of the rates of crystallization and transformation. (7) Further development of the theory of the kinetics of crystallization processes with due account of the dimensionality of the growing crystals of the new phase, changes in composition, and the temperature dependence of the crystallization parameters, with due consideration of the presence of a crystallization-shielding layer. (8) The theoretical development of specific processes of crystallization, phase

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transformations, and, especially, crystallization processes in films and the for-
mation of single crystals. (9) A theoretical examination of real nonstationary
crystallization processes, determined by the conditions of heat rejection and heat
and mass transfer, in connection with the general problem of crystallization.
(10) A theoretical investigation and development of methods for the growing of
single crystals with prescribed densities of defects and with prescribed (controlled)
filling of energy levels of various impurities. (11) Theoretical development of new
methods for the growing of single crystals and specific methods of recrystallization,
including such methods as floating-zone melting, the Chokhral'skiy method, et al.
(12) Development of a method of autocatalytic and cooperative processes of crys-
tallization and transformations, and experimental and theoretical development of
crystallization problems which accompany the electrically produced break-up of
crystals, etc. The cooperation of a broader circle of physicists and physical
mathematicians, as well as the use of electronic computers, is invited. Orig. art.
has: 19 figures.

ASSOCIATION: none		
SUBMITTED: 00	DATE ACQ: 16Apr63	ENCL: 00
SUB CODE: CH, PH, MA.	NO REF SOV: 116	OTHER: 046

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L 18831-63   EWP(q)/EWT(m)/BDS   AFFTC/ASD   JW/JD

ACCESSION NR: AT3001899   S/2912/62/000/000/0082/0106

55

AUTHOR: Sirota, N. N.

TITLE: The effect of impurities on the process of crystallization (effect of inoculants, influence of their crystallochemical affinity)

SOURCE: Kristallizatsiya i fazovyye perekhody. Minsk, Izd-vo AN BSSR, 1962, 82-106

TOPIC TAGS: crystal, crystallization, crystallography, phase, transformation, change, inoculation, inoculant, impurity, addition, affinity, crystallochemical, crystallographic

ABSTRACT: This paper examines the characteristics of the action of inoculants and impurities of various types on the crystallization process and the mechanism of their effect from the point of view of the theory of spontaneous crystallization (SC). The examination poses these problems in their most general form, assuming that the discussions and conclusions may be applied to specific instances of crystallization from a gaseous phase and from a fusion, and, in the latter case, either from the fusion itself or through recrystallization in the solid state. Four general classes of inoculant impurities are distinguished: (1) Inoculants that act

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on the process of crystallization as solid extraneous inclusions (usually in a highly dispersed state); (2) inoculants that go into solution and which affect the crystalli-zation process primarily by altering the composition of the phase interfaces and of the regions of the parent phase with an increase in the specific free energy (SFE); (3) various external effects that create nonuniformities in the structure, the physi-cal and chemical state of the substance, and, consequently, nonuniformities of the magnitude of the SFE and of the chemical composition in various regions of the parent phase; (4) selfinoculation. The present study is limited to an analysis of the effect of inoculant impurities of the first class (inclusions), the second class (surface-active substances that go into solution), and the fourth class (selfinocula-tion). A further subdivision of these classes is specified and tabulated. Two im-portant subjects of crystallization theory are entertained, namely, the SC of new-phase nuclei on impurities and the role of the dimensional and orientational corre-spondence between the lattices of the inclusions and those of the germinating new phase in the processes of germination and growth of its nuclei. These problems are examined in two sections: (1) The mechanism of the effect of the inclusions on the crystallization process. The effects of chemically noninteracting and crystal-lographically nonaffine inclusions on the crystallization process are attributed to the following factors: The inclusions can offer ready surfaces, at the boundary of which germination of new-phase nuclei is facilitated. The impurity surfaces can

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offer a germination opportunity through their surface nonuniformities and presence
of fissures. The dispersivity of the inclusions on nucleus formations and the
growth of new-phase crystal germs can be great because of their disturbing effect
on the layer of surrounding phase and differences in surface energy. Adsorptional
phenomena between impurity and parent phase can also aid the crystallization pro-
cess. Each of these factors is analyzed theoretically. The reasonings adduced in-
dicate convincingly that, as a rule, inclusions of various degree of dispersivity can
affect the germination rate of new-phase centers within a broad range of supercool-
ing and time. The nucleus-germination process on inclusions can have a purely
fluctuational character; here, as a rule, the work of nucleus germination on the
impurities will be intermediate between the work of the formation of 3-dimensional
and 2-dimensional nuclei. Further quantitative analysis of these qualitative reason-
ings is desirable. (2) The mechanism of the effect of chemically noninteracting,
but crystallographically affine, impurities on the crystallization process. This
section deals with the existence of inoculants which have a crystallographic affinity
with the new germinating new phase and on which the new phase can form directly
as well as on an interlayer and can continue to grow in accordance with the crys-
tallography of the interlayer. Such inoculants constitute ready crystallization
centers. The probability of germination of two-dimensional new-phase nuclei on
the faces of these inclusions is approximately equal to the probability of the

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germination of two-dimensional nuclei on the faces of three-dimensional new-phase nuclei. Various special problems in this process are analyzed. Among the important problems of the effects of soluble impurities we note the problems of their effect on the form of growing and dissolving crystals and on the rate of their growth and dissolution. These problems are linked directly with the entire complex of problems of the adsorption of impurities on various crystal faces and with the problem of the effect of impurities on the structure of the parent phase of a solid or liquid solution or fusion. This second portion of the present study will be published in the second volume of "Kristallizatsiya i fazovyye perekhody (Crystallization and phase transformations)." Orig. art. has 9 figures and 2 tables.

ASSOCIATION: 00

SUBMITTED: 00   DATE ACQ: 16Apr63   ENCLS: 00

SUB CODE: CH, PH, MA.   NO REF SOV: 040   OTHER: 002

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L 19752-63

EWP(q)/EWT(m)/EWP(B)/BDS   AFFTC/ASD   RM/JD/MAY

S/2912/62/000/000/0420/0424

ACCESSION NR: AT3001944

AUTHORS: Sirota, N. N.; Varikash, V. M.

TITLE: On the rate of growth of crystals of triglycinsulfate in the vicinity of the Curie temperature.

SOURCE: Kristallizatsiya i fazovyye perekhody. Minsk, Izd-vo AN BSSR, 1962, 420-424

TOPIC TAGS: crystal, crystallization, crystallography, triglycinsulfate, Curie, temperature, seignette, electricity, seignette-electric, phase, transition, change, supersaturation, supercooling

ABSTRACT: The paper describes experimentation which revealed a significant anomaly of the rate of growth on faces (110) and (001) of crystals of triglycinsulfate (TGS) in the vicinity of the Curie temperature (T). The process reported was studied as a function of the supercooling of solutions, the saturation T of which lies within the 30-60°C interval. The Curie T, that is, the T of seignette-electrical phase transformation of TGS lies in the 47-50° interval. The TGS was synthesized from glycol and concentrated H_2SO_4. The substance obtained was recrystallized 4 times in distilled water. The test equipment used was similar to that employed by G. Bliznakov and Ye. Kirkova (Zeitschr. f. Phys. Chemie, no. 3/4, 1957). The equipment consists basically of a saturator in which the solution was saturated through

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the dissolution of small crystals placed on a glass filter and was then brought into another vessel in which circulating cold water supersaturated the solution. Crystallization began on a small crystal, 3-4 mm in size, with clearly defined faces, which had been fastened on a holder in such a way that the test face was at the level of a microscope sighting tube, parallel to the visual ray, and was oriented suitably relative to the flow lines of the supersaturated solution (usually parallel thereto). Micrometric readings were made every 4-5 hrs at low degrees of supersaturation (SS), every 45-60 min at elevated degrees of SS. The rate of change of translation (RC) of the face (001) as a function of T for various degrees of supercooling grows up to T close to the Curie T. In the vicinity of that T (in the $35-45^\circ$ range) the RC decreases. Above 45° it grows again sharply. The RC of the (110) face behaves differently: It increases with increasing T up to $46-47^\circ$, drops slightly in the $47-50^\circ$ interval, and then grows again. With more elevated degrees of supercooling the RC anomaly near the Curie T decreases and vanishes completely for a supercooling of $1.4^\circ C$. Orig. art. has 4 figs.

ASSOCIATION: none

SUBMITTED: 00   DATE ACQ: 16Apr63   ENCL: 00

SUB.CODE: CH, PH, MA   NO REF SOV: 002   OTHER: 004

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L 19757-63   EWP(q)/EWT(m)/EWP(B)/BDS   AFFTC/ASD   RM/JD/MAY

ACCESSION NR: AT3001947   S/2912/62/000/000/0439/0445

AUTHORS: Sirota, N. N.; Varikash, V. M.

TITLE: Changes in heat conductivity and linear expansion coefficient in the vicinity of the Curie temperature in triglycinsulfate

SOURCE: Kristallizatsiya i fazovyye perekhody. Minsk, Izd-vo AN BSSR, 1962, 439-445

TOPIC TAGS: crystal, crystallization, crystallography, temperature, point, Curie, seignette, seignette-electrical, transformation, heat conductivity, linear expansion coefficient, expansion, linear, triglycinsulfate.

ABSTRACT: The paper describes an experimental investigation of the change in heat conductivity (HC) and the linear expansion coefficient (LEC) of triglycinsulfate (TGS) along the axes [100], [010], and [001] between 20 and 60°C, a temperature (T) range that comprises the seignette-electrical transformation segment of TGS (47-50°C). Measurements of the HC were performed as follows: Two half-crystals were fitted together closely along the (001) plane, and a heater wire and a thermocouple were clamped between them at a distance of 6-7 mm from one another. HC along the [100] axis was determined by orienting the heater wire

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and the thermocouple along the axis [010] . HC along the axis [010] was measured by orienting the two wires along the axis [100] . A heat pulse was imparted by energizing the heater wire, and the change in T, the time required to attain the T maximum, and the maximum-T value were measured. The HC curve vs. T in the direction [100] shows a nearly linear decrease up to the Curie point; above the Curie T, the decrease continues linearly, but at a smaller slope. The HC-vs.-T curve in the direction [010] is nearly linear from 20°C to the Curie point, rises to a hump at 50-51°, and then continues with the same slope as the initial segment. These anomalies are attributed to a change in the character of the thermal motions of the ions. The measurements of the LEC were performed with a quartz dilatometer. T steps of 5 to 6° were reduced to 0.4-0.5° in the vicinity of the Curie T. Hold: 20-30 min. Specimens were cut from a TGS single crystal in the form of parallelepipeda 3x3 mm in cross section, 18-25 mm long. Specimens cut along the axes [100] and [010] exhibit a nonlinear decrease in length up to the Curie point and a linear increase beyond it. The exact opposite occurs with specimens cut along the axis [001] . The results obtained concur with those of the X-ray tests by Z. I. Yezhkiva, et al. (Kristallografiya, v.1, no.1, 1956). Wherever differences are noted, such as those in the character of the change of the LEC along the [010] axis and some of the differences in the absolute values of the LEC, the present testing method is regarded to be more accurate than the

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X-ray method. The tensor surfaces of the LEC at 30°, 40°, and $50^\circ C$ are drawn both in cross section and in isometric representation. The isometric images of the tensor surfaces below and above the Curie point show that at the Curie point there is not only a rotation of the surfaces, but also a deformation, as a result of which increased internal stresses arise in the TGS crystal. Orig. art. has 6 figs.

ASSOCIATION: none

SUBMITTED: 00   DATE ACQ: 16Apr63   ENCL: 00

SUB CODE: CH, PH, MA   NO REF SOV: 004   OTHER: 002

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S/250/62/006/010/001/006
A006/A101

AUTHORS: Sirota, N. N., Koren', N. N.

TITLE: Investigating kinetics of ZnS film formation during reactive dif-
            fusion of sulfur into zinc

PERIODICAL: Akademiya nauk BSSR. Doklady. v. 6, no. 10, 1962, 626 - 628

TEXT: The authors studied the rate of ZnS film formation on various faces
of a Zn single crystal during the interaction with sulfur vapors, as a function
of time and temperature. Kinetics of ZnS film formation on liquid metal sur-
faces was also investigated. Zn single crystals were grown by zonal recrystalli-
zation. Zn of 99.99% purity was used as initial material. Diffusion annealing
was performed in a glass ampoule evacuated to $5 - 10^{-5}$ mm Hg. The thickness of
the films, as a function of time at temperatures ranging from 320 - 450°C was
determined. The results obtained confirm the theory that the reactive diffusion
obeys the parabolic law. The coefficient of diffusion as a function of tempera-
ture obeys the exponential law. To determine the process of ZnS film formation
on Zn the pre-exponential factor ($D = 1.2 \cdot 10^{-2}$ cm^2/sec) and activation energy

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Investigating kinetics of...

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($Q = 32 \mp 3$ kcal/mole) were graphically found. The coefficient of reactive diffusion as a function of temperature for the process investigated can then be expressed by equation

$$D = 1.2 \cdot 20^{-2} e^{-\frac{32000 \pm 3000}{RT}} \quad cm^2/sec.$$

The process of ZnS film formation on molten metal surfaces at 430 - 600°C also obeys the parabolic law. Values of logarithms of diffusion coefficients lie well on the straight line ln $D(1/T)$, obtained for the reactive diffusion in Zn single-crystals. There are 2 figures.

ASSOCIATION: Otdel fiziki tverdogo tela i poluprovodnikov, AN BSSR (Division of Physics of Solids and Semiconductors, AS BSSR)

SUBMITTED: June 19, 1962

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25850
S/020/61/139/004/010/025
B104/B209

24.7900

AUTHORS: Sirota, N. N., Academician AS BSSR, and Olekhnovich, N. M.

TITLE: Density distribution of 3d-shell electrons causing ferro-
             magnetism in nickel, cobalt, and iron

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 139, no. 4, 1961, 844-846

TEXT: Using the known form factors of neutron scattering the authors
studied the distribution of those electrons in nickel, cobalt, and iron
causing ferromagnetism. The amplitude P of neutron scattering is determined
by the relation $P = e^2 \mu f S/mc^2$, where f denotes the unit form factor of neutron
scattering, and S the effective quantum number. S is determined from the
magnetic moment of the element under examination: $S = \mu/2$. The following
magnetic moments were used in this calculation: 2.22 for Fe; 1.74 for Co;
0.60 for Ni. The fS values as calculated after data taken from R. Nathans
et al. (Phys. Chem. Solids, 10, 138 (1959); Phys. Rev. Letters, 2, 254
(1959)) are shown in Fig. 1 for iron (curve 1), nickel (curve 2), and for
cobalt (curve 3). By means of a three-dimensional Fourier expansion or by

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an approximation it is possible to calculate electron density at any point of a unit cell as well as the radial distribution of the 3d-electrons which cause ferromagnetism. Fig. 2 illustrates the electron density (Fig. 2a) and the radial density of 3d-electrons in the three metals studied. The graphs show that the electron density in all three metals attains a maximum near the center of the nucleus. On the other hand, the radial electron densities attain maxima at 0.44 $\overset{\circ}{A}$ for nickel, at 0.40 $\overset{\circ}{A}$ for iron, and at 0.39 $\overset{\circ}{A}$ for cobalt (Fig. 2b). Further discussions on the basis of experimental data about the amplitudes of atomic scattering (G. W. Brindley: Phil. Mag., 21 778 (1936)) lead to the conclusion that the "magnetic" electrons do not exert any essential influence upon electron density between the nickel atoms. There are 4 figures and 4 references: 1 Soviet-bloc and 3 non-Soviet-bloc.

ASSOCIATION: Otdel fiziki tverdogo tela i poluprovodnikov Akademii nauk
               BSSR (Division of the Physics of Solids and Semiconductors,
               Academy of Sciences BSSR)

SUBMITTED: May 8, 1961

Card 2/4

SIROTA, N.N.; KOREN', N.N.

Kinetics of the formation of films of zinc selenide on zinc single crystals in the process of reactive diffusion. Dokl. AN BSSR 6 no. 12:760-761 D '62.
(MIRA 16:9)

1. Otdel fiziki tverdogo tela i poluprovodnikov AN BSSR.

S/020/62/142/006/009/019
B104/B108

24.7200

24.7200 (1147, 1164, 1182)

AUTHOR: Sirota, N. N., Academician AS BSSR

TITLE: Distribution of the electron density determinable by
              experiment in crystals and the diamagnetic susceptibility

PERIODICAL: Akademiya nauk SSSR. Doklady, v. 142, no. 6., 1962, 1278-1281

TEXT: The diamagnetic susceptibility of simple crystals and semiconductors
is determined by X-ray studies from the intensity distribution of
scattered X-rays. The electron density in the lattice of a monatomic
crystal can be split into two components: $\varrho = \varrho_1 + \varrho_2$. Most of the
electrons chiefly those near the nucleus have a Gaussian distribution, ϱ_1.
The distribution ϱ_2 of the remainder must be determined by experiment.
Consequently, the diamagnetic susceptibility is made up of two parts:
$\chi = \chi_1 + \chi_2$. The indices 1 and 2 refer to the electrons with Gaussian
distribution and the remainder, respectively, as above. Here,

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