"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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RYZHAKOV, L.Yu.

Role of turbulence in the transport of atmospheric eddies. Probl.Arkt.i Antarkt. no.1:25-31 '59.
(MIRA 13:7)

(Atmospheric turbulence) (Cyclones)

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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RYSTRAKOV, Z. Yu.

PHASE I BOOK EXPLOITATION SOV/4610

Leningrad. Arkticheskiy i Antarkticheskiy nauchno-issledovatel'skiy institut

Problemy Arktiki i Antarktiki; sbornik statey, vyp. 3 (Problems of the Arctic and Antarctic; Collection of Articles, No. 3) Leningrad, Izd-vo "Morskoy transport," 1960. 119 p. 500 copies printed. [Xerox copy]

Sponsoring Agencies: Arkticheskiy i Antarkticheskiy nauchno-issledovatel'skiy institut Glavnogo upravleniya Severnogo morskogo puti Ministerstva morskogo flota SSSR.

Resp. Ed.: V.V. Frolov; Editorial Board: L.L. Balakshin, A.A. Girs, P.A. Gordiyenko (Deputy Resp. Ed.), I.M. Dolgin, L.G. Kaplinskaya, A.A. Kirillov, Ye.S. Korotkevich, V.V. Lavrov, I.V. Maksimov, A.I. Ol', I.I. Poznyak, and B.V. Felisov; Tech. Ed.: L.P. Drozhzhina.

PURPOSE: This collection of articles is intended for geographers and geophysicists, particularly those interested in the problems of the Arctic and Antarctic.

COVERAGE: This publication of the Arctic and Antarctic Scientific Research Institute contains articles on the water temperature in the Arctic Basin, the

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tides of Arctic seas, the structure of Arctic cyclones and anticyclones, radiosonde measurements of temperature, the determination of ice thickness by dipole electromagnetic methods, and magnetic activity in relation to geographical longitude and latitude. No personalities are mentioned. References follow each article.

TABLE OF CONTENTS:

Sychev, K.A. Heat Content of Atlantic Waters and Heat Expenditure in the Arctic Basin 5

Maksimov, I.V. Long-Period Lunar-Solar Tides Along the Coasts of the Arctic Seas 17

Ryzhakov, L.Yu. Use of Vortex Transport Equation for Prognostic Purposes 21

Knyazeva, V.I. The Problem of the Vertical Structure of Arctic Cyclones 25

Gavrilova, L.A. Structure of Winter Upper Level Anticyclones in the Arctic 31

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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RYZHAKOV, L.Yu.

Characteristics of basic atmospheric circulation patterns over the Northern Hemisphere. Trudy AANII 240:52-67 '61.
(MIRA 15:3)

(Atmosphere)

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S/169/61/000/009/025/056
D228/D304

AUTHOR: Ryzhakov, L. Yu.

TITLE: Peculiarities of the temperature conditions in the lower stratosphere and their connection with the tropospheric circulation

PERIODICAL: Referativnyy zhurnal. Geofizika, no. 9, 1961, 14, abstract 9B133 (V sb. Probl. Arktiki i Antarktiki, no. 5, L., Morsk. transport, 1960, 39-46)

TEXT: Results are given for analysis of the temperature course in the lower stratosphere over the central Arctic and the connection of this course with tropospheric processes. Two provisional temperature sections for the winters of 1954/55 and 1955/56 were constructed from the data of the drifting station "Severnyy polyus-4" (North Pole 4). In the first case it appeared that heating which occurred in the troposphere on the invasion of warm air-masses from the Atlantic brought about cooling in the stratosphere. In the other case, cooling the stratosphere through

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RYZHAKOV, N.I., inzh.

Rules for using hydrogen peroxide. Tekst. prom. 18 no.3:68-69 Mr '58. (MIRA 11:3)
(Hydrogen peroxide)

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PATRIN, A.A.; YEREMCHENKO, M.I.; RYZHAKOV, P.V.; BAKHIR, Yu.V.; DEKAPOLITOV, I.P.

Concerning the article "Mounting of wire broadcasting networks and electric power transmission lines on common poles." Prom. energ. 17 no.8:32-34 Ag '62. (MIRA 16:4)

1. Belomorskaya elektroset' Karel'skoy ASSR (for Patrin). 2. Gossel'-elektronadzor, g. Groznyy (for Yeremchenko). 3. Glavnoye upravleniye elektrifikatsii sel'skogo khozyaystva, g. Groznyy (for Ryzhakov). 4. Tuymazaneft' (for Bakhir). 5. Darnitskiy setevoy rayon Yugo-Zapadnoy zheleznoy dorogi (for Dekapolitov).

(Electric lines—Overhead) (Electric lines—Poles and towers)

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RYZHAKOV, V. N.

AID P - 5597

Subject : USSR/Engineering

Card 1/1 Pub. 107-a - 9/12

Author : Ryzhakov, V. N., Eng.

Title : First welders and shipbuilders conference in China

Periodical : Svar. proizv., 11, 30, N 1956

Abstract : A brief report on the conference held in Peking, China last March (1956). Some 139 delegates of 45 plants and enterprises gathered to listen 24 reports on welding technology and related subjects, and another 900 persons visited the exhibition of welding craftsmanship during the converence.

Institution : None

Submitted : No date

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RYZHAKOV, Vasiliy Nikolayevich; NARSKIY, Sergey Aleksandrovich; VYDRIN, Lev Borisovich; NAZAROV, M.I., red.

[Using gases as acetylene substitutes in welding] Primenenie gazov-zamenitelei atsetilena v svarochnom proizvodstve. Leningrad, 1963. 21 p. (Leningradskii dom nauchno-tekhn. propagandy. Obmen peredovym opytom. Seriia: Svarka, rezka i paika metallov, no.4) (MIRA 18:3)

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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Ryzhakov, V.N.

AID P - 998

Subject : USSR/Engineering

Card 1/1 Pub. 11 - 12/13

Authors : Kolenda, B. G. and Ryzhakov, V. N.

Title : Technical conference on welding in shipbuilding

Periodical : Avtom. svar., #5, 55-99, S-O 1954

Abstract : General review of the 24 papers presented at the Conference on welding in the shipbuilding industry. The Conference was sponsored by the Central Scientific Research Institute and 220 representatives of 54 organizations participated. The theoretical and practical problems on automatic and semi-automatic methods of welding were discussed in reference to the structure of ships, boilers and machinery parts.

Institutions: Academy of Sciences, USSR; Main Administration of the Ministry of the Shipbuilding Industry; design bureaus of various shipbuilding works; and 3 engineering institutions: Moscow Higher Engineering College, Leningrad Polytechnic Institute and Leningrad Shipbuilding Institute.

Submitted : No date

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RYZHAKOV, V. N., inzh.; MALYKHIN, V. Ya., inzh.; CHERNAKOV, F. A., inzh.

Expanded use of welding in enterprises of the Leningrad Economic Region. Svar. proizv. no.10:44-45 O '62. (MIRA 15:10)

(Leningrad Economic Region—Welding)

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RYZHAKOV, V.N., inzhener.

First conference of welders in shipbuilding held in the Chinese People's Republic. Svar. proizv. no.11:30 N '56. (MLRA 10:9)
(China--Shipbuilding)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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RYZHAKOV, V.N.

KOLENDA, B.G.; RYZHAKOV, V.N.

Technical conference on welding in shipbuilding. Avtom.svar. 7 no.5:95-99 S-O '54. (MLRA 7:11)
(Shipbuilding--Welding)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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FAYERMAN, Aron Iudovich; RYZHAKOV, V.N., inzh.; [illegible]ent; KONSON, A.S., kand. ekon. nauk, red.; LEYKINA, T.L., red. izd-va; SHCHETININA, L.V., tekhn. red.

[Selecting an economical variant of the welding process] Vybor ekonomichnogo varianta protsessa svarki. Moskva, Mashgiz, 1962. 127 p. (MIRA 15:6)

(Welding--Costs)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

ZAMYSHEVSKAYA, N.N.; RYZHAKOVA, L.A.

Methods of rapid determination of the degree of polymerization of alkali cellulose. Khim.volok no.4:69-71 '62. (MIRA 15:8)

1. Opytno-konstruktorskoye byuro avtomatiki, Barnaul'skiy filial.
(Cellulose) (Polymerization)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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SHIKHER, M.G.; RYZHAKOVA, T.S.

Simplified method for the control of bleaching solutions. Tekst. prom. 19 no.4:58-59 Ap '59. (MIRA 12:6)
(Bleaching agents)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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A

Spontaneous polarization of polycrystalline samples of barium titanate. A. V. Rzhanov (Acad. Sci. U.S.S.R., Moscow). *Zhur. Eksptl. Teoret. Fiz.* 19, 335-45(1949).—In the calcn. of the spontaneous polarization of seignettoelectrics from the observed total polarization P, the nonlinear dependence of the induced component of P on the elec. field strength E must be taken into account. Contrary to accepted assumptions, that nonlinearity occurs, in the neighborhood of the dielec. Curie point, even in relatively weak fields, as in that region the cubic term of the right-hand member of the empirical expression $E = \alpha_1 P + \beta P^3$ becomes comparable with the 1st term. Nonlinear dependence of P on E is found also above the Curie point where spontaneous polarization is absent, and, consequently, cannot but bear on the induced polarization. This effect is particularly pronounced in $BaTiO_3$ owing to the great width of the temp. range of fast increase of the dielec. const. ϵ with the temp. (50-60°, as compared with 5-7° in Rochelle salt, and 10-15° in KH_2PO_4). Oscillograms of the dielec. hysteresis loops in fields up to 25 kv./cm., at the temps. −183, 20, 113.2, 125.3, 134.8, 138.8°, obtained with polycryst. samples of $BaTiO_3$ with 2% Al_2O_3 (Curie point 123°), actually show nonlinear increase of P with E and relatively high P also in the nonseignettoelec. region, not farther than 20-30° from the Curie point. At still higher temps. above the Curie point, P is a linear function of E, and ϵ const. In the seignettoelec. region well below the Curie point, it can be concluded from the behavior of ϵ that the induced P varies linearly with E, and the nonlinearity of the total P is entirely detd. by reorientation of the domains. Peculiar aftereffects were observed, particularly at room temp., when the recording of hysteresis loops was repeated after the sample was allowed to rest for 10-15 min. Polarization in weak fields appears increased, and losses, residual polarization, and coercive force are more marked; the ends of the loops obtained at different E lie all on the loop corresponding to the highest E = 25 kv./cm. These effects disappear at the Curie point. At room temp., the samples lose their "memory" of the previous polarization only in a matter of days. A qual. interpretation of these aftereffects is given on the basis of considerations valid for single crystals, and leading, for the relation between the dielec. const. in the seignettoelec. region, ϵ_1 and above the Curie point, ϵ_2, with the nonlinear variation of the induced P and E taken into account, to $\epsilon_1 = \epsilon_2 [1 + A = A \sqrt{1 + (2/A)}]$, where $A = (9/16\pi)(\epsilon_2 E - 4\pi P)/P$. In a polycryst. sample, the orientation of the spontaneous moments of individual single crystals, produced by the 1st polarization cycle, disappears only partly when the field is removed, and there remains a residual anisotropy in the sense that the majority of the moments are oriented in the direction of the field. In sufficiently strong fields ensuring satn. of the orientation of the spontaneous moments, the polycryst. samples can be treated as quasi-monocryst., and the above method of calcn. of the spontaneous polarization is applicable. Numerical calcns. of ϵ_1 and the induced P' in the temp. range 137-60° (above the Curie point), and of the spontaneous P_s in the range 109.5-122.5° (below the Curie point), are given for a specific sample. P_s^2 is a linear function of the temp. in a fairly wide temp. range, 105-123°, below the Curie point. At room temp., P_s of the polycryst. samples is of the order of 5×10^{-6} coulomb/sq. cm., i.e. less than half of that of single crystals (Matthias and Von Hippel, *C.A.* **42**, 8038h).

N. Thon

Physics Inst.-im. P.N. Lebedev, AS USSR

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RZhFiz(5)

Piezoelectric effect of barium titanate. A. V. Rzhanov. (P. N. Lebedev Phys. Inst., Acad. Sci. U.S.S.R., Moscow). *Zhur. Eksptl. Teoret. Fiz.* 19, 502-6(1949).—Under static conditions, by electrometric measurements of the potential difference arising on compression, the piezoelec. modulus d_{31} and d_{33}, corresponding to stress applied, resp., in the direction of the polarization and perpendicularly to that direction, was 3.2×10^{-8} and 1.4×10^{-8} e.s.u., resp. In terms of the temp., d_{31} passes through a shallow min. at about 60°, then rises rapidly to a sharp peak at the Curie point, following exactly the temp. variation of the spontaneous polarization P_s. Dynamic detns., from the difference $\Delta f = f_a - f_r$ of the resonance and antiresonance frequencies of longitudinal vibrations of bars of d. ρ, length l, and dielec. const. ϵ, with f_a and f_r detd. by the frequency dependence of the current passing through the sample (peak at about 182 kilohertzes), $d_{33} = g \cdot \Delta f \cdot 64\ \rho l^2 f_r^2$ was found to vary between 2.5×10^{-8} and 1.3×10^{-8} e.s.u. The piezoelec. const. $g = d/\epsilon_0$, where ϵ_0 is the value of ϵ in the absence of stress, is from 1.3×10^{-7} to 1.0×10^{-7} e.s.u. Consequently, $BaTiO_3$ is usable with advantage in piezoelec. devices of the type of piezoelec. microphone and loudspeaker. In terms of the temp., f_r and d remain approx. const. up to about 110°, but the difference of the abs. currents in resonance and antiresonance decreases with rising temp. N. Thon

RZHANOV, A. V.
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PA 67/49T106

USSR/Physics - Piezoelectricity Aug 49
Barium Titanate

"Barium Titanate, a New Piezoelectric," A. V. Rzhanov, 29 pp

"Uspekh Fiz Nauk" Vol XXXVIII, No 4

Discusses dielectric permeability as a function of temperature and field strength; dielectric permeability as a function of frequency, dielectric hysteresis, and spontaneous polarization the specific heat anomaly; and the index of refraction and electroconductivity for polycrystallic and monocrystallic barium titanate

67/49T106

USSR/Physics - Piezoelectricity (Cont'd) Aug 49

specimens. The piezoeffect of barium titanate is covered in four divisions: the piezo effect o a monocrystal, the piezo effect of polarized polycrystallic specimens, static testing of piez elements, and piezoelectric oscillations of rods Discusses practical applications of the anomalou properties of barium titanate. V. P. Vologdin first used barium titanate as a nonlinear elemen in his construction of a frequency multiplier.

67/49T106

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RZHANOV, A.V., redaktor; FRIDMAN, V.Ya., redaktor.

[Semiconductor electronic instruments; some problems in the physics and technology of germanium diodes and triodes (collection of translations). Poluprovodnikovye elektronnye pribory; nekotorye voprosy fiziki i tekhnologii germanievykh diodov i triodov, sbornik perevodov. Moskva, Izd-vo inostrannoi lit-ry, 1953. 260 p. (MLRA 7:4)

(Germanium) (Electronic apparatus and appliances)

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RZHANOV, A. V.

USSR/ Physics - Technical physics

Card 1/1 Pub. 22 - 17/48

Authors : Rzhanov, A. V.

Title : Effect of contact recombination on the volt-ampere characteristics of a rectifier

Periodical : Dok. AN SSSR 98/3, 389-390, Sep 21, 1954

Abstract : The results obtained during the study of the contact recombination and its effect on the volt-ampere characteristics of a rectifier are listed. The results obtained pertain mainly to the case of concentration of non-basic charge carriers (gaps), much smaller than the equilibrium concentration of basic carriers (electrons), i. e., carriers suitable for reverse and small DC-currents passing through the rectifier. Formula expressing the volt-ampere characteristic for this particular case is included. Two references: 1-USSR and 1-USA (1952 and 1953).

Institution : Academy of Sciences USSR, The P. N. Lebedev Physics Institute

Presented by: Academician D. V. Skobel'tsin, April 27, 1954

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RZHANOV, A.

FD-3218

USSR/Physics - Semiconductors

Card 1/1 Pub. 153-27/28

Authors : Paramonova R. and Rzhanov A.

Title : Relation of life span of excess charge carriers to concentration of equilibrium charge carriers

Periodical : Zhur. Tekh. Fiz., 25, No 7, 1342-1343, 1955

Abstract : The stability of recombination centers seems to be confirmed by an experimentally deduced linear behavior of life span vs the value of reverse concentration of equilibrium charge carriers. Such straight lines were obtained from the study of germanium single crystals. Data of these crystals are tabulated. Two US references.

Institution: --

Submitted : March 22, 1955

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RZHANOV, A.V., redaktor; MASHAROVA, V.G., redaktor; KORUZEV, N.N., tekhnicheskiy redaktor.

[Electrophysical characteristics of germanium and silicon] Electrofizicheskie svoistva germaniia i kremniia; sbornik perevodov. Moskva, Izd-vo "Sovetskoe radio," 1956. 391 p. (MLRA 9:12)
(Germanium) (Silicon)

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ZHANOV, [illegible]

2

The ratio of surface and volume recombination in germanium triodes with alloyed junctions. A. O. Pzhanov. Soviet Phys. Tech. Phys. 1, 235-6(1956)(English translation). See C.A. 50, 10519b. B. M. R.

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RZHANOV, A. O.

2
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0
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The ratio of surface and volume recombination in germanium triodes with alloyed junctions. A. O. Rzhanov. *Zhur. Tekh. Fiz.* 26, 239-40(1956).—It is shown that the amplification coeff. at low currents (1-α) is a linear function of the base thickness *W*, indicating the predominance of surface recombination. S. Pakswer.

Phys

BS
MM

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RZHANOV, A.V.

Surface recombination and its effect on the characterisitcs of semiconductor devices. Radiotekh. i elektron 1 no.8:1086-1092 Ag '56. (MIRA 10:1)

1. Fizicheskiy institutut Akademii nauk SSSR imeni P.N. Lebedeva.
(Transistors)

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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RZHANOV, A. V.

USSR/Physical Chemistry - Crystals, B-5

Abst Journal: Referat Zhur - Khimiya, No 1, 1957, 250

Author: Rzhanov, A. V.

Institution: None

Title: The Effect of Impurities on the Lifetime of Excess Carriers in Germanium

Original Periodical: Zh. tekhn. fiziki, 1956, Vol 26, No 7, 1389-1393

Abstract: In single crystals of n-Ge containing impurities Sb and Bi and single crystals of p-Ge with In impurities, the lifetime of the carriers is inversely proportional to the concentration of the impurities. It has been found that in single crystals of p- and n-type Ge, the recombination zones are largely located in 2 different portions of the barrier region: in the lower half, for n-Ge and in the upper half, for p-Ge. On the basis of the values for the energy of activation of the residual impurities in n- and p-type Ge, the conclusion is made that super-pure Ge contains Ni and Au.

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USSR /Physical Chemistry. Crystals.

Abs Jour : Ref Zhur - Khimiya, No 8, 1957, 25947

Author : A.V. Rzhanov, I.G. Neizvestnyy, V.V. Roslyakov.

Title : Study of Surface Conductivity and Surface Recombination of Germanium Specimens.

Orig Pub : Zh. Tekhn. fiziki, 1956, 26, No 10, 2142 - 2153

Abstract : A correlation was established between the changes in the s surface conductivity and the speed of the surface recombination on Ge specimens in changing gaseous medium (dry, humid and ozonized O_2). It was shown that this correlation is caused by the change of the surface potential, the magnitudes of which were evaluated depending on the spefific conductivity and its type. The results agree with the existing suffface model.

Card : 1/1

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RZHANOV, A.V.

137-58-3-5783

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 3, p 186 (USSR)

AUTHOR: Rzhanov, A. V.

TITLE: The Effect of Impurities on the Life of the Excess Charge Carriers in Germanium (Vliyaniye primesey na vremya zhizni izbytochnykh nositeley zaryadov v germanii)

PERIODICAL: V sb.: Vopr. metallurgii i fiz. poluprovodnikov. Moscow, AN SSSR, 1957, pp 133-137

ABSTRACT: Bibliographic entry. See RzhMet, 1957, Nr 6, abstract 10715

Card 1/1

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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R2

AUTHORS: Rzhanov, A. V., Novototskiy-Vlasov, Yu. F., Neizvestnyy, I. G., 57-11-3/33

TITLE: Study of the Field Effect and Surface Recombination in Germanium Samples (Issledovaniye effekta polya i poverkhnostnoy rekombinatsii v obraztsakh germaniya)

PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol. 27, Nr 11, pp. 2440-2450 (USSR)

ABSTRACT: The purpose of the present paper was the check of the assumption of the invariability of the surface-recombination-centres in the course of a gas cycle as well as the maintainance of the dependence of the surface recombination velocity on the electrostatic surface potential by way of experiment. A parallel investigation of the surface recombination and of the variation of the conductivity in the case of an action of the electric transversal field (field effect) in different gas atmospheres facilitated the detection that under the influence of ozone new "rapid" surface states a part of which is connected with the recombination develop on the germanium surface. Assuming that in consequence of the influence of the ozone two energetic position states are introduced their density and the variations of the density according to the time after the ozone influence were computed and the effective electron capture cross sections of the deeper lying re-

Card 1/2

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RZHANOV, A.V., kandidat fiziko-matematicheskikh nauk.

Creators of the "transistor". Priroda 46 no.3:49-50 Mr '57.
(MLRA 10:3)

1. Fizicheskiy institut im. P.I. Lebedeva Akademii nauk SSSR (Moskva).
(Transistors)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

AUTHOR: Rzhanov, A. V., Candidate of Physical and Mathematical Sciences 30-2-21/49

TITLE: Summer Course of the International School of Physics in Italy (Kursy international'noy fizicheskoy shkoly v Italii)

PERIODICAL: Vestnik AN SSSR, 1958, Nr 2, pp 87-88 (USSR)

ABSTRACT: Several years age an International School of Physics was founded by the Italian Physics Society, which every year holds a summer course. Every course is devoted to a problem of modern physics, which, as a rule, is selected from the number of problems being in most rapid development. The summer courses take place at Varenna, a health resort near the Italian-Swiss border. They are arranged for the vacation time of universities and of scientific research centers. This circumstance, as well as the high prestige of the school, facilitates the invitation of well known specialists from different countries. The author of this paper also participated as a student during the period from July 14 to August 3, in the 5th summer course. This course

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Summer Course of the International School of Physics in Italy 30-2-21/49

was devoted to the physics of solids. The program consisted of three parts: The quantum theory, the structural defects of solids, and the properties of semiconductors. 26 scientists from various countries held lectures and seminars. Among others, the following scientists gave lectures: Professors G. Bruks (USA) and N. Mott (England), D. Bardin and collaborators (USA), the profe.sor F. Zeytz (USA) and F. Franck (England), professor G. Fen (USA), professor C. Busch (Switzerland), Doctor P. Egren (France), O. Madelung (German Federal Republic). Concluding, the author states, that the close contact of all participants in a small town promotes an inofficial scientific intercourse, which was of at least the same profit as the courses themselves. It was possible to establish much closer scientific contacts than it is possible during conferences and congresses of short duration.

AVAILABLE: Library of Congress

1. Physics-Study and teaching-Italy

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24(6) SOV/57-58-12-1/15

AUTHORS: Rzhanov, A. V., Pavlov, N. M., Selezneva, M. A.

TITLE: Investigation of the Energy Levels and of the Effective Capture Cross Sections of the Surface Recombination Levels in Germanium (Issledovaniye energeticheskikh polozheniy i effektivnykh secheniy zakhvata poverkhnostnykh rekombinatsionnykh urovney v germanii)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, Nr 12, pp 2645-2656 (USSR)

ABSTRACT: An investigation of the surface recombination levels occurring as a consequence of heating the germanium samples in vacuum or because of the action of ozone upon these samples was carried out. Preliminary data on the temperature dependence of the energy levels and of the effective capture cross sections when a hole and an electron are captured by these levels and the dependence of these characteristics on the cross-field amplitude were obtained. The supposition is expressed that the charges captured at the "slow" levels at the surface have a considerable influence upon the characteristics of the surface recombination levels. From this supposition is deduced that the nature of the recombination levels occurring because of

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heating in vacuum is the same as the nature of the levels caused by the action of ozone. A considerable parallelism between concentration and charge of "slow" surface levels and the concentration of the recombination levels was found. There are 9 figures, 2 tables, and 10 references, 3 of which are Soviet.

ASSOCIATION: Fizicheskiy institut imeni P. N. Lebedeva AN SSSR Moskva (Physics Institute imeni P. N. Lebedev, AS USSR, Moscow)

SUBMITTED: December 28, 1957

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AUTHORS: Rzhanov, A. V., Arkhipova, I. A., Bidulya, V. N. 57-28-5-23/36

TITLE: On the Applicability of the Method of Velocity Measurement of Surface Recombination by Means of the Change of Semiconductor Resistance in a Magnetic Field (O primenimosti metoda izmereniya skorosti poverkhnostnoy rekombinatsii po izmeneniyu soprotivleniya poluprovodnika v magnitnom pole)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958, Vol. 28, Nr 5, pp. 1051-1052 (USSR)

ABSTRACT: In the paper by Zhuze, Pikus and Sorokin (Ref 1) a new method of measuring the surface recombination velocity s by means of the modification of the resistance of a thin semiconductor sample in a magnetic field was proposed. The author of this letter to the editor employed the described method in the investigation of the modification s according to the change of the electric surface potential. The measurements were conducted with two devices. One served for the measurement of the constant component F_c, one of the sample surface being subjected to the action of a constant transverse field or of various gas media. On the other device the voltage of the doubled frequency $E_{2\omega}$ was mea-

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sured, one of the surface media being subjected to the action of a sinusoidal transverse field with low frequency. The obtained results show, that the method of measuring the surface recombination velocity by means of the modification of the conductivity of the samples in a magnetic field yields correct values of Δ_s at a modification of the concentration of the recombination centers which was also proved by grinding experiments. If s changes because of the modification of the electrostatic surface potential, this method, however, gives too low values. This can be seen from a direct comparison of this method with the bridge method of measuring the effective life. The authors thank Yu.F. Novototskiy-Vlasov for his help. There are 1 figure and 5 references, 4 of which are Soviet.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva AN SSSR, Moskva (Moscow, Physics Institute imeni P.N. Lebedev, AS USSR)

SUBMITTED: December 28, 1957

 1. Semiconductors--Surface properties

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3

PHASE I BOOK EXPLOITATION SOV/3818

Postoyannyy mezhinstitutskiy kollokvium po tverdym fazam peremennogo sostava

Kachestvo materialov dlya poluprovodnikovoy tekhniki (Quality of Materials for Semiconductor Technology) Moscow, Metallurgizdat, 1959. 192 p. (Series: Its: Trudy, 1957-1958, vyp. 8-30) 3,600 copies printed.

Sponsoring Agencies: USSR. Sovet Ministrov. Gosudarstvennyy komitet po khimii; Akademiya nauk SSSR. Fiziko-khimicheskiy institut imeni L.Ya. Karpova.

Ed. (Title Page): B.F. Ormont, Professor; Ed. (Inside Book): Ya.V. Yakovlev; Ed. of Publishing House: L.M. El'kind; Tech. Ed.: P.G. Islent'yeva; Editorial Board of Series: I.P. Alimarin, Corresponding Member, Academy of Sciences USSR, Geochemistry Institute, M.V. Grigor'yev, Scientific Research Institute, Committee on Radioelectronics, R.P. Lastovskiy, Professor, Institute of Chemical Reagents, Chemistry Committee, B.F. Ormont, Professor, Academy of Sciences USSR, Institute of Physics and Chemistry imeni L.Ya. Karpov, B.L. Poroshenko, State Rare Metals Scientific Research Institute, N.P. Sazhin, Corresponding Member, Academy of Sciences USSR, State Rare Metals Scientific Research Institute, G.Ya. Tarasov, Scientific Research Institute, Committee on Radioelectronics, Ya.V. Yakovlev, (Resp. Secretary of the Board) Institute of Geochemistry, Academy of Sciences USSR.

PURPOSE: This book is intended for technical personnel engaged in the manufacture and utilization of semiconductors.

COVERAGE: This book treats methods of obtaining quality semiconductor materials and presents current standardized specifications for semiconductors and auxiliary materials. The book is divided into three parts. Part I consists of 16 reports delivered at two conferences in January 1957 and December 1958 at the Fiziko-khimicheskiy institut imeni L.Ya. Karpova (Institute of Physics and Chemistry imeni L.Ya. Karpov) by members of 36 participating institutes and industrial plants. The reports deal with the standardization of characteristics of pure semiconductor materials and describe spectral and spectrochemical analysis, and chemical, vacuum-fusion, polarographic, and radioactivation methods for studying semiconductor materials and determining impurities in them, along with the equipment used.

PART I. REPORTS ON METHODS FOR THE DETERMINATION OF ULTRAMICROIMPURITIES IN SEMICONDUCTOR MATERIALS PRESENTED AT THE CONFERENCES ON THE QUALITY OF SEMICONDUCTOR MATERIALS

Shafran, I.S. [USSR MKhP SSSR (All-Union Scientific Research Institute of Chemical Reagents)]. Chemical Methods for the Determination of Microimpurities in a Number of Substances of High Purity 13

Turovtseva, Z.M. [GEOKhI AN SSSR]. Apparatus and Methods for the Determination of Gases in Metals by the Vacuum-Fusion Method 25

Kazin, L.L. [TsNIICheMet . (Central Scientific Research Institute of Ferrous Metals)]. Experiment on the Determination of Gases in Metals by the Vacuum-Fusion Method and the Possible Use of This Method for the Analysis of Semiconductor Materials 30

Gokhshteyn, Ya.P., and A.M. Demkin [GEOKhI AN SSSR]. Polarographic Quantitative Determination of Copper, Bismuth, Lead and Titanium Impurities in Metalliferous Silicon 41

Halak, A.I. [MKhTI imeni D.I. Mendeleyeva (Moscow Chemical and Technological Institute imeni D.I. Mendeleyev)]. Determination of Microimpurities of Certain Elements in Antimony and Gold by the Radioactivation Method 60

Brager, A.Kh., B.F. Ormont, V.S. Kutsev, B.A. Chapyzhnikov, V.A. Khramchenkov, and D.I. Viting [FKhI imeni L.Ya. Karpova (Physics and Chemistry Institute imeni L.Ya. Karpov)]. The Radioactivation Method of Determining Oxygen in Semiconductors and Metals by Reaction O^{16} (γ ; n) O^{15} 68

Shvengirodze, R.R., T.A. Mozgovaya, and N.V. Simonova. Spectral Determination of Impurities in Certain Pure Substances 72

Rabanov, A.V. [FIAN (Physics Institute imeni P.N. Lebedev, Academy of Sciences USSR)]. Electrophysical Method of Determining Microimpurities in Semiconductors 95

Kupriyanov, S.Ye. [FKhI imeni L.Ya. Karpova]. Use of an MS-1 Mass Spectrometer in Analysis of Inert Gases and Determination of Small Quantities of Impurities in Them 104

Ormont, B.F. [FKhI imeni L.Ya. Karpova]. Concerning the Problem of Standardizing the Characteristics of High-Purity Semiconductor Materials 108

Seledovnik, S.M., L.S. Vasilevskaya, and A.I. Kondrashina [Giredmet (State Institute of Rare Metals)]. Spectrochemical Analysis of Elementary Silicon, Silicon Dioxide, Hydrofluoric Acid, Nitric Acid, and Hydrochloric Acid 116

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"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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RZHANOV, A.V.

Correlation between the relationship of capture cross sections and the energy levels of the surface recombination centers in germanium. Fiz. tver. tela 1 no.3:522-524 Mr '59.
(MIRA 12:5)

(Germanium) (Electrons)

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24.7700
~~24(6), 24(3)~~

67403
SOV/181-1-9-27/31

AUTHORS: Rzhanov, A. V., Novototskiy-Vlasov, Yu. F., Neizvestnyy, I.G.

TITLE: On the Problem Concerning the Nature of the Surface Recombination Centers on Germanium

PERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 9, pp 1471 - 1474 (USSR)

ABSTRACT: The authors had already found out in 1955 that preheating of germanium samples leads to a considerable increase in the surface recombination rate of the surplus charge carriers at about 100°C. The occurrence of new recombination- and capture centers is explained by an adsorption of oxygen- and hydrogen molecules on the germanium surface. To investigate the nature of these centers, one must know their activation energy and the concentration limit; one obtains both from an investigation of the dependence of the center concentration on the preheating temperature. For this purpose the authors conducted simultaneous measurements of the stationary photoconductivity and of the field effect on the large signal. The samples were irradiated with square light pulses; an oscillogram taken in this connection is shown in

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On the Problem Concerning the Nature of the Surface Recombination Centers on Germanium

conductivity on the transversal electric field in the dark, the interval between the two curves illustrates the value of the steady photoconductivity. Measurements were made on p-type germanium samples with a resistivity of 20-25 ohm.cm. The maximum preheating temperature was 475°K. Measurements were made in vacuum (10^{-6} torr) at 300°K. Figure 2 shows on a semi-logarithmic scale the dependence of the maximum surface recombination rate on the reciprocal sample temperature. The activation energy of the centers, evaluated from the inclination of the linear curve portion yielded ~ 0.2 ev, their maximum concentration in the saturation region $\sim 10^{12}/cm^2$. When assuming that a concentration increase of the recombination centers is due to desorption of water molecules, the adsorption heat can be calculated as being 4.5 kcal/mole. In the samples under investigation the ratio of the capture cross sections for holes and electrons was ranging from 2 to 100, the recombination levels ranged between 3 - 6 kT. The results obtained are utilized by the authors in order to discuss their surface model of germanium and in order to

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On the Problem Concerning the Nature of the Surface Recombination Centers on Germanium

mechanism. The authors thank S. V. Pokrovskaya and T.I.Galkina for their assistance. There are 2 figures and 4 Soviet references.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva (Institute of Physics imeni P. N. Lebedev of the AS USSR, Moscow)

SUBMITTED: April 6, 1959

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S/181/60/002/010/012/051
B019/B070

9.4340 (1143, 1160, 1331)

AUTHOR: Rzhanov, A. V.

TITLE: Applicability of the Method of Steady Photoconductivity for Studying the Dependence of the Surface Recombination Rate on the Surface Potential

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 10, pp. 2431-2438

TEXT: An experimental method for studying the surface states of a semiconductor is described. It has been tested for two years in the laboratory. The method is based on the simultaneous measurement of the steady photoconductivity and the field effect for large signals. The samples were irradiated with square light impulses following one another at a frequency of 140 cps. The transverse electric field varied between 20 and 100 cps. The conductivity of the sample was observed by an oscillograph (Fig. 1). The theory of the method is given in detail. The method permits a study of the dependence of the surface recombination rate on the surface potential, a particular advantage of the method being the short time interval (1/10 of a second) required for this study. This is important because of the

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Applicability of the Method of Steady Photoconductivity for Studying the Dependence of the Surface Recombination Rate on the Surface Potential

S/181/60/002/010/012/051
B019/B070

experimentally found variability of the spectrum of the surface recombination centers on a change of the external medium. The error due to the change of injection levels and carrier trapping on surface levels was estimated to be small. It is found that the method is applicable for any injection level. It has been checked in a number of studies of germanium samples. Yu. F. Novototskiy-Vlasov and I. G. Neizvestnyy participated in the development of the method. There are 3 figures and 12 references: 5 Soviet, 6 US, and 1 British.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva (Institute of Physics imeni P. N. Lebedev of the AS USSR, Moscow)

SUBMITTED: March 31, 1960

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S/030/60/000/012/008/018
B004/B056

AUTHOR: Rzhanov, A. V., Candidate of Physical and Mathematical Sciences

TITLE: Conference on the Physics of Semiconductors

PERIODICAL: Vestnik Akademii nauk SSSR, 1960, No. 12, pp 46 - 48

TEXT: The present paper is a report of the Conference on the Physics of Semiconductors held at Prague from August 29 to September 2. It was organized by the International Union of Pure and Applied Physics with the support of the Czechoslovakian Government and the UNESCO. Besides a plenary session, the Conference worked in 16 sections and 5 discussion groups. Mention is made of the section of the band structure of semiconductors, the section of recombination effects, the section of semiconductors of complex structure. The following topics are mentioned as having been dealt with: Calculation of the energy spectrum of crystals by means of a computer; the problem of "hot" electrons accelerated by means of strong fields; tunnel effects; the optical properties of semiconductors and excitons; surface phenomena, studied by E. Antončik,

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K. Koutecky, and M. Tomaŝek (Czechoslovakia) et al.; the study of the state of impurities by means of the resonance method, properties of ion crystals. Among Soviet scientists, A. F. Ioffe is mentioned, whose lecture was published in the same number of this periodical.

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RZHANOV, A. V., Dr. Phys-Math Sci. (diss) "Investigations of Some Electronic Processes on the Surface of Germanium," Kiev, 1961. 19 pp. (Combined Scientific Council of Institutes of Mathematics, Physics, Semi-conductors and Metallic Physics, Acad of Sci, UkSSR), 170 copies (KL Supp, 12-61, 248).

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S/194/62/000/002/047/096
D201/D301

9,4340

AUTHORS: Zvyagin, V. I., Lobanov, Ye. M. and Rzhanov, A. V.

TITLE: Differential resistance of germanium diodes

PERIODICAL: Referativnyy zhurnal, Avtomatika i radioelektronika, no. 2, 1962, abstract 2-4-12zh (V sb. Nekotoryye vopr. prikl. fiz. Tashkent, AN UzSSR, 1961, 58-63)

TEXT: A study of the differential resistance R_d of germanium diodes. The diodes were prepared by the method of fusing indium into an electron conducting germanium. The resistivity of germanium was varied from 3.5 to 35 ohm/cm. R_d was evaluated from the measurements by a valve millivoltmeter with small a.c. voltage ($V < \frac{kT}{e}$) superimposed on the reverse d.c. bias and from the voltage drop across a calibrated resistor connected in series with the diode. The results investigations, at a frequency of 70 c/s, were obtained by statiprocessing of a large quantity of experimental material. Ty-

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Differential resistance of ...

pical graphs of the dependence of R_d on $\sqrt{V}$ at different temperatures are given, together with $\log_e R_d$ on the reciprocal of temperature $(\frac{1000}{T^oK})$ for various voltages and a table of values of activation energy calculated from graphs of semiconductor diodes made of material with different specific resistances. Graphs of dependence of $\log_e \tau_p$ (τ_p - lifetime of holes) on reciprocal of temperature are also given for typical diodes and diodes made of germanium with a lower specific resistivity. The graphs show the values of activation energy ΔE's at low temperatures and those for temperatures higher than 40^oC ($\Delta E''$). It is shown that the whole set of experimental data may be successfully described by the formula of K. V. Tolpygo and E. I. Rashba (see ZhT Fiz. 1956, XXVI, 7), if one assumes in it $\tau_p = \tau_o e^{\frac{\Delta E}{kT}}$, provided $\Delta E = -\Delta E'$ at low and $\Delta E = \Delta E'$ at high temperatures. It follows from this formula that R_d increases with de-

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creasing specific resistivity. As an example R_d is given in the form of graphs for diodes with different specific resistivities at V = 30 V. 1 reference. [Abstracter's note: Complete translation.]

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RZHANOV, A.V.; NOVOTOTSKIY-VLASOV, Yu.F.; NEIZVESTNYY, I.G.; POKROVSKAYA, S.V.; GALKINA, T.I.

Nature of surface recombination centers in germanium. Fiz. tver. tela 3 no. 3:822-831 Mr '61. (MIRA 14:5)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR, Moskva.
(Crystal lattices) (Germanium)

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RZHANOV, A.V.; PAVLOV, N.M.; SELEZNEVA, M.A.

Effect of temperature on the parameters of surface recombination centers in germanium. Fiz. tver. tela 3 no. 3:832-840 Mr '61.
(MIRA 14:5)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR, Moskva.
(Crystal lattices) (Germanium)

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S/181/61/003/005/029/042
B108/B209

9,4177

AUTHORS: Rzhanov, A. V. and Plotnikov, A. F.

TITLE: The surface levels in germanium according to data on the photoconductivity in the infrared range of the spectrum

PERIODICAL: Fizika tverdogo tela, v. 3, no. 5, 1961, 1557-1560

TEXT: The authors measured the photoconductivity of Ge samples which were illuminated with intermittent light from an ИКС-12 (IKS-12) spectrometer. The amplified circuit equipped with phase detector had a sensitivity of the order of 0.1 μv. The 20 · 5 · 0.4 mm^3 large p-type samples had a resistivity of 25-30 ohm.cm; measurements were performed in a cryostat with an NaCl window at a temperature of the samples of about 80°K. The vacuum was of the order of 10^{-4} mm Hg. The results of measurements taken in a range between the edge of the principal absorption band and 3.4μ are shown in the accompanying figure. The results agree with those of other studies insofar as the concentration of the surface levels and, accordingly, the photoconductivity increases with the temperature of preheating up to 500°K, but

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The surface levels in germanium ...

decreases (at energies of the light quanta less than 0.5 ev) when previously heated to 600°K. The effect of preheating and of elemental oxygen leads to an increase in the concentration of surface levels of one and the same type. The results obtained prove the existence of discrete surface levels near the middle of the forbidden band. The rise of photoconductivity at quantum energies of 0.38-0.4 ev corresponds to an electron transition from a surface level about 0.04 ev below the middle of the forbidden band to the conduction band. The subsequent decrease in photoconductivity may be explained by an electron transition from the valence band to a surface level about 0.06 ev above the forbidden band. The holes arising therefrom undergo quick recombination with the electrons in the conduction band. Thus, a negative photoconductivity must correspond to this process if it takes place. In order that both phenomena appear together, the Fermi level has to be 0.02-0.04 ev above the middle of the forbidden band. The decrease in photoconductivity may also be related to a decrease in the absorption coefficient. Finally, the monotonic rise in photoconductivity at energies above 0.42 ev is evidently due to a system of continuous surface levels. Preheating at 600°K changes not only the concentration but also the character of energy distribution of these levels. The authors thank

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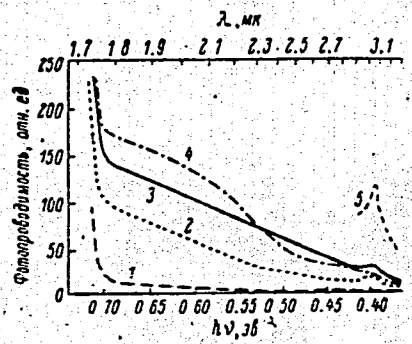
The surface levels in germanium ...

V. S. Vavilov for his assistance. There are 1 figure and 14 references: 9 Soviet-bloc and 5 non-Soviet-bloc.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva
(Physics Institute imeni P. N. Lebedev AS USSR, Moscow)

SUBMITTED: November 28, 1960

Fig.: Photoconductivity (ordinate axis; arbitrary units) versus energy of the exciting light quanta (abscissas: hν in ev and λ in μ).



Legend: 1 - before heating, 2 - after heating to 400°K, 3 - 500°K, 4 - 600°K, 5 - after the action of a high-voltage discharge at low pressure.

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S/181/61/003/006/009/031
B102/B201

24912

9,4300

AUTHOR: Rzhanov, A. V.

TITLE: Changes of the surface charge on germanium during heating of specimens in vacuum

PERIODICAL: Fizika tverdogo tela, v. 3, no. 6, 1961, 1718-1722

TEXT: Experimental results obtained from studies of the surface-charge properties of germanium are discussed along with effects exerted on them by heating, adsorption and descrption, and others. Moreover, it is shown that changes, found experimentally, of the total surface charge during heating of germanium in vacuum are considerably smaller than those one might expect in view of the change of concentration of the fast surface states. A model of surface centers that takes account of this fact is suggested. It had been already shown in previous papers (Rzhanov et al. FTT I, vyp.9,1471,1959; FTT III, vyp.3,1961) that heating in vacuum leads to a considerable concentration increase of the so-called fast surface states. To explain this, the water molecules in the oxide layer were assumed to neutralize the surface defects acting as recombination or

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trapping centers. During heating there occurred a desorption of water and a reactivation of the centers; thus, the concentration of the fast surface states increased, and the surface charge changed. On the other hand, as has been repeatedly shown, the water molecules adsorbed on Ge themselves are the cause of a positive surface charge (slow surface states). The total surface charge, composed of fast and slow surface states, determines the electrostatic surface potential of the specimens, from the modification of which during heating in vacuum one may draw conclusions as to the charge and the surface states. A study of the field effect showed that in a good vacuum the accumulation of surface charge under the action of a sinusoidal transverse field is negligibly small. Numerous Ge specimens were examined and it was established in all cases that the changes of the surface charge were not so great as might have been expected in view of the charge change of the fast surface states (caused by their rise of concentration). Results of measurement are collected in the table for some specimens. The absolute value of the charge of fast states is, of course, dependent on whether these states constitute donors or acceptors. The levels N_{t_1} and N_{t_2}, and N_{t_3} and N_{t_4}

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form two pairs; each pair corresponds to another charge state of one and the same center, and, depending on the position of these levels, these centers constitute acceptors or donors. The model of surface recombination centers is based on these and other experimental results. It is assumed in this connection that at the interface between germanium and oxide layer there are structural defects, whose concentration is considerably lower than that of the surface atoms. To these defects correspond donor levels situated well above the forbidden band; the electron trapping cross section upon these levels is taken to be small, and oxygen is considered to be adsorbed by the defects lightly (and loosely). Such defects are positively charged with all values of the surface potential and correspond to slow surface states. Oxygen adsorption on such defects is further assumed to have a considerable effect upon their properties. The carrier trapping cross section is rendered considerably smaller thereby due to water adsorption, while the donor level lies well above the forbidden band. This explains the compensating action of water (destruction of recombination states in Ge). The model (described here in great detail) appears as the likeliest but not the only way of explaining the experimental results (cf. M.Lax.Phys.Rev,119,5,

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1502, 1960). There are 1 table and 12 references: 7 Soviet-bloc and 5 non-Soviet-bloc. The two references to the English-language publications read as follows: A. Many, J. Phys. Chem. Sol. 8, 87, 1959; W. Shockley, J.T. Last. Phys. Rev. 107, 2, 392, 1957.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva AN SSSR Moskva
(Institute of Physics imeni P. N. Lebedev AS USSR, Moscow)

SUBMITTED: December 26, 1960

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25682
S/181/61/003/007/004/023
B102/B202

24.7700

AUTHORS: Rzhanov, A. V. and Arkhipova, I. A.

TITLE: Surface recombination in germanium with raised injection levels

PERIODICAL: Fizika tverdogo tela, v. 3, no. 7, 1961, 1954 - 1959

TEXT: The authors report on measurements of the surface recombination rate as a function of the surface potential for different injection levels. They also give a comparison with the theory. This problem is of interest since today a large number of semiconductor devices operate at increased injection levels (where the concentration of the non-equilibrium carriers equals or exceeds that of the equilibrium carriers) and because it has hitherto not been studied experimentally. In the laboratory of the authors a method was devised for the combined study of steady photoconductivity and field effect, which can be employed for different injection levels. It is based on the following principle: A rectangular germanium plate is covered by 2 mica foils and fixed between two glass plates to the inner surfaces of which the transparent tin oxide electrodes

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Surface recombination ...

are fitted. A sinusoidal transverse voltage is applied to this two-sided capacitor which simultaneously is exposed through the electrodes to square light pulses of equal intensity but different repetition frequency. Under these conditions, three curves can simultaneously be observed on the oscilloscope screen: The curve of the conductivity variation in the dark, and the conductivity curves for one- and two-sided exposure (with double total intensity). The surface dark potential can be determined from the former, the steady photoconductivity is determined from the ordinate difference between first and second curve. From this difference, the effective lifetime and surface recombination rate are determined if the calibration coefficient (which is determined from the second and third curves) is known. The theoretical considerations are based on the formula for the surface recombination rate

$$S=\frac{N_t(\sigma_p\sigma_n)^{1/2}\frac{1}{2}(\lambda+\lambda^{-1})\left[1+\delta\left(\frac{1}{\lambda+\lambda^{-1}}\right)\right]}{\mathrm{ch}\left(Y_s-\ln\lambda-\frac{q\zeta_0}{kT}\right)+\mathrm{ch}\left(\frac{\varepsilon_t-q\zeta_0}{kT}\right)+\delta\,\mathrm{ch}\left(Y_s-\frac{q\zeta_0}{kT}\right)}. \qquad (1)$$

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Surface recombination ...

where Y_s is the surface potential in a recombination via centers of concentration N_t with energy levels $\varepsilon_t = E_t - E_i$, α_p and α_n are the hole and electron trapping constants, n_o and p_o are the balanced volume concentrations of electrons and holes, $\delta = \frac{\Delta n}{n_i} = \frac{\Delta p}{n_i}$ is the injection level and $\lambda = p_o/n_i = n_i/n_o$; $q\zeta_o/kT = \frac{1}{2} \ln \frac{\alpha_p}{\alpha_n}$. With increasing δ, the position of the maximum of the curve $S = f(Y_s)$ is shifted from $Y_s' = \frac{q\zeta_o}{kT} + \ln \lambda$ (for small δ) to $Y_s'' = q\zeta_o/kT$ for large δ. If (1) is written in the form

$$S = S_0 \frac{1 + \delta\left(\frac{1}{\lambda + \lambda^{-1}}\right)}{1 + \delta \frac{\operatorname{ch}\left(Y_s - \frac{q\zeta_0}{kT}\right)}{\operatorname{ch}\left(Y_s - \ln\lambda - \frac{q\zeta_0}{kT}\right) + \operatorname{ch}\left(\frac{\varepsilon_t - q\zeta_0}{kT}\right)}}. \qquad (4)$$

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Surface recombination ....

where S_o is the surface recombination rate for small δ, the variation of the maximum surface recombination rate with the injection level becomes manifest. (4) shows that also at relatively small δ, the maximum surface recombination rate decreases with the injection level if $\frac{1}{2}(\lambda+\lambda^{-1})^2 > 1 + ch(\frac{\epsilon_t - q\zeta_o}{kT})$, and increases with the inverse inequality sign. With large δ S_{max} decreases with increasing δ, if $\frac{1}{2}(\lambda+\lambda^{-1}) > ch(\frac{\epsilon_t - q\zeta_o}{kT})$ and with a further increase of δ, S approaches the value $S_{\delta\to\infty} = N_t \frac{\alpha_p \alpha_n}{\alpha_p + \alpha_n}$.

In the following, these results are applied to practical cases. A comparison of the theoretical results with the experimental ones for the two extreme values $\delta = 0.1$ and $\delta = 4.3$ showed good agreement. The authors thank A. L. Vol'sk, Member of Warsaw University, for assistance and advice.
There are 2 figures and 8 references: 6 Soviet-bloc and 2 non-Soviet-bloc. The references to the English-language publications read as follows:
R. H. Kingston. Semiconductor Surface Physics, p. 85, 1957; G. Dousmanis. J. Appl. Phys. 30, 2, 180, 1959.

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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25682
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B102/B202

Surface recombination ....

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva
(Institute of Physics imeni P. N. Lebedev AS USSR, Moscow)

SUBMITTED: January 14, 1961

Card 5/5

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

S/1[illegible]/61/003/011/010/056
B102/B138

AUTHORS: Rzhanov, A. V., and Neizvestnyy, I. G.

TITLE: The influence of molecule adsorption on germanium upon the parameters of the surface recombination centers

PERIODICAL: Fizika tverdogo tela, v. 3, no. 11, 1961, 3317-3323

TEXT: The authors have already published several papers on adsorption effects. They have shown that the density of recombination centers depends in a compensative and reversible manner on the polarity of the adsorbed molecules. The fact that the surface recombination centers are neutralized by adsorbed molecules could be explained on the assumption of chemical or electrostatic processes taking place between adsorbent and recombination center. In order to find out which possibility really holds, the authors used a field effect method to study how the recombination parameters change when adsorbed water molecules are substituted by ether or benzene. The surface recombination rate, and the charge trapped by fast surface states were recorded as functions of the surface potential. For this purpose the germanium samples were placed in a mica holder with transparent electrodes

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providing a transverse field independent of the liquid investigated. The whole arrangement was placed in a special thermostatic vessel. The surface recombination rates as functions of the surface potential Y with and without heat treatment of the specimens are shown in Figs. 1,2. The trapped negative charge was found to increase with increasing Y in a weakly non-linear manner; after heat treatment (500°C) the increase was more rapidly. The maximum surface recombination rated were found to be between 820 cm/sec (3.4 kT/q, c. f. Fig. 1) and 1650 cm/sec (3.0 kT/q) in benzene and between 460 cm/sec (5.5 kT/q) and 2100 cm/sec (6.2 kT/q) in ether. From the experiments made with benzene it was found that in the nonpolar benzene the surface recombination centers are activated in the same manner as in vacuo and that the characteristics of the recombination centers are in no way affected by benzene. In ether, which is weakly polar, the surface recombination centers are activated in the same manner as in benzene or in vacuo. Adsorption of ether leads only to a shift of the maxima of $S(Y_s)$ (Fig. 1) from +3kT/q (where they are for benzene or vacuum) to + 6kT/q. The results indicate that the adsorption of ether on germanium is a physical process. The interaction between ether and

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germanium is purely electrostatic. There are 4 figures, 1 table, and 6 references: 5 Soviet and 1 non-Soviet. The latter reads as follows: M. Lax. Phys. Rev. 119, no. 5, 1502, 1960.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva (Physics Institute imeni P. N. Lebedev AS USSR, Moscow)

SUBMITTED: May 22, 1961

Fig. 1. Surface recombination rate as a function of the surface potential before heating (1) and after heating at 350°K (2), 400°K (3), 450°K (4) and 500°K (5) in ether.

Fig. 2. The same for benzene.

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32085
S/181/61/003/012/020/028
B108/B138

24,7000 (1144, 1385, 1559)

AUTHOR: Rzhanov, A. V.

TITLE: Statistics of recombination in the capture of carriers onto excited levels of a recombination center

PERIODICAL: Fizika tverdogo tela, v. 3, no. 12, 1961, 3691-3697

TEXT: The statistics of carrier capture and recombination in a non-degenerate semiconductor is studied for the case of a single-charge recombination center with one ground state and one excited level each for electron and hole capture. It is assumed that the carriers are captured from the bands onto excited levels of the recombination center. The electron and hole fluxes into the excited levels of the recombination centers are

$U_n = C_n r_n (N_t^* n - n_t n_o N_{to}^*/n_{to})/(C_n n_o N_{to}^*/n_{to} + r_n)$ and

$U_p = C_p r_p (n_t p - N_t^* p_o n_{to}/N_{to}^*)/(C_p p_o n_{to}/N_{to}^{**} + r_p)$, respectively.

n_t = concentration of recombination centers with an electron in the ground

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Statistics of recombination in the ...

state (capture of holes on the excited level), n_t^* = concentration of recombination centers with an electron on the excited level (capture of electron, N_t^* = conc. of rec. c. without electron in their ground states (electron capture on the excited level), N_t^{**} = conc. of rec. c. with a hole on their excited levels for hole capture. $n_t+n_t^*+N_t^*+N_t^{**} = N_{total}$. The subscript o indicates equilibrium concentration. The r's are the transition probabilities. A general expression for the recombination rate is derived from the above formulas for the case concentration of recombination centres is low and the excess hole and electron concentrations are equal.

$$U=\frac{N_t C_p C_n (np-n_0p_0)}{C_p\left[1+\frac{C_n}{r_n}n_1^*\right](p+p_1)+C_n\left[1+\frac{C_p}{r_p}p_1^{**}\right](n+n_1)+\delta p\left[\frac{C_n}{r_n}p+\frac{C_p}{r_p}n\right]}. \qquad (12)$$

This expression goes over into the Shockley-Read relation (Ref. 1, see

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Statistics of recombination in the ...

below) for small injection levels and the conditions $1 \gg C_n n_1^*/r_n$; $1 \gg C_p p_1^{**}/r_p$. n_1^* and p_1^{**} are the electron and hole concentrations, respectively, in the bands where the Fermi level intersects the excited level. The above conditions involve the postulate that the carrier lifetimes on the excited levels τ_n', $\tau_p' \ll (10^{-9} - 10^{-10})$ sec. However, these conditions do not always apply. E. I. Adirovich is thanked for discussions. Yu. V. Gulyayev (FTT, 3, no. 2, 382, 1961) is mentioned. There are 1 figure and 7 references: 3 Soviet and 4 non-Soviet. The 4 references to English-language publications read as follows: Ref. 1: W. Shockley a. W. Read, Phys. Rev., 87, 835, 1952; R. N. Hall. Phys. Rev., 87, 387, 1952; W. Shockley a. J. Last. Phys. Rev., 107, 392, 1957; M. Lax. Phys. Rev., 119, 1502, 1960.

ASSOCIATION: Fizicheskiy institut im. P. I. Lebedeva AN SSSR Moskva
(Physics Institute imeni P. I. Lebedev AS USSR, Moscow)

SUBMITTED: July 10, 1961

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...September 26, 2002 CIA-RDP86-00513R001446520006-3
...ASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

32086
S/181/61/003/012/021/028
B108/B138

24,7000 (1144, 1385, 1559)

AUTHOR: Rzhanov, A. V.

TITLE: Surface recombination in semiconductors

PERIODICAL: Fizika tverdogo tela, v. 3, no. 12, 1961, 3698 - 3705

TEXT: An expression for the maximum surface recombination rate is derived on the basis of a previously (FTT, v. 3, no. 12, 1961, 3691 - 3697) derived expression

$$S = \frac{N_t (C_p C_n)^{1/2} \frac{n_0 + p_0}{2n_i}}{\operatorname{ch}\frac{q(\varphi_S - \zeta)}{kT} + \operatorname{ch}\left(\frac{\delta_t - q\zeta}{kT}\right) + M\left[\operatorname{ch}\frac{q(\varphi_S - \eta)}{kT} + \operatorname{ch}\left(\frac{\delta_t - q\eta}{kT}\right)\right]}. \quad (1)$$

which is rewritten using the terms

$$M = \left(\frac{C_p C_n}{r_p r_n} p_1^{\bullet\bullet} n_1^{\bullet}\right)^{1/2}, \qquad \frac{q\eta}{kT} = \frac{1}{2}\ln\left(\frac{r_p}{r_n}\frac{n_1^{\bullet}}{p_1^{\bullet\bullet}}\right), \quad (2), (3)$$

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FRUMKIN, A.N., akademik, otv. red.; RZHANOV, A.V., otv. red.; BURSHTEYN, R.Kh., doktor khim. nauk, otv. red.; YUNOVICH, A.E., red. izd-va; TIKHOMIROVA, S.G., tekhn. red.

[Surface characteristics of semiconductors]Poverkhnostnye svoistva poluprovodnikov. Moskva, Izd-vo Akad. nauk SSSR, 1962. 231 p. (MIRA 15:12)

1. Soveshchaniye po poverkhnostnym svoistvam poluprovodnikov, Moscow, 1961. 2. Chlen-korrespondent Akademii nauk SSSR (for Rzhanov).
(Germanium--Electric properties) (Transistors)
(Selenium--Electric properties)

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RZHANOV, A. V.

"A Study of the Surface States of Germanium (a copy typed from the handwritten text--spelling and grammer unchanged-- as well as the original handwritten copy)"

Report presented at the Massachusetts Institute of Technology (MIT) Physical Electronics Conference. Cambridge, Massachusetts, 21-23 March 62.

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L 17926-63 EWT(1)/EWG(k)/EWP(q)/EWT(m)/BDS AFFTC/ASD/ESD-3/IJP(C) Pg-4
ACCESSION NR: AT3002445 AT/JD S/2935/62/000/000/0101/0114 67 66

AUTHOR: Rzhanov, A. V.

TITLE: Investigating some electron processes on the real germanium surface [Report at the Conference on Surface Properties of Semiconductors, Institute ofElectrochesmistry, AN SSSR, Moscow, 5-6 June 1961]

SOURCE: Poverkhnostny*ye svoystva poluprovodnikov, Moscow, Izd-vo AN SSSR, 1962, 101-114

TOPIC TAGS: germanium, germanium surface

ABSTRACT: A review is offered of experimental results relating to surface recombination and capture on Ge surface; the results are compared with theoretical notions. All steps of surface treatment of Ge specimens were standardized which brought about good reproducibility of experimental results. To analyze recombination and capture phenomena, additional experiments with injection level, temperature, concentration and other properties of surface centers were staged; also various crystallographic orientations of Ge surface were used and spectrum-photoconductivity relations were studied. On the strength of the above experi-

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ACCESSION NR: AT3002445

ments the old assumption that only one type of recombination centers predominates was abandoned. Ozonated oxygen and vacuum heating up to 700K were used to study variations in recombination concentrations and capture; these studies permitted important conclusions about the nature of surface recombination centers and capture. The crystallographic orientation (110) yielded recombination curves much different from those at the orientations (100) and (111). Energy topography of surface levels was studied on the basis of infrared-spectrum / photoconductivity relations. A modified theory of surface recombination offered by Soviet researchers differs from the conventional theory in the interpretation of the effective sections of capture of carriers by the recombination center. Generally accepted methods of treating Ge surface were found inadequate as the resulting film had unstable characteristics; entirely different methods are suggested. Orig. art. has: 6 figures and 2 formulas.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Institute of Physics, AN SSSR)

SUBMITTED: 00 DATE ACQ: 15May63 ENCL: 00

SUB CODE: PH NO REF SOV: 012 OTHER: 004

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37938

S/181/62/004/005/029/055
B108/B112

24.7400

AUTHORS: Rzhanov, A. V., and Arkhipova, I. A.

TITLE: Surface recombination on germanium with a large quantity of water adsorbed

PERIODICAL: Fizika tverdogo tela, v. 4, no. 5, 1962, 1274 - 1278

TEXT: The changes in the character of the recombination curves during gradual drying of p-type germanium were examined. Conclusions: Virtually no quantitative relationship exists between the changes in the maximum surface recombination rate of germanium with adsorbed water and the slope of the capture curves. Recombination is accomplished at discrete levels as well as on continuous energy levels in the surface forbidden band. As a first approximation it is assumed that the effective capture cross sections of the discrete and continuous levels are determined only by the donor or acceptor character of the respective centers and that they are independent of the energy position of the level. An approximately linear increase of the recombination rate on the side of positive surface potentials was observed on the p-type specimens (resistivity ~20 ohm.cm).

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Surface recombination on ...

A detailed description of the experiments will follow later. There are 3 figures.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva (Physics Institute imeni P. N. Lebedev) Moscow

SUBMITTED: January 2, 1962

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24.7400

S/181/62/004/005/030/055
B108/B112

AUTHOR: Rzhanov, A. V.

TITLE: Surface recombination and capture through a continuous surface level spectrum

PERIODICAL: Fizika tverdogo tela, v. 4, no. 5, 1962, 1279 - 1284

TEXT: Theoretical expressions are derived and discussed relating to capture and surface recombination rate in donor-acceptor semiconductors with continuous surface level spectrum. Comparison between theory and experimental data on germanium led to the following conclusions: The half width of the calculated recombination curves is less than that of the experimental curves. This argument against the significance of the continuous surface level systems is not, however, decisive. It may be well possible that comparable contributions to surface recombination are added by those systems of levels that are continuous in the forbidden band and by discrete surface levels. A number of experimental features can be explained on the assumption that the ratio of their concentrations to be such that the shape of the major part of the experimental capture curve is

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S/181/62/004/007/013/037
B102/B104

AUTHORS: Paramonova, R. A., and Rzhanov, A. V.

TITLE: Investigation of the volume recombination in copper-doped germanium crystals

PERIODICAL: Fizika tverdogo tela, v. 4, no. 7, 1962, 1820-1825

TEXT: The temperature dependence of the volume (recombinative) lifetime of carriers in p-type Ge with copper concentrations of $0.6\text{-}2.0\cdot10^{14}$ cm^{-3} and with resistivities of 1.4-2.3 ohm·cm at 300°K was measured. The carrier lifetime was found to decrease with temperature throughout the range of concentrations. This agrees with FTT, 1, 1294, 1959 but not with Schultz in Phil. Res. Rept., 16, 182, 1961 who found the dislocation density to be very low ($\lesssim 100$ cm^{-2}) and attributed to surface recombination. To examine the question more closely the Cu impurity in some specimens was compensated by Sb ($\lesssim 2\cdot10^{14}$ cm^{-3}). The ... was still $10^3\text{-}10^4$ cm^{-2}, and the $\tau(1/T)$ curves showed

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Investigation of the volume ...

a distinct maximum. In addition the carrier lifetime and the cross section for carrier trapping by Cu^{4+} ions were investigated for low-ohmic n-type specimens. The specimens had a Cu concentration of $1 \cdot 10^{14}$ cm^{-3}, a resistivity of 0.14-6.8 ohm·cm at 300°K, and a dislocation density of $\approx 10^3$ cm^{-2}. At low temperatures, the lifetime was $\sim T^{2.5}$ and the hole trapping cross section was proportional to T^{-3}. The third copper level is 0.26 ev below the bottom of the conduction band. At 300°K the trapping cross section is $1 \cdot 10^{-16}$ cm^{-2}. The electron lifetime at first increases rapidly from ≈ 10 μsec with decreasing temperature, tending to saturation. Though unable to account for the different trends of the $\tau(1/T)$ curves, the authors do not think these are due to the different effects of surface recombination as Schultz suggested, but rather to the different positions of the copper impurities (in the lattice or at dislocations). This assumption, however, remains to be proved. There are 5 figures.

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Investigation of the volume ...

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva
(Physics Institute imeni P. N. Lebedev AS USSR, Moscow)

SUBMITTED: December 23, 1961 (initially)
February 23, 1962 (after revision)

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

S/181/62/004/012/014/052
B104/B102

AUTHORS: Guro, G.M., and Rzhanov, A.V.

TITLE: Kinetics of the nonequilibrium conductivity in the case of high generation levels

PERIODICAL: Fizika tverdogo tela, v. 4, no. 12, 1962, 3441-3445

TEXT: How the period that the carriers are trapped in a recombination center affects the kinetics of the nonequilibrium conductivity in the case of high generation levels is studied. For the case of low generation levels, the effect of the carrier lifetime on the excited levels of the recombination centers in stationary processes was investigated by A.V. Rzhanov (FTT, 3, 3691, 1961) as an extension of the recombination theory by W. Shockley and W. Read (Phys.Rev., 87, 835, 1952). G.M. Guro (ZhETF, 33, 158, 1957) derived an attenuation law of the carrier equilibrium concentration at arbitrary deviations from thermodynamic equilibrium, assuming, however, that recombination takes place via the ground state of the recombination center. The same conception is adopted here, but a more general expression for the recombination rate is taken as initial equation, whereby the effect of the

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

ACCESSION NR: AT3012119 S/2504/63/020/000/0003/0125

AUTHOR: Rzhanov, A. V.

TITLE: Investigation of some electronic processes on the surface of germanium

SOURCE: AN SSSR. Fizicheskiy institut. Trudy*, v. 20, 1963, 3-125

TOPIC TAGS: germanium, semiconductor, germanium semiconductor diode, surface recombination, surfaces space charge, surface potential barrier, surface conductivity, surface energy level, surface defects

ABSTRACT: This is a doctoral dissertation devoted to surface recombination and its influence on the characteristics of certain type of germanium diodes and transistors. The topics covered are: 1. Effect of surface recombination on the saturation current of low-power germanium diodes. 2. Effect of surface recombination on the characteristics of low-power germanium transistors. 3. Surface electronic processes occurring on semiconductors (equilibrium between surface and volume of the semiconductor, surface space charge layer, surface potential barrier and work function, surface conduc-

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tivity, field effect and fast and slow surface states, and surface recombination. 4. Surface recombination and capture as a method for investigating surface defects of a structure (combined investigations of the surface conductivity, recombination, and carrier capture character of the experimental results and their reproducibility and interpretation). A procedure is described for determining the surface levels from the spectral dependence of photoconductivity outside the region of the main absorption of light by germanium. The experimental data indicate that the rate of surface recombination on a real germanium surface depends on the injection level, the temperature, the state of the gaseous medium (ozone content and dryness), and the crystallographic orientation and finish of the surface. The data can also be useful in the construction of various types of germanium devices. Further developments in the theory of surface recombination are discussed, with emphasis on the kinetics of the capture and recombination processes. "The author is sincerely grateful to the director of the Laboratoriya fiziki poluprovodnikov (Semiconductor Physics Laboratory), B. M. Vul, for interest in

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the work and for help, to E. I. Adirovich for many fruitful discussions, and to V. S. Vavilov for collaboration in individual measurements. Participating in the work were the scientists from the Group of Surface Phenomena in Semiconductors I. A. Arkhipova, T. I. Galkina, I. G. Neizvestny'y, Yu. F. Novototskiy-Vlasov, N. M. Pavlov, S. V. Pokrovskaya, and M. A. Selezneva, engineer Ye. V. Gorskin and laboratory assistants G. A. Balandina, O. A. Gry*zlova, V. S. Maksimkin. The author is sincerely grateful to all his colleagues for collaboration and also takes the opportunity to thank engineer B. D. Kopy*lovskiy, graduate student A. F. Plotnikov, mechanics Yu. A. Kolotov and A. F. Zinov'yev and the entire staff of the Semiconductor Physics Laboratory for help with individual problems." Orig. art. has: 54 figures, 75 formulas, and 14 tables.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Physics Institute, AN SSSR)

SUBMITTED: 00 DATE ACQ: 01Aug63 ENCL: 00

SUB CODE: PH NO REF SOV: 066 OTHER: 065

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

LAVRENT'YEV, A.M., akademik; RABOTNOV, Yu.N., akademik; RZHANOV, A.V.; VOROB'YEV, A.A., prof.; KUZNETSOV, Yu.A.; SOKOLOV, V.A., prof.

Vladimir Dmitrievich Kuznetsov, 1887-1963; an obituary. Izv. SO AN SSSR no.2. Ser. tekh. nauk no.1:142-143 '64. (MIRA 17:8)

1. Chleny-korrespondenty AN SSSR (for Rzhanov, Kuznetsov).

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KRAVCHENKO, A.F.; REZHANOV, A.V.; SARDARYAN, V.S.

Longitudinal Hall effect in cubic crystals. Dokl. AN SSSR 164 (MIRA 18:10)
no.5:1016-1018 O '65.

1. Institut fiziki poluprovodnikov Sibirskogo otdeleniya AN SSSR.
2. Chlen-korrespondent AN SSSR (for Rezhanov).

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L 22914-66 EWT(m)/EWP(t) IJP(c) JD/JG

ACC NR: AP6009657 SOURCE CODE: UR/0181/66/008/003/0758/0766

64
B

AUTHORS: Rzhanov, A. V.; Svitashev, K. K.; Filatova, Ye. S.; Shepel', V. M.

ORG: Institute of Semiconductors, SO AN SSSR, Novosibirsk (Institut poluprovodnikov SO AN SSSR)

TITLE: Investigation of the surface photoconductivity of germanium 27

SOURCE: Fizika tverdogo tela, v. 8, no. 3, 1966, 758-766

TOPIC TAGS: germanium, photoconductivity, surface property, semiconductor conductivity, semiconductor impurity, forbidden band, spectral energy distribution

ABSTRACT: This is a continuation of earlier work (FTT v. 3, 1557, 1961) dealing with impurity photoconductivity and the concentration of photoactive surface defects. The present investigation was made with p-type germanium doped with gallium, and having a specific resistivity 20 -- 30 ohm cm and a carrier lifetime ~800 μsec. The samples were placed in a cryostat in vacuum 5×10^{-7} torr and exposed

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ACC NR: AP6009657

to monochromatic radiation from the IKS-12 instrument. Measurements were made of the temperature and spectral dependences of the surface photoconductivity and also of its time lag. The impurity photoconductivity of a thin sample of germanium was measured with light modulated at 12 cps. No impurity photoconductivity was observed at room temperature and at dry ice temperature, but was observed at liquid nitrogen temperature (- 170C), at which all other measurements were made. The results demonstrated once more the existence of a specific photoconductivity in germanium, connected with excitation of surface defects. The experimental reasons for this conclusion are presented in detail. The results also show that it is possible in principle to obtain data on the energy levels of the photoactive surface defects in the forbidden band of the semiconductor by analyzing the surface-photoconductivity spectra. Further data can be expected from these results if the surface potential can be determined by an independent method and the spectral resolution is improved. Work is continued in this direction. Orig. art. has: 12 figures, 3 formulas, and 1 table.

SUB CODE: 20/ SUBM DATE: 20Jul65/ ORIG REF: 003/ OTH REF: 005

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

ACC NR: AP6018576 SOURCE CODE: UR/0181/66/008/006/1955/1957

AUTHOR: Rzhanov, A. V.; Svitashev, K. K.; Shepel', V. M.

ORG: Institute of Physics of Semiconductors, SO AN SSSR, Novosibirsk (Institut fiziki poluprovodnikov SO AN SSSR)

TITLE: Influence of capture of nonequilibrium carriers by surface defects on the spectrum of the intrinsic photoconductivity of a thin sample of germanium

SOURCE: Fizika tverdogo tela, v. 8, no. 6, 1966, 1955-1957

TOPIC TAGS: photoconductivity, germanium semiconductor, capture cross section

ABSTRACT: The authors compare the pulses of intrinsic photoconductivity of thick and thin samples of p-type germanium at liquid-nitrogen temperature. The shape of the photoconductivity pulse of the thin sample exhibited singularities characteristic of the presence of traps. It is shown that the total change of the conductivity of the sample under the influence of the light consists of three factors (photoconductivity proper, change in surface conductivity as a result of change in carrier density, and change in surface conductivity as a result of change of the surface charge), and in the region of 1.64 μ the contribution of the third process is comparable in magnitude with the contributions of the first two. The additional illumination, which normally eliminates adhesion of nonequilibrium carriers on the germanium surface at low temperatures, reduced the photoconductivity of the thin germanium to approximately the same value as that of thick germanium (5 vs. 0.5 mm) and eliminated the peak at 1.64 μ.

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RY2

USSR.

Rotation levels and rotation spectra of heavy nuclei. S. G. Ryzhanov. *Zhur. Eksptl. i Teoret. Fiz.*, 23, 417-24 (1953); *Science Abstr.*, 56A, 731(1953).—A new scheme of α- and γ-spectra of naturally radioactive nuclei is proposed: the parent nucleus undergoing α-decay in the ground state imparts energy to 2 or 3 rotators; and γ-radiation is detd. by transition of each rotator, subject to selection rules. The γ-intensities can be obtained, by using the correspondence principle, from elec. quadrupole, together with some magnetic dipole, emission. K. L. C.

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PLAKSIN, S.A.; GOTOVTSEVA, L.A.; ZERNOVA, K.N.; RYZHAKOVA, T.S.

Peroxide bleaching of back grey. Tekst.prom. 20 no.2: 45-48 F '60. (MIRA 13:6)
(Textile printing--Equipment and supplies)
(Bleaching) (Textile fabrics)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

ANDREYENKO, G.V.; BAZAZ'YAN, G.G.; SMYSLOVA, S.N.; RYZHAKOVA, V.G.

Comparative study of the methods of the determination of heparin in the blood. Lab. delo no.2:102-105 '65. (MIRA 18:2)

1. Laboratoriya fiziologii i biokhimii svertyvaniya krovi (zaveduyushchiy - prof. B.A. Kudryashov) Moskovskogo gosudarstvennogo universiteta.

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RYZHANOV, S.G.

Rotation levels and rotation spectra of nuclei. Uch. zap. Kish. un. 75:12-17 '64. (MIRA 18:10)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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L 26486-65 EWT(l)/EWT(m) DIAAP/IJP(c) S/0058/64/000/011/V014/V014

ACCESSION NR: AR5004846

SOURCE: Ref. zh. Fizika, Abs. 11V120

AUTHORS: Ryzhanov, S. G.

TITLE: Role of K-forbiddenness in alpha spectra of transuranic elements

CITED SOURCE: Uch. zap. Kishinevsk. un-t, v. 69, 1964, 19-22

TOPIC TAGS: alpha spectrum, transuranic element, alpha decay, forbidden transition, half life

TRANSLATION: On the basis of the scheme of radioactive alpha decay of the transuranic elements Am^{241}, Cm^{245}, and Cf^{249}, proposed in earlier papers (RZhFiz, 1962, 9V318; 1963, 3B52), it is shown that forbidden E1 transitions exist between crossing levels of opposite parity, and that there are no E2 or M1 transitions between levels of equal parity. The average lifetime of such levels is estimated and found to be larger than the half lives of the indicated nuclei. S. Ryzhanov.

SUB CODE: NP ENCL: 00

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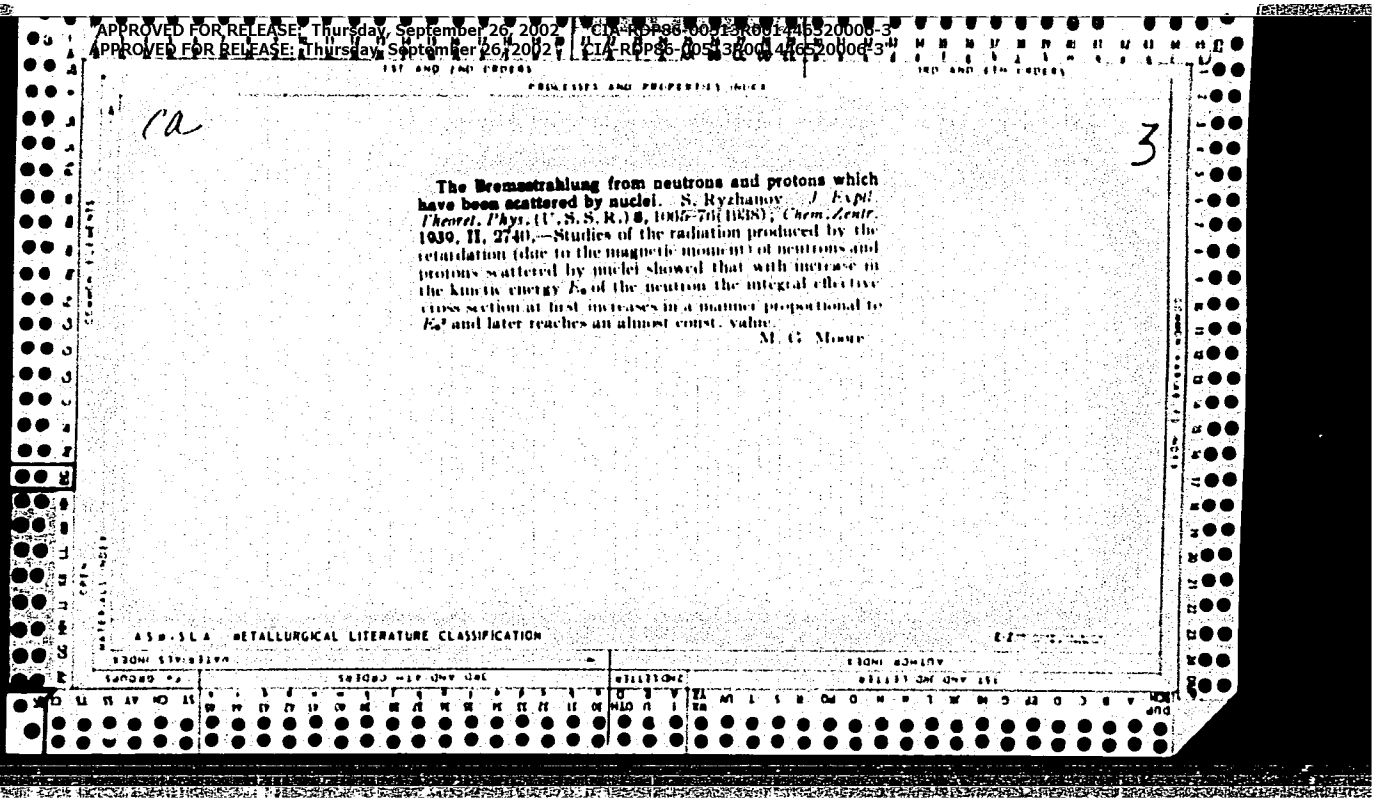

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The Bremsstrahlung from neutrons and protons which have been scattered by nuclei. S. Ryzhanov. *J. Exptl. Theoret. Phys.* (U.S.S.R.) **8**, 1005–7(1938); *Chem. Zentr.* **1939, II**, 2740.—Studies of the radiation produced by the retardation (due to the magnetic moment) of neutrons and protons scattered by nuclei showed that with increase in the kinetic energy E_0 of the neutron the integral effective cross section at first increases in a manner proportional to E_0^2 and later reaches an almost const. value.

M. G. Mason

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

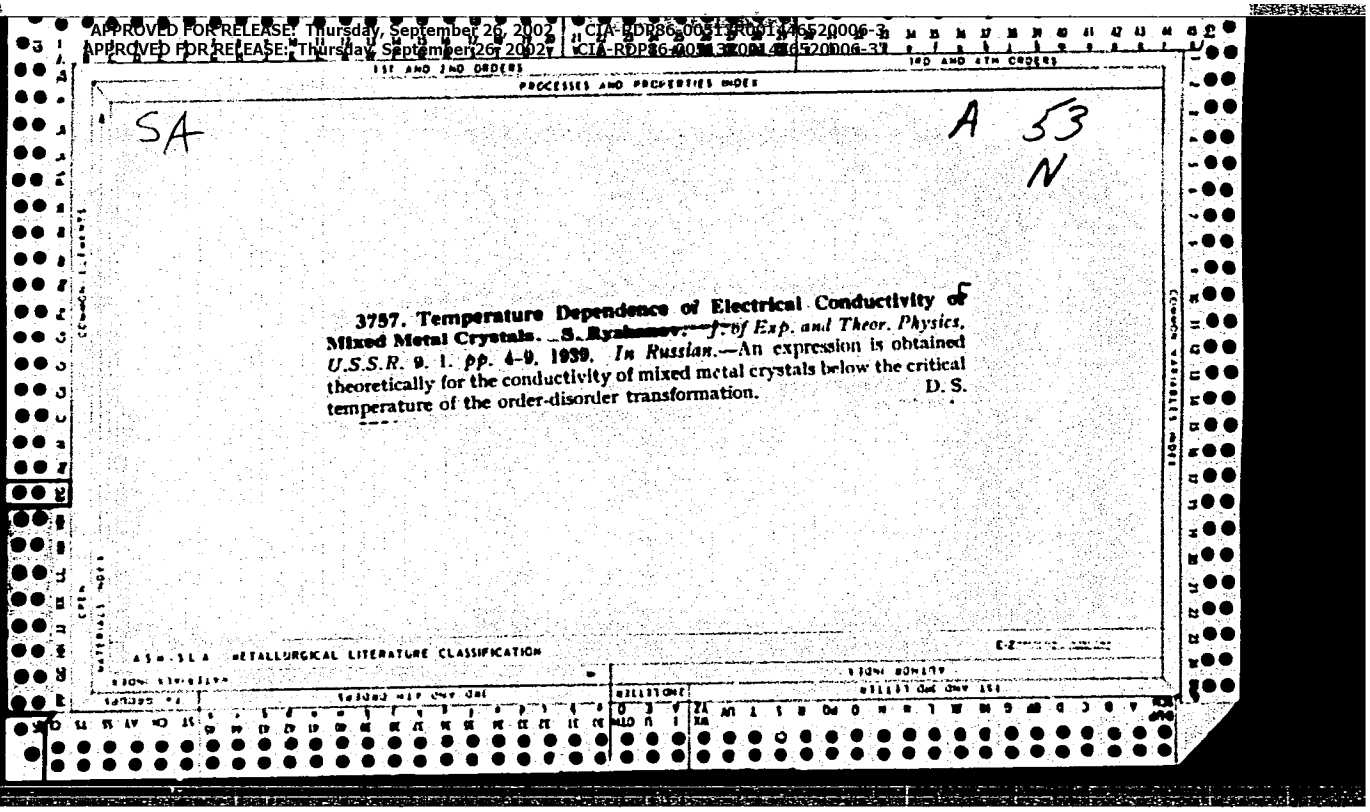
APPROVED FOR RELEASE: Thursday, September 26, 2002 | CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 | CIA-RDP86-00513R001446520006-3

Theory of the diffraction of electrons from crystals. Ya. Frenkel and S. Ryabinin. *J. Exptl. Theoret. Phys.* (U. S. S. R.) **8**, 1255-60(1938). — F. and R. show that the discrepancy between the exptl. data of Davisson and Germer (cf. *C. A.* **23**, 29) and the theoretical values calcd. by Bethe and Kikuchi (B., *C. A.* **23**, 332, and K., *C. A.* **24**, 5003) can be satisfactorily explained by a consideration of noncoherent collisions which cause an electron absorption and widen the diffraction max.

F. H. Rathmann

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

APPROVED FOR RELEASE: Thursday, September 26, 2002 | CIA-RDP86-00513R001146520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 | CIA-RDP86-00513R001146520006-3



SA

A 53
N

3757. **Temperature Dependence of Electrical Conductivity of Mixed Metal Crystals.** S. Ryabinov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 4–9. 1939. *In Russian.*—An expression is obtained theoretically for the conductivity of mixed metal crystals below the critical temperature of the order-disorder transformation. D. S.

APPROVED FOR RELEASE: Thursday, September 26, 2002 | CIA-RDP86-00513R001461920006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 | CIA-RDP86-00513R001461920006-3

Photoelectric effect from photoelectrically sensitized active cathodes. S. Ryzhanov, *J. Exptl. Theoret. Phys.* (U. S. S. R.) 9, 38–45(1939).—Theoretical-mathematical. The surface effect is highly selective; the vol. effect increases with decreasing wave length, with layer thickness up to a certain max., and is practically independent of polarization. The photoelec. yield is $^1/_{100}$ electrons per quantum. These results agree with those obtained by Fowler from statistic considerations, as well as those found experimentally by Ives (*C. A.* 26, 903). F. H. R.

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CA

3

Interaction between barytrons and electromagnetic field in the presence of heavy particles. S. Ryzhanov. *J. Exptl. Theoret. Phys.* (U.S.S.R.) 10, 129-38(1940).—Using Bhabha's theory of mesons (cf. *C. A.* 33, 8487*) (mesotrons, barytrons, heavy electrons, etc.) in which their wave functions are represented by four-dimensional vectors, R. calcs. effective cross sections for the following processes: (1) formation of meson pairs by the high-energy radiation in the neighborhood of heavy nuclei; (2) photo emission resulting from the scattering of mesons by heavy nuclei; (3) formation of single mesons resulting from the transformations of heavy elementary particles under the action of high-energy radiation. R. G.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

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RYZHAKOV, L.Yu.

Role of turbulence in the transport of atmospheric eddies. Probl.Arkt.i Antarkt. no.1:25-31 '59.
(MIRA 13:7)

(Atmospheric turbulence) (Cyclones)

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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RYSTRAKOV, Z. Yu.

PHASE I BOOK EXPLOITATION SOV/4610

Leningrad. Arkticheskiy i Antarkticheskiy nauchno-issledovatel'skiy institut

Problemy Arktiki i Antarktiki; sbornik statey, vyp. 3 (Problems of the Arctic and Antarctic; Collection of Articles, No. 3) Leningrad, Izd-vo "Morskoy transport," 1960. 119 p. 500 copies printed. [Xerox copy]

Sponsoring Agencies: Arkticheskiy i Antarkticheskiy nauchno-issledovatel'skiy institut Glavnogo upravleniya Severnogo morskogo puti Ministerstva morskogo flota SSSR.

Resp. Ed.: V.V. Frolov; Editorial Board: L.L. Balakshin, A.A. Girs, P.A. Gordiyenko (Deputy Resp. Ed.), I.M. Dolgin, L.G. Kaplinskaya, A.A. Kirillov, Ye.S. Korotkevich, V.V. Lavrov, I.V. Maksimov, A.I. Ol', I.I. Poznyak, and B.V. Felisov; Tech. Ed.: L.P. Drozhzhina.

PURPOSE: This collection of articles is intended for geographers and geophysicists, particularly those interested in the problems of the Arctic and Antarctic.

COVERAGE: This publication of the Arctic and Antarctic Scientific Research Institute contains articles on the water temperature in the Arctic Basin, the

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tides of Arctic seas, the structure of Arctic cyclones and anticyclones, radiosonde measurements of temperature, the determination of ice thickness by dipole electromagnetic methods, and magnetic activity in relation to geographical longitude and latitude. No personalities are mentioned. References follow each article.

TABLE OF CONTENTS:

Sychev, K.A. Heat Content of Atlantic Waters and Heat Expenditure in the Arctic Basin 5

Maksimov, I.V. Long-Period Lunar-Solar Tides Along the Coasts of the Arctic Seas 17

Ryzhakov, L.Yu. Use of Vortex Transport Equation for Prognostic Purposes 21

Knyazeva, V.I. The Problem of the Vertical Structure of Arctic Cyclones 25

Gavrilova, L.A. Structure of Winter Upper Level Anticyclones in the Arctic 31

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RYZHAKOV, L.Yu.

Characteristics of basic atmospheric circulation patterns over the Northern Hemisphere. Trudy AANII 240:52-67 '61.
(MIRA 15:3)

(Atmosphere)

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

S/169/61/000/009/025/056
D228/D304

AUTHOR: Ryzhakov, L. Yu.

TITLE: Peculiarities of the temperature conditions in the lower stratosphere and their connection with the tropospheric circulation

PERIODICAL: Referativnyy zhurnal. Geofizika, no. 9, 1961, 14, abstract 9B133 (V sb. Probl. Arktiki i Antarktiki, no. 5, L., Morsk. transport, 1960, 39-46)

TEXT: Results are given for analysis of the temperature course in the lower stratosphere over the central Arctic and the connection of this course with tropospheric processes. Two provisional temperature sections for the winters of 1954/55 and 1955/56 were constructed from the data of the drifting station "Severnyy polyus-4" (North Pole 4). In the first case it appeared that heating which occurred in the troposphere on the invasion of warm air-masses from the Atlantic brought about cooling in the stratosphere. In the other case, cooling the stratosphere through

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RYZHAKOV, N.I., inzh.

Rules for using hydrogen peroxide. Tekst. prom. 18 no.3:68-69 Mr '58. (MIRA 11:3)
(Hydrogen peroxide)

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

PATRIN, A.A.; YEREMCHENKO, M.I.; RYZHAKOV, P.V.; BAKHIR, Yu.V.; DEKAPOLITOV, I.P.

Concerning the article "Mounting of wire broadcasting networks and electric power transmission lines on common poles." Prom. energ. 17 no.8:32-34 Ag '62. (MIRA 16:4)

1. Belomorskaya elektroset' Karel'skoy ASSR (for Patrin). 2. Gossel'-elektronadzor, g. Groznyy (for Yeremchenko). 3. Glavnoye upravleniye elektrifikatsii sel'skogo khozyaystva, g. Groznyy (for Ryzhakov). 4. Tuymazaneft' (for Bakhir). 5. Darnitskiy setevoy rayon Yugo-Zapadnoy zheleznoy dorogi (for Dekapolitov).

(Electric lines—Overhead) (Electric lines—Poles and towers)

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RYZHAKOV, V. N.

AID P - 5597

Subject : USSR/Engineering

Card 1/1 Pub. 107-a - 9/12

Author : Ryzhakov, V. N., Eng.

Title : First welders and shipbuilders conference in China

Periodical : Svar. proizv., 11, 30, N 1956

Abstract : A brief report on the conference held in Peking, China last March (1956). Some 139 delegates of 45 plants and enterprises gathered to listen 24 reports on welding technology and related subjects, and another 900 persons visited the exhibition of welding craftsmanship during the converence.

Institution : None

Submitted : No date

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RYZHAKOV, Vasiliy Nikolayevich; NARSKIY, Sergey Aleksandrovich; VYDRIN, Lev Borisovich; NAZAROV, M.I., red.

[Using gases as acetylene substitutes in welding] Primenenie gazov-zamenitelei atsetilena v svarochnom proizvodstve. Leningrad, 1963. 21 p. (Leningradskii dom nauchno-tekhn. propagandy. Obmen peredovym opytom. Seriia: Svarka, rezka i paika metallov, no.4) (MIRA 18:3)

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

Ryzhakov, V.N.

AID P - 998

Subject : USSR/Engineering

Card 1/1 Pub. 11 - 12/13

Authors : Kolenda, B. G. and Ryzhakov, V. N.

Title : Technical conference on welding in shipbuilding

Periodical : Avtom. svar., #5, 55-99, S-O 1954

Abstract : General review of the 24 papers presented at the Conference on welding in the shipbuilding industry. The Conference was sponsored by the Central Scientific Research Institute and 220 representatives of 54 organizations participated. The theoretical and practical problems on automatic and semi-automatic methods of welding were discussed in reference to the structure of ships, boilers and machinery parts.

Institutions: Academy of Sciences, USSR; Main Administration of the Ministry of the Shipbuilding Industry; design bureaus of various shipbuilding works; and 3 engineering institutions: Moscow Higher Engineering College, Leningrad Polytechnic Institute and Leningrad Shipbuilding Institute.

Submitted : No date

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RYZHAKOV, V. N., inzh.; MALYKHIN, V. Ya., inzh.; CHERNAKOV, F. A., inzh.

Expanded use of welding in enterprises of the Leningrad Economic Region. Svar. proizv. no.10:44-45 O '62. (MIRA 15:10)

(Leningrad Economic Region—Welding)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RYZHAKOV, V.N., inzhener.

First conference of welders in shipbuilding held in the Chinese People's Republic. Svar. proizv. no.11:30 N '56. (MLRA 10:9)
(China--Shipbuilding)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RYZHAKOV, V.N.

KOLENDA, B.G.; RYZHAKOV, V.N.

Technical conference on welding in shipbuilding. Avtom.svar. 7 no.5:95-99 S-O '54. (MLRA 7:11)
(Shipbuilding--Welding)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3

FAYERMAN, Aron Iudovich; RYZHAKOV, V.N., inzh.; [illegible]ent; KONSON, A.S., kand. ekon. nauk, red.; LEYKINA, T.L., red. izd-va; SHCHETININA, L.V., tekhn. red.

[Selecting an economical variant of the welding process] Vybor ekonomichnogo varianta protsessa svarki. Moskva, Mashgiz, 1962. 127 p. (MIRA 15:6)

(Welding--Costs)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

ZAMYSHEVSKAYA, N.N.; RYZHAKOVA, L.A.

Methods of rapid determination of the degree of polymerization of alkali cellulose. Khim.volok no.4:69-71 '62. (MIRA 15:8)

1. Opytno-konstruktorskoye byuro avtomatiki, Barnaul'skiy filial.
(Cellulose) (Polymerization)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

SHIKHER, M.G.; RYZHAKOVA, T.S.

Simplified method for the control of bleaching solutions. Tekst. prom. 19 no.4:58-59 Ap '59. (MIRA 12:6)
(Bleaching agents)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

A

Spontaneous polarization of polycrystalline samples of barium titanate. A. V. Rzhanov (Acad. Sci. U.S.S.R., Moscow). *Zhur. Eksptl. Teoret. Fiz.* 19, 335-45(1949).—In the calcn. of the spontaneous polarization of seignettoelectrics from the observed total polarization P, the nonlinear dependence of the induced component of P on the elec. field strength E must be taken into account. Contrary to accepted assumptions, that nonlinearity occurs, in the neighborhood of the dielec. Curie point, even in relatively weak fields, as in that region the cubic term of the right-hand member of the empirical expression $E = \alpha_1 P + \beta P^3$ becomes comparable with the 1st term. Nonlinear dependence of P on E is found also above the Curie point where spontaneous polarization is absent, and, consequently, cannot but bear on the induced polarization. This effect is particularly pronounced in $BaTiO_3$ owing to the great width of the temp. range of fast increase of the dielec. const. ϵ with the temp. (50-60°, as compared with 5-7° in Rochelle salt, and 10-15° in KH_2PO_4). Oscillograms of the dielec. hysteresis loops in fields up to 25 kv./cm., at the temps. −183, 20, 113.2, 125.3, 134.8, 138.8°, obtained with polycryst. samples of $BaTiO_3$ with 2% Al_2O_3 (Curie point 123°), actually show nonlinear increase of P with E and relatively high P also in the nonseignettoelec. region, not farther than 20-30° from the Curie point. At still higher temps. above the Curie point, P is a linear function of E, and ϵ const. In the seignettoelec. region well below the Curie point, it can be concluded from the behavior of ϵ that the induced P varies linearly with E, and the nonlinearity of the total P is entirely detd. by reorientation of the domains. Peculiar aftereffects were observed, particularly at room temp., when the recording of hysteresis loops was repeated after the sample was allowed to rest for 10-15 min. Polarization in weak fields appears increased, and losses, residual polarization, and coercive force are more marked; the ends of the loops obtained at different E lie all on the loop corresponding to the highest E = 25 kv./cm. These effects disappear at the Curie point. At room temp., the samples lose their "memory" of the previous polarization only in a matter of days. A qual. interpretation of these aftereffects is given on the basis of considerations valid for single crystals, and leading, for the relation between the dielec. const. in the seignettoelec. region, ϵ_1 and above the Curie point, ϵ_2, with the nonlinear variation of the induced P and E taken into account, to $\epsilon_1 = \epsilon_2 [1 + A = A \sqrt{1 + (2/A)}]$, where $A = (9/16\pi)(\epsilon_2 E - 4\pi P)/P$. In a polycryst. sample, the orientation of the spontaneous moments of individual single crystals, produced by the 1st polarization cycle, disappears only partly when the field is removed, and there remains a residual anisotropy in the sense that the majority of the moments are oriented in the direction of the field. In sufficiently strong fields ensuring satn. of the orientation of the spontaneous moments, the polycryst. samples can be treated as quasi-monocryst., and the above method of calcn. of the spontaneous polarization is applicable. Numerical calcns. of ϵ_1 and the induced P' in the temp. range 137-60° (above the Curie point), and of the spontaneous P_s in the range 109.5-122.5° (below the Curie point), are given for a specific sample. P_s^2 is a linear function of the temp. in a fairly wide temp. range, 105-123°, below the Curie point. At room temp., P_s of the polycryst. samples is of the order of 5×10^{-6} coulomb/sq. cm., i.e. less than half of that of single crystals (Matthias and Von Hippel, *C.A.* **42**, 8038h).

N. Thon

Physics Inst.-im. P.N. Lebedev, AS USSR

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RZhFiz(5)

Piezoelectric effect of barium titanate. A. V. Rzhanov. (P. N. Lebedev Phys. Inst., Acad. Sci. U.S.S.R., Moscow). *Zhur. Eksptl. Teoret. Fiz.* 19, 502-6(1949).—Under static conditions, by electrometric measurements of the potential difference arising on compression, the piezoelec. modulus d_{31} and d_{33}, corresponding to stress applied, resp., in the direction of the polarization and perpendicularly to that direction, was 3.2×10^{-8} and 1.4×10^{-8} e.s.u., resp. In terms of the temp., d_{31} passes through a shallow min. at about 60°, then rises rapidly to a sharp peak at the Curie point, following exactly the temp. variation of the spontaneous polarization P_s. Dynamic detns., from the difference $\Delta f = f_a - f_r$ of the resonance and antiresonance frequencies of longitudinal vibrations of bars of d. ρ, length l, and dielec. const. ϵ, with f_a and f_r detd. by the frequency dependence of the current passing through the sample (peak at about 182 kilohertzes), $d_{33} = g \cdot \Delta f \cdot 64\ \rho l^2 f_r^2$ was found to vary between 2.5×10^{-8} and 1.3×10^{-8} e.s.u. The piezoelec. const. $g = d/\epsilon_0$, where ϵ_0 is the value of ϵ in the absence of stress, is from 1.3×10^{-7} to 1.0×10^{-7} e.s.u. Consequently, $BaTiO_3$ is usable with advantage in piezoelec. devices of the type of piezoelec. microphone and loudspeaker. In terms of the temp., f_r and d remain approx. const. up to about 110°, but the difference of the abs. currents in resonance and antiresonance decreases with rising temp. N. Thon

RZHANOV, A. V.
"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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PA 67/49T106

USSR/Physics - Piezoelectricity Aug 49
Barium Titanate

"Barium Titanate, a New Piezoelectric," A. V. Rzhanov, 29 pp

"Uspekh Fiz Nauk" Vol XXXVIII, No 4

Discusses dielectric permeability as a function of temperature and field strength; dielectric permeability as a function of frequency, dielectric hysteresis, and spontaneous polarization the specific heat anomaly; and the index of refraction and electroconductivity for polycrystallic and monocrystallic barium titanate

67/49T106

USSR/Physics - Piezoelectricity (Cont'd) Aug 49

specimens. The piezoeffect of barium titanate is covered in four divisions: the piezo effect o a monocrystal, the piezo effect of polarized polycrystallic specimens, static testing of piez elements, and piezoelectric oscillations of rods Discusses practical applications of the anomalou properties of barium titanate. V. P. Vologdin first used barium titanate as a nonlinear elemen in his construction of a frequency multiplier.

67/49T106

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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RZHANOV, A.V., redaktor; FRIDMAN, V.Ya., redaktor.

[Semiconductor electronic instruments; some problems in the physics and technology of germanium diodes and triodes (collection of translations). Poluprovodnikovye elektronnye pribory; nekotorye voprosy fiziki i tekhnologii germanievykh diodov i triodov, sbornik perevodov. Moskva, Izd-vo inostrannoi lit-ry, 1953. 260 p. (MLRA 7:4)

(Germanium) (Electronic apparatus and appliances)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3

RZHANOV, A. V.

USSR/ Physics - Technical physics

Card 1/1 Pub. 22 - 17/48

Authors : Rzhanov, A. V.

Title : Effect of contact recombination on the volt-ampere characteristics of a rectifier

Periodical : Dok. AN SSSR 98/3, 389-390, Sep 21, 1954

Abstract : The results obtained during the study of the contact recombination and its effect on the volt-ampere characteristics of a rectifier are listed. The results obtained pertain mainly to the case of concentration of non-basic charge carriers (gaps), much smaller than the equilibrium concentration of basic carriers (electrons), i. e., carriers suitable for reverse and small DC-currents passing through the rectifier. Formula expressing the volt-ampere characteristic for this particular case is included. Two references: 1-USSR and 1-USA (1952 and 1953).

Institution : Academy of Sciences USSR, The P. N. Lebedev Physics Institute

Presented by: Academician D. V. Skobel'tsin, April 27, 1954

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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RZHANOV, A.

FD-3218

USSR/Physics - Semiconductors

Card 1/1 Pub. 153-27/28

Authors : Paramonova R. and Rzhanov A.

Title : Relation of life span of excess charge carriers to concentration of equilibrium charge carriers

Periodical : Zhur. Tekh. Fiz., 25, No 7, 1342-1343, 1955

Abstract : The stability of recombination centers seems to be confirmed by an experimentally deduced linear behavior of life span vs the value of reverse concentration of equilibrium charge carriers. Such straight lines were obtained from the study of germanium single crystals. Data of these crystals are tabulated. Two US references.

Institution: --

Submitted : March 22, 1955

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RZHANOV, A.V., redaktor; MASHAROVA, V.G., redaktor; KORUZEV, N.N., tekhnicheskiy redaktor.

[Electrophysical characteristics of germanium and silicon] Electrofizicheskie svoistva germaniia i kremniia; sbornik perevodov. Moskva, Izd-vo "Sovetskoe radio," 1956. 391 p. (MLRA 9:12)
(Germanium) (Silicon)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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ZHANOV, [illegible]

2

The ratio of surface and volume recombination in germanium triodes with alloyed junctions. A. O. Pzhanov. Soviet Phys. Tech. Phys. 1, 235-6(1956)(English translation). See C.A. 50, 10519b. B. M. R.

84

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3

RZHANOV, A. O.

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The ratio of surface and volume recombination in germanium triodes with alloyed junctions. A. O. Rzhanov. *Zhur. Tekh. Fiz.* 26, 239-40(1956).—It is shown that the amplification coeff. at low currents (1-α) is a linear function of the base thickness *W*, indicating the predominance of surface recombination. S. Pakswer.

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RZHANOV, A.V.

Surface recombination and its effect on the characterisitcs of semiconductor devices. Radiotekh. i elektron 1 no.8:1086-1092 Ag '56. (MIRA 10:1)

1. Fizicheskiy institutut Akademii nauk SSSR imeni P.N. Lebedeva.
(Transistors)

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RZHANOV, A. V.

USSR/Physical Chemistry - Crystals, B-5

Abst Journal: Referat Zhur - Khimiya, No 1, 1957, 250

Author: Rzhanov, A. V.

Institution: None

Title: The Effect of Impurities on the Lifetime of Excess Carriers in Germanium

Original Periodical: Zh. tekhn. fiziki, 1956, Vol 26, No 7, 1389-1393

Abstract: In single crystals of n-Ge containing impurities Sb and Bi and single crystals of p-Ge with In impurities, the lifetime of the carriers is inversely proportional to the concentration of the impurities. It has been found that in single crystals of p- and n-type Ge, the recombination zones are largely located in 2 different portions of the barrier region: in the lower half, for n-Ge and in the upper half, for p-Ge. On the basis of the values for the energy of activation of the residual impurities in n- and p-type Ge, the conclusion is made that super-pure Ge contains Ni and Au.

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USSR /Physical Chemistry. Crystals.

Abs Jour : Ref Zhur - Khimiya, No 8, 1957, 25947

Author : A.V. Rzhanov, I.G. Neizvestnyy, V.V. Roslyakov.

Title : Study of Surface Conductivity and Surface Recombination of Germanium Specimens.

Orig Pub : Zh. Tekhn. fiziki, 1956, 26, No 10, 2142 - 2153

Abstract : A correlation was established between the changes in the s surface conductivity and the speed of the surface recombination on Ge specimens in changing gaseous medium (dry, humid and ozonized O_2). It was shown that this correlation is caused by the change of the surface potential, the magnitudes of which were evaluated depending on the spefific conductivity and its type. The results agree with the existing suffface model.

Card : 1/1

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RZHANOV, A.V.

137-58-3-5783

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 3, p 186 (USSR)

AUTHOR: Rzhanov, A. V.

TITLE: The Effect of Impurities on the Life of the Excess Charge Carriers in Germanium (Vliyaniye primesey na vremya zhizni izbytochnykh nositeley zaryadov v germanii)

PERIODICAL: V sb.: Vopr. metallurgii i fiz. poluprovodnikov. Moscow, AN SSSR, 1957, pp 133-137

ABSTRACT: Bibliographic entry. See RzhMet, 1957, Nr 6, abstract 10715

Card 1/1

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

R2

AUTHORS: Rzhanov, A. V., Novototskiy-Vlasov, Yu. F., Neizvestnyy, I. G., 57-11-3/33

TITLE: Study of the Field Effect and Surface Recombination in Germanium Samples (Issledovaniye effekta polya i poverkhnostnoy rekombinatsii v obraztsakh germaniya)

PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol. 27, Nr 11, pp. 2440-2450 (USSR)

ABSTRACT: The purpose of the present paper was the check of the assumption of the invariability of the surface-recombination-centres in the course of a gas cycle as well as the maintainance of the dependence of the surface recombination velocity on the electrostatic surface potential by way of experiment. A parallel investigation of the surface recombination and of the variation of the conductivity in the case of an action of the electric transversal field (field effect) in different gas atmospheres facilitated the detection that under the influence of ozone new "rapid" surface states a part of which is connected with the recombination develop on the germanium surface. Assuming that in consequence of the influence of the ozone two energetic position states are introduced their density and the variations of the density according to the time after the ozone influence were computed and the effective electron capture cross sections of the deeper lying re-

Card 1/2

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RZHANOV, A.V., kandidat fiziko-matematicheskikh nauk.

Creators of the "transistor". Priroda 46 no.3:49-50 Mr '57.
(MLRA 10:3)

1. Fizicheskiy institut im. P.I. Lebedeva Akademii nauk SSSR (Moskva).
(Transistors)

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

AUTHOR: Rzhanov, A. V., Candidate of Physical and Mathematical Sciences 30-2-21/49

TITLE: Summer Course of the International School of Physics in Italy (Kursy international'noy fizicheskoy shkoly v Italii)

PERIODICAL: Vestnik AN SSSR, 1958, Nr 2, pp 87-88 (USSR)

ABSTRACT: Several years age an International School of Physics was founded by the Italian Physics Society, which every year holds a summer course. Every course is devoted to a problem of modern physics, which, as a rule, is selected from the number of problems being in most rapid development. The summer courses take place at Varenna, a health resort near the Italian-Swiss border. They are arranged for the vacation time of universities and of scientific research centers. This circumstance, as well as the high prestige of the school, facilitates the invitation of well known specialists from different countries. The author of this paper also participated as a student during the period from July 14 to August 3, in the 5th summer course. This course

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Summer Course of the International School of Physics in Italy 30-2-21/49

was devoted to the physics of solids. The program consisted of three parts: The quantum theory, the structural defects of solids, and the properties of semiconductors. 26 scientists from various countries held lectures and seminars. Among others, the following scientists gave lectures: Professors G. Bruks (USA) and N. Mott (England), D. Bardin and collaborators (USA), the profe.sor F. Zeytz (USA) and F. Franck (England), professor G. Fen (USA), professor C. Busch (Switzerland), Doctor P. Egren (France), O. Madelung (German Federal Republic). Concluding, the author states, that the close contact of all participants in a small town promotes an inofficial scientific intercourse, which was of at least the same profit as the courses themselves. It was possible to establish much closer scientific contacts than it is possible during conferences and congresses of short duration.

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1. Physics-Study and teaching-Italy

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24(6) SOV/57-58-12-1/15

AUTHORS: Rzhanov, A. V., Pavlov, N. M., Selezneva, M. A.

TITLE: Investigation of the Energy Levels and of the Effective Capture Cross Sections of the Surface Recombination Levels in Germanium (Issledovaniye energeticheskikh polozheniy i effektivnykh secheniy zakhvata poverkhnostnykh rekombinatsionnykh urovney v germanii)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, Nr 12, pp 2645-2656 (USSR)

ABSTRACT: An investigation of the surface recombination levels occurring as a consequence of heating the germanium samples in vacuum or because of the action of ozone upon these samples was carried out. Preliminary data on the temperature dependence of the energy levels and of the effective capture cross sections when a hole and an electron are captured by these levels and the dependence of these characteristics on the cross-field amplitude were obtained. The supposition is expressed that the charges captured at the "slow" levels at the surface have a considerable influence upon the characteristics of the surface recombination levels. From this supposition is deduced that the nature of the recombination levels occurring because of

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heating in vacuum is the same as the nature of the levels caused by the action of ozone. A considerable parallelism between concentration and charge of "slow" surface levels and the concentration of the recombination levels was found. There are 9 figures, 2 tables, and 10 references, 3 of which are Soviet.

ASSOCIATION: Fizicheskiy institut imeni P. N. Lebedeva AN SSSR Moskva (Physics Institute imeni P. N. Lebedev, AS USSR, Moscow)

SUBMITTED: December 28, 1957

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

AUTHORS: Rzhanov, A. V., Arkhipova, I. A., Bidulya, V. N. 57-28-5-23/36

TITLE: On the Applicability of the Method of Velocity Measurement of Surface Recombination by Means of the Change of Semiconductor Resistance in a Magnetic Field (O primenimosti metoda izmereniya skorosti poverkhnostnoy rekombinatsii po izmeneniyu soprotivleniya poluprovodnika v magnitnom pole)

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1958, Vol. 28, Nr 5, pp. 1051-1052 (USSR)

ABSTRACT: In the paper by Zhuze, Pikus and Sorokin (Ref 1) a new method of measuring the surface recombination velocity s by means of the modification of the resistance of a thin semiconductor sample in a magnetic field was proposed. The author of this letter to the editor employed the described method in the investigation of the modification s according to the change of the electric surface potential. The measurements were conducted with two devices. One served for the measurement of the constant component F_c, one of the sample surface being subjected to the action of a constant transverse field or of various gas media. On the other device the voltage of the doubled frequency $E_{2\omega}$ was mea-

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sured, one of the surface media being subjected to the action of a sinusoidal transverse field with low frequency. The obtained results show, that the method of measuring the surface recombination velocity by means of the modification of the conductivity of the samples in a magnetic field yields correct values of Δ_s at a modification of the concentration of the recombination centers which was also proved by grinding experiments. If s changes because of the modification of the electrostatic surface potential, this method, however, gives too low values. This can be seen from a direct comparison of this method with the bridge method of measuring the effective life. The authors thank Yu.F. Novototskiy-Vlasov for his help. There are 1 figure and 5 references, 4 of which are Soviet.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva AN SSSR, Moskva (Moscow, Physics Institute imeni P.N. Lebedev, AS USSR)

SUBMITTED: December 28, 1957

 1. Semiconductors--Surface properties

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3

PHASE I BOOK EXPLOITATION SOV/3818

Postoyannyy mezhinstitutskiy kollokvium po tverdym fazam peremennogo sostava

Kachestvo materialov dlya poluprovodnikovoy tekhniki (Quality of Materials for Semiconductor Technology) Moscow, Metallurgizdat, 1959. 192 p. (Series: Its: Trudy, 1957-1958, vyp. 8-30) 3,600 copies printed.

Sponsoring Agencies: USSR. Sovet Ministrov. Gosudarstvennyy komitet po khimii; Akademiya nauk SSSR. Fiziko-khimicheskiy institut imeni L.Ya. Karpova.

Ed. (Title Page): B.F. Ormont, Professor; Ed. (Inside Book): Ya.V. Yakovlev; Ed. of Publishing House: L.M. El'kind; Tech. Ed.: P.G. Islent'yeva; Editorial Board of Series: I.P. Alimarin, Corresponding Member, Academy of Sciences USSR, Geochemistry Institute, M.V. Grigor'yev, Scientific Research Institute, Committee on Radioelectronics, R.P. Lastovskiy, Professor, Institute of Chemical Reagents, Chemistry Committee, B.F. Ormont, Professor, Academy of Sciences USSR, Institute of Physics and Chemistry imeni L.Ya. Karpov, B.L. Poroshenko, State Rare Metals Scientific Research Institute, N.P. Sazhin, Corresponding Member, Academy of Sciences USSR, State Rare Metals Scientific Research Institute, G.Ya. Tarasov, Scientific Research Institute, Committee on Radioelectronics, Ya.V. Yakovlev, (Resp. Secretary of the Board) Institute of Geochemistry, Academy of Sciences USSR.

PURPOSE: This book is intended for technical personnel engaged in the manufacture and utilization of semiconductors.

COVERAGE: This book treats methods of obtaining quality semiconductor materials and presents current standardized specifications for semiconductors and auxiliary materials. The book is divided into three parts. Part I consists of 16 reports delivered at two conferences in January 1957 and December 1958 at the Fiziko-khimicheskiy institut imeni L.Ya. Karpova (Institute of Physics and Chemistry imeni L.Ya. Karpov) by members of 36 participating institutes and industrial plants. The reports deal with the standardization of characteristics of pure semiconductor materials and describe spectral and spectrochemical analysis, and chemical, vacuum-fusion, polarographic, and radioactivation methods for studying semiconductor materials and determining impurities in them, along with the equipment used.

PART I. REPORTS ON METHODS FOR THE DETERMINATION OF ULTRAMICROIMPURITIES IN SEMICONDUCTOR MATERIALS PRESENTED AT THE CONFERENCES ON THE QUALITY OF SEMICONDUCTOR MATERIALS

Shafran, I.S. [UNIA MEAP SSSR (All-Union Scientific Research Institute of Chemical Reagents)]. Chemical Methods for the Determination of Microimpurities in a Number of Substances of High Purity 13

Turovtseva, Z.M. [GEOKhI AN SSSR]. Apparatus and Methods for the Determination of Gases in Metals by the Vacuum-Fusion Method 25

Kazin, L.L. [TsNIIChEMET . (Central Scientific Research Institute of Ferrous Metals)]. Experiment on the Determination of Gases in Metals by the Vacuum-Fusion Method and the Possible Use of This Method for the Analysis of Semiconductor Materials 30

Gokhshteyn, Ya.P., and A.M. Demkin [GEOKhI AN SSSR]. Polarographic Quantitative Determination of Copper, Bismuth, Lead and Titanium Impurities in Metalliferous Silicon 41

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"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RZHANOV, A.V.

Correlation between the relationship of capture cross sections and the energy levels of the surface recombination centers in germanium. Fiz. tver. tela 1 no.3:522-524 Mr '59.
(MIRA 12:5)

(Germanium) (Electrons)

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

24.7700
~~24(6), 24(3)~~

67403
SOV/181-1-9-27/31

AUTHORS: Rzhanov, A. V., Novototskiy-Vlasov, Yu. F., Neizvestnyy, I.G.

TITLE: On the Problem Concerning the Nature of the Surface Recombination Centers on Germanium

PERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 9, pp 1471 - 1474 (USSR)

ABSTRACT: The authors had already found out in 1955 that preheating of germanium samples leads to a considerable increase in the surface recombination rate of the surplus charge carriers at about 100°C. The occurrence of new recombination- and capture centers is explained by an adsorption of oxygen- and hydrogen molecules on the germanium surface. To investigate the nature of these centers, one must know their activation energy and the concentration limit; one obtains both from an investigation of the dependence of the center concentration on the preheating temperature. For this purpose the authors conducted simultaneous measurements of the stationary photoconductivity and of the field effect on the large signal. The samples were irradiated with square light pulses; an oscillogram taken in this connection is shown in

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On the Problem Concerning the Nature of the Surface Recombination Centers on Germanium

conductivity on the transversal electric field in the dark, the interval between the two curves illustrates the value of the steady photoconductivity. Measurements were made on p-type germanium samples with a resistivity of 20-25 ohm.cm. The maximum preheating temperature was 475°K. Measurements were made in vacuum (10^{-6} torr) at 300°K. Figure 2 shows on a semi-logarithmic scale the dependence of the maximum surface recombination rate on the reciprocal sample temperature. The activation energy of the centers, evaluated from the inclination of the linear curve portion yielded ~ 0.2 ev, their maximum concentration in the saturation region $\sim 10^{12}/cm^2$. When assuming that a concentration increase of the recombination centers is due to desorption of water molecules, the adsorption heat can be calculated as being 4.5 kcal/mole. In the samples under investigation the ratio of the capture cross sections for holes and electrons was ranging from 2 to 100, the recombination levels ranged between 3 - 6 kT. The results obtained are utilized by the authors in order to discuss their surface model of germanium and in order to

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On the Problem Concerning the Nature of the Surface Recombination Centers on Germanium

mechanism. The authors thank S. V. Pokrovskaya and T.I.Galkina for their assistance. There are 2 figures and 4 Soviet references.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva (Institute of Physics imeni P. N. Lebedev of the AS USSR, Moscow)

SUBMITTED: April 6, 1959

4

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S/181/60/002/010/012/051
B019/B070

9.4340 (1143, 1160, 1331)

AUTHOR: Rzhanov, A. V.

TITLE: Applicability of the Method of Steady Photoconductivity for Studying the Dependence of the Surface Recombination Rate on the Surface Potential

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 10, pp. 2431-2438

TEXT: An experimental method for studying the surface states of a semiconductor is described. It has been tested for two years in the laboratory. The method is based on the simultaneous measurement of the steady photoconductivity and the field effect for large signals. The samples were irradiated with square light impulses following one another at a frequency of 140 cps. The transverse electric field varied between 20 and 100 cps. The conductivity of the sample was observed by an oscillograph (Fig. 1). The theory of the method is given in detail. The method permits a study of the dependence of the surface recombination rate on the surface potential, a particular advantage of the method being the short time interval (1/10 of a second) required for this study. This is important because of the

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

Applicability of the Method of Steady Photoconductivity for Studying the Dependence of the Surface Recombination Rate on the Surface Potential

S/181/60/002/010/012/051
B019/B070

experimentally found variability of the spectrum of the surface recombination centers on a change of the external medium. The error due to the change of injection levels and carrier trapping on surface levels was estimated to be small. It is found that the method is applicable for any injection level. It has been checked in a number of studies of germanium samples. Yu. F. Novototskiy-Vlasov and I. G. Neizvestnyy participated in the development of the method. There are 3 figures and 12 references: 5 Soviet, 6 US, and 1 British.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva (Institute of Physics imeni P. N. Lebedev of the AS USSR, Moscow)

SUBMITTED: March 31, 1960

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

S/030/60/000/012/008/018
B004/B056

AUTHOR: Rzhanov, A. V., Candidate of Physical and Mathematical Sciences

TITLE: Conference on the Physics of Semiconductors

PERIODICAL: Vestnik Akademii nauk SSSR, 1960, No. 12, pp 46 - 48

TEXT: The present paper is a report of the Conference on the Physics of Semiconductors held at Prague from August 29 to September 2. It was organized by the International Union of Pure and Applied Physics with the support of the Czechoslovakian Government and the UNESCO. Besides a plenary session, the Conference worked in 16 sections and 5 discussion groups. Mention is made of the section of the band structure of semiconductors, the section of recombination effects, the section of semiconductors of complex structure. The following topics are mentioned as having been dealt with: Calculation of the energy spectrum of crystals by means of a computer; the problem of "hot" electrons accelerated by means of strong fields; tunnel effects; the optical properties of semiconductors and excitons; surface phenomena, studied by E. Antončik,

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K. Koutecky, and M. Tomaŝek (Czechoslovakia) et al.; the study of the state of impurities by means of the resonance method, properties of ion crystals. Among Soviet scientists, A. F. Ioffe is mentioned, whose lecture was published in the same number of this periodical.

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RZHANOV, A. V., Dr. Phys-Math Sci. (diss) "Investigations of Some Electronic Processes on the Surface of Germanium," Kiev, 1961. 19 pp. (Combined Scientific Council of Institutes of Mathematics, Physics, Semi-conductors and Metallic Physics, Acad of Sci, UkSSR), 170 copies (KL Supp, 12-61, 248).

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...ber 26, 2002 CIA-RDP86-00513R001446520006-3"

S/194/62/000/002/047/096
D201/D301

9,4340

AUTHORS: Zvyagin, V. I., Lobanov, Ye. M. and Rzhanov, A. V.

TITLE: Differential resistance of germanium diodes

PERIODICAL: Referativnyy zhurnal, Avtomatika i radioelektronika, no. 2, 1962, abstract 2-4-12zh (V sb. Nekotoryye vopr. prikl. fiz. Tashkent, AN UzSSR, 1961, 58-63)

TEXT: A study of the differential resistance R_d of germanium diodes. The diodes were prepared by the method of fusing indium into an electron conducting germanium. The resistivity of germanium was varied from 3.5 to 35 ohm/cm. R_d was evaluated from the measurements by a valve millivoltmeter with small a.c. voltage ($V < \frac{kT}{e}$) superimposed on the reverse d.c. bias and from the voltage drop across a calibrated resistor connected in series with the diode. The results investigations, at a frequency of 70 c/s, were obtained by statiprocessing of a large quantity of experimental material. Ty-

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Differential resistance of ...

pical graphs of the dependence of R_d on $\sqrt{V}$ at different temperatures are given, together with $\log_e R_d$ on the reciprocal of temperature $(\frac{1000}{T^oK})$ for various voltages and a table of values of activation energy calculated from graphs of semiconductor diodes made of material with different specific resistances. Graphs of dependence of $\log_e \tau_p$ (τ_p - lifetime of holes) on reciprocal of temperature are also given for typical diodes and diodes made of germanium with a lower specific resistivity. The graphs show the values of activation energy ΔE's at low temperatures and those for temperatures higher than 40^oC ($\Delta E''$). It is shown that the whole set of experimental data may be successfully described by the formula of K. V. Tolpygo and E. I. Rashba (see ZhT Fiz. 1956, XXVI, 7), if one assumes in it $\tau_p = \tau_o e^{\frac{\Delta E}{kT}}$, provided $\Delta E = -\Delta E'$ at low and $\Delta E = \Delta E'$ at high temperatures. It follows from this formula that R_d increases with de-

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creasing specific resistivity. As an example R_d is given in the form of graphs for diodes with different specific resistivities at V = 30 V. 1 reference. [Abstracter's note: Complete translation.]

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RZHANOV, A.V.; NOVOTOTSKIY-VLASOV, Yu.F.; NEIZVESTNYY, I.G.; POKROVSKAYA, S.V.; GALKINA, T.I.

Nature of surface recombination centers in germanium. Fiz. tver. tela 3 no. 3:822-831 Mr '61. (MIRA 14:5)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR, Moskva.
(Crystal lattices) (Germanium)

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

RZHANOV, A.V.; PAVLOV, N.M.; SELEZNEVA, M.A.

Effect of temperature on the parameters of surface recombination centers in germanium. Fiz. tver. tela 3 no. 3:832-840 Mr '61.
(MIRA 14:5)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR, Moskva.
(Crystal lattices) (Germanium)

APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3

S/181/61/003/005/029/042
B108/B209

9,4177

AUTHORS: Rzhanov, A. V. and Plotnikov, A. F.

TITLE: The surface levels in germanium according to data on the photoconductivity in the infrared range of the spectrum

PERIODICAL: Fizika tverdogo tela, v. 3, no. 5, 1961, 1557-1560

TEXT: The authors measured the photoconductivity of Ge samples which were illuminated with intermittent light from an ИКС-12 (IKS-12) spectrometer. The amplified circuit equipped with phase detector had a sensitivity of the order of 0.1 μv. The 20 · 5 · 0.4 mm^3 large p-type samples had a resistivity of 25-30 ohm.cm; measurements were performed in a cryostat with an NaCl window at a temperature of the samples of about 80°K. The vacuum was of the order of 10^{-4} mm Hg. The results of measurements taken in a range between the edge of the principal absorption band and 3.4μ are shown in the accompanying figure. The results agree with those of other studies insofar as the concentration of the surface levels and, accordingly, the photoconductivity increases with the temperature of preheating up to 500°K, but

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The surface levels in germanium ...

decreases (at energies of the light quanta less than 0.5 ev) when previously heated to 600°K. The effect of preheating and of elemental oxygen leads to an increase in the concentration of surface levels of one and the same type. The results obtained prove the existence of discrete surface levels near the middle of the forbidden band. The rise of photoconductivity at quantum energies of 0.38-0.4 ev corresponds to an electron transition from a surface level about 0.04 ev below the middle of the forbidden band to the conduction band. The subsequent decrease in photoconductivity may be explained by an electron transition from the valence band to a surface level about 0.06 ev above the forbidden band. The holes arising therefrom undergo quick recombination with the electrons in the conduction band. Thus, a negative photoconductivity must correspond to this process if it takes place. In order that both phenomena appear together, the Fermi level has to be 0.02-0.04 ev above the middle of the forbidden band. The decrease in photoconductivity may also be related to a decrease in the absorption coefficient. Finally, the monotonic rise in photoconductivity at energies above 0.42 ev is evidently due to a system of continuous surface levels. Preheating at 600°K changes not only the concentration but also the character of energy distribution of these levels. The authors thank

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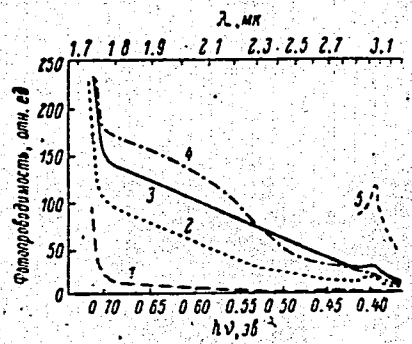
The surface levels in germanium ...

V. S. Vavilov for his assistance. There are 1 figure and 14 references: 9 Soviet-bloc and 5 non-Soviet-bloc.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva
(Physics Institute imeni P. N. Lebedev AS USSR, Moscow)

SUBMITTED: November 28, 1960

Fig.: Photoconductivity (ordinate axis; arbitrary units) versus energy of the exciting light quanta (abscissas: hν in ev and λ in μ).



Legend: 1 - before heating, 2 - after heating to 400°K, 3 - 500°K, 4 - 600°K, 5 - after the action of a high-voltage discharge at low pressure.

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S/181/61/003/006/009/031
B102/B201

24912

9,4300

AUTHOR: Rzhanov, A. V.

TITLE: Changes of the surface charge on germanium during heating of specimens in vacuum

PERIODICAL: Fizika tverdogo tela, v. 3, no. 6, 1961, 1718-1722

TEXT: Experimental results obtained from studies of the surface-charge properties of germanium are discussed along with effects exerted on them by heating, adsorption and descrption, and others. Moreover, it is shown that changes, found experimentally, of the total surface charge during heating of germanium in vacuum are considerably smaller than those one might expect in view of the change of concentration of the fast surface states. A model of surface centers that takes account of this fact is suggested. It had been already shown in previous papers (Rzhanov et al. FTT I, vyp.9,1471,1959; FTT III, vyp.3,1961) that heating in vacuum leads to a considerable concentration increase of the so-called fast surface states. To explain this, the water molecules in the oxide layer were assumed to neutralize the surface defects acting as recombination or

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trapping centers. During heating there occurred a desorption of water and a reactivation of the centers; thus, the concentration of the fast surface states increased, and the surface charge changed. On the other hand, as has been repeatedly shown, the water molecules adsorbed on Ge themselves are the cause of a positive surface charge (slow surface states). The total surface charge, composed of fast and slow surface states, determines the electrostatic surface potential of the specimens, from the modification of which during heating in vacuum one may draw conclusions as to the charge and the surface states. A study of the field effect showed that in a good vacuum the accumulation of surface charge under the action of a sinusoidal transverse field is negligibly small. Numerous Ge specimens were examined and it was established in all cases that the changes of the surface charge were not so great as might have been expected in view of the charge change of the fast surface states (caused by their rise of concentration). Results of measurement are collected in the table for some specimens. The absolute value of the charge of fast states is, of course, dependent on whether these states constitute donors or acceptors. The levels N_{t_1} and N_{t_2}, and N_{t_3} and N_{t_4}

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form two pairs; each pair corresponds to another charge state of one and the same center, and, depending on the position of these levels, these centers constitute acceptors or donors. The model of surface recombination centers is based on these and other experimental results. It is assumed in this connection that at the interface between germanium and oxide layer there are structural defects, whose concentration is considerably lower than that of the surface atoms. To these defects correspond donor levels situated well above the forbidden band; the electron trapping cross section upon these levels is taken to be small, and oxygen is considered to be adsorbed by the defects lightly (and loosely). Such defects are positively charged with all values of the surface potential and correspond to slow surface states. Oxygen adsorption on such defects is further assumed to have a considerable effect upon their properties. The carrier trapping cross section is rendered considerably smaller thereby due to water adsorption, while the donor level lies well above the forbidden band. This explains the compensating action of water (destruction of recombination states in Ge). The model (described here in great detail) appears as the likeliest but not the only way of explaining the experimental results (cf. M.Lax.Phys.Rev,119,5,

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1502, 1960). There are 1 table and 12 references: 7 Soviet-bloc and 5 non-Soviet-bloc. The two references to the English-language publications read as follows: A. Many, J. Phys. Chem. Sol. 8, 87, 1959; W. Shockley, J.T. Last. Phys. Rev. 107, 2, 392, 1957.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva AN SSSR Moskva
(Institute of Physics imeni P. N. Lebedev AS USSR, Moscow)

SUBMITTED: December 26, 1960

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25682
S/181/61/003/007/004/023
B102/B202

24.7700

AUTHORS: Rzhanov, A. V. and Arkhipova, I. A.

TITLE: Surface recombination in germanium with raised injection levels

PERIODICAL: Fizika tverdogo tela, v. 3, no. 7, 1961, 1954 - 1959

TEXT: The authors report on measurements of the surface recombination rate as a function of the surface potential for different injection levels. They also give a comparison with the theory. This problem is of interest since today a large number of semiconductor devices operate at increased injection levels (where the concentration of the non-equilibrium carriers equals or exceeds that of the equilibrium carriers) and because it has hitherto not been studied experimentally. In the laboratory of the authors a method was devised for the combined study of steady photoconductivity and field effect, which can be employed for different injection levels. It is based on the following principle: A rectangular germanium plate is covered by 2 mica foils and fixed between two glass plates to the inner surfaces of which the transparent tin oxide electrodes

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Surface recombination ...

are fitted. A sinusoidal transverse voltage is applied to this two-sided capacitor which simultaneously is exposed through the electrodes to square light pulses of equal intensity but different repetition frequency. Under these conditions, three curves can simultaneously be observed on the oscilloscope screen: The curve of the conductivity variation in the dark, and the conductivity curves for one- and two-sided exposure (with double total intensity). The surface dark potential can be determined from the former, the steady photoconductivity is determined from the ordinate difference between first and second curve. From this difference, the effective lifetime and surface recombination rate are determined if the calibration coefficient (which is determined from the second and third curves) is known. The theoretical considerations are based on the formula for the surface recombination rate

$$S=\frac{N_t(\sigma_p\sigma_n)^{1/2}\frac{1}{2}(\lambda+\lambda^{-1})\left[1+\delta\left(\frac{1}{\lambda+\lambda^{-1}}\right)\right]}{\mathrm{ch}\left(Y_s-\ln\lambda-\frac{q\zeta_0}{kT}\right)+\mathrm{ch}\left(\frac{\varepsilon_t-q\zeta_0}{kT}\right)+\delta\,\mathrm{ch}\left(Y_s-\frac{q\zeta_0}{kT}\right)}. \qquad (1)$$

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Surface recombination ...

where Y_s is the surface potential in a recombination via centers of concentration N_t with energy levels $\varepsilon_t = E_t - E_i$, α_p and α_n are the hole and electron trapping constants, n_o and p_o are the balanced volume concentrations of electrons and holes, $\delta = \frac{\Delta n}{n_i} = \frac{\Delta p}{n_i}$ is the injection level and $\lambda = p_o/n_i = n_i/n_o$; $q\zeta_o/kT = \frac{1}{2} \ln \frac{\alpha_p}{\alpha_n}$. With increasing δ, the position of the maximum of the curve $S = f(Y_s)$ is shifted from $Y_s' = \frac{q\zeta_o}{kT} + \ln \lambda$ (for small δ) to $Y_s'' = q\zeta_o/kT$ for large δ. If (1) is written in the form

$$S = S_0 \frac{1 + \delta\left(\frac{1}{\lambda + \lambda^{-1}}\right)}{1 + \delta \frac{\operatorname{ch}\left(Y_s - \frac{q\zeta_0}{kT}\right)}{\operatorname{ch}\left(Y_s - \ln\lambda - \frac{q\zeta_0}{kT}\right) + \operatorname{ch}\left(\frac{\varepsilon_t - q\zeta_0}{kT}\right)}}. \qquad (4)$$

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Surface recombination ....

where S_o is the surface recombination rate for small δ, the variation of the maximum surface recombination rate with the injection level becomes manifest. (4) shows that also at relatively small δ, the maximum surface recombination rate decreases with the injection level if $\frac{1}{2}(\lambda+\lambda^{-1})^2 > 1 + ch(\frac{\epsilon_t - q\zeta_o}{kT})$, and increases with the inverse inequality sign. With large δ S_{max} decreases with increasing δ, if $\frac{1}{2}(\lambda+\lambda^{-1}) > ch(\frac{\epsilon_t - q\zeta_o}{kT})$ and with a further increase of δ, S approaches the value $S_{\delta\to\infty} = N_t \frac{\alpha_p \alpha_n}{\alpha_p + \alpha_n}$.

In the following, these results are applied to practical cases. A comparison of the theoretical results with the experimental ones for the two extreme values $\delta = 0.1$ and $\delta = 4.3$ showed good agreement. The authors thank A. L. Vol'sk, Member of Warsaw University, for assistance and advice.
There are 2 figures and 8 references: 6 Soviet-bloc and 2 non-Soviet-bloc. The references to the English-language publications read as follows:
R. H. Kingston. Semiconductor Surface Physics, p. 85, 1957; G. Dousmanis. J. Appl. Phys. 30, 2, 180, 1959.

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

25682
S/181/61/003/007/004/023
B102/B202

Surface recombination ....

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva
(Institute of Physics imeni P. N. Lebedev AS USSR, Moscow)

SUBMITTED: January 14, 1961

Card 5/5

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S/1[illegible]/61/003/011/010/056
B102/B138

AUTHORS: Rzhanov, A. V., and Neizvestnyy, I. G.

TITLE: The influence of molecule adsorption on germanium upon the parameters of the surface recombination centers

PERIODICAL: Fizika tverdogo tela, v. 3, no. 11, 1961, 3317-3323

TEXT: The authors have already published several papers on adsorption effects. They have shown that the density of recombination centers depends in a compensative and reversible manner on the polarity of the adsorbed molecules. The fact that the surface recombination centers are neutralized by adsorbed molecules could be explained on the assumption of chemical or electrostatic processes taking place between adsorbent and recombination center. In order to find out which possibility really holds, the authors used a field effect method to study how the recombination parameters change when adsorbed water molecules are substituted by ether or benzene. The surface recombination rate, and the charge trapped by fast surface states were recorded as functions of the surface potential. For this purpose the germanium samples were placed in a mica holder with transparent electrodes

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providing a transverse field independent of the liquid investigated. The whole arrangement was placed in a special thermostatic vessel. The surface recombination rates as functions of the surface potential Y with and without heat treatment of the specimens are shown in Figs. 1,2. The trapped negative charge was found to increase with increasing Y in a weakly non-linear manner; after heat treatment (500°C) the increase was more rapidly. The maximum surface recombination rated were found to be between 820 cm/sec (3.4 kT/q, c. f. Fig. 1) and 1650 cm/sec (3.0 kT/q) in benzene and between 460 cm/sec (5.5 kT/q) and 2100 cm/sec (6.2 kT/q) in ether. From the experiments made with benzene it was found that in the nonpolar benzene the surface recombination centers are activated in the same manner as in vacuo and that the characteristics of the recombination centers are in no way affected by benzene. In ether, which is weakly polar, the surface recombination centers are activated in the same manner as in benzene or in vacuo. Adsorption of ether leads only to a shift of the maxima of $S(Y_s)$ (Fig. 1) from +3kT/q (where they are for benzene or vacuum) to + 6kT/q. The results indicate that the adsorption of ether on germanium is a physical process. The interaction between ether and

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germanium is purely electrostatic. There are 4 figures, 1 table, and 6 references: 5 Soviet and 1 non-Soviet. The latter reads as follows: M. Lax. Phys. Rev. 119, no. 5, 1502, 1960.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva (Physics Institute imeni P. N. Lebedev AS USSR, Moscow)

SUBMITTED: May 22, 1961

Fig. 1. Surface recombination rate as a function of the surface potential before heating (1) and after heating at 350°K (2), 400°K (3), 450°K (4) and 500°K (5) in ether.

Fig. 2. The same for benzene.

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32085
S/181/61/003/012/020/028
B108/B138

24,7000 (1144, 1385, 1559)

AUTHOR: Rzhanov, A. V.

TITLE: Statistics of recombination in the capture of carriers onto excited levels of a recombination center

PERIODICAL: Fizika tverdogo tela, v. 3, no. 12, 1961, 3691-3697

TEXT: The statistics of carrier capture and recombination in a non-degenerate semiconductor is studied for the case of a single-charge recombination center with one ground state and one excited level each for electron and hole capture. It is assumed that the carriers are captured from the bands onto excited levels of the recombination center. The electron and hole fluxes into the excited levels of the recombination centers are

$U_n = C_n r_n (N_t^* n - n_t n_o N_{to}^*/n_{to})/(C_n n_o N_{to}^*/n_{to} + r_n)$ and

$U_p = C_p r_p (n_t p - N_t^* p_o n_{to}/N_{to}^*)/(C_p p_o n_{to}/N_{to}^{**} + r_p)$, respectively.

n_t = concentration of recombination centers with an electron in the ground

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Statistics of recombination in the ...

state (capture of holes on the excited level), n_t^* = concentration of recombination centers with an electron on the excited level (capture of electron, N_t^* = conc. of rec. c. without electron in their ground states (electron capture on the excited level), N_t^{**} = conc. of rec. c. with a hole on their excited levels for hole capture. $n_t+n_t^*+N_t^*+N_t^{**} = N_{total}$. The subscript o indicates equilibrium concentration. The r's are the transition probabilities. A general expression for the recombination rate is derived from the above formulas for the case concentration of recombination centres is low and the excess hole and electron concentrations are equal.

$$U=\frac{N_t C_p C_n (np-n_0p_0)}{C_p\left[1+\frac{C_n}{r_n}n_1^*\right](p+p_1)+C_n\left[1+\frac{C_p}{r_p}p_1^{**}\right](n+n_1)+\delta p\left[\frac{C_n}{r_n}p+\frac{C_p}{r_p}n\right]}. \qquad (12)$$

This expression goes over into the Shockley-Read relation (Ref. 1, see

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Statistics of recombination in the ...

below) for small injection levels and the conditions $1 \gg C_n n_1^*/r_n$; $1 \gg C_p p_1^{**}/r_p$. n_1^* and p_1^{**} are the electron and hole concentrations, respectively, in the bands where the Fermi level intersects the excited level. The above conditions involve the postulate that the carrier lifetimes on the excited levels τ_n', $\tau_p' \ll (10^{-9} - 10^{-10})$ sec. However, these conditions do not always apply. E. I. Adirovich is thanked for discussions. Yu. V. Gulyayev (FTT, 3, no. 2, 382, 1961) is mentioned. There are 1 figure and 7 references: 3 Soviet and 4 non-Soviet. The 4 references to English-language publications read as follows: Ref. 1: W. Shockley a. W. Read, Phys. Rev., 87, 835, 1952; R. N. Hall. Phys. Rev., 87, 387, 1952; W. Shockley a. J. Last. Phys. Rev., 107, 392, 1957; M. Lax. Phys. Rev., 119, 1502, 1960.

ASSOCIATION: Fizicheskiy institut im. P. I. Lebedeva AN SSSR Moskva
(Physics Institute imeni P. I. Lebedev AS USSR, Moscow)

SUBMITTED: July 10, 1961

Card 3/3

...September 26, 2002 CIA-RDP86-00513R001446520006-3
...ASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

32086
S/181/61/003/012/021/028
B108/B138

24,7000 (1144, 1385, 1559)

AUTHOR: Rzhanov, A. V.

TITLE: Surface recombination in semiconductors

PERIODICAL: Fizika tverdogo tela, v. 3, no. 12, 1961, 3698 - 3705

TEXT: An expression for the maximum surface recombination rate is derived on the basis of a previously (FTT, v. 3, no. 12, 1961, 3691 - 3697) derived expression

$$S = \frac{N_t (C_p C_n)^{1/2} \frac{n_0 + p_0}{2n_i}}{\operatorname{ch}\frac{q(\varphi_S - \zeta)}{kT} + \operatorname{ch}\left(\frac{\delta_t - q\zeta}{kT}\right) + M\left[\operatorname{ch}\frac{q(\varphi_S - \eta)}{kT} + \operatorname{ch}\left(\frac{\delta_t - q\eta}{kT}\right)\right]}. \quad (1)$$

which is rewritten using the terms

$$M = \left(\frac{C_p C_n}{r_p r_n} p_1^{\bullet\bullet} n_1^{\bullet}\right)^{1/2}, \qquad \frac{q\eta}{kT} = \frac{1}{2}\ln\left(\frac{r_p}{r_n}\frac{n_1^{\bullet}}{p_1^{\bullet\bullet}}\right), \quad (2), (3)$$

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FRUMKIN, A.N., akademik, otv. red.; RZHANOV, A.V., otv. red.; BURSHTEYN, R.Kh., doktor khim. nauk, otv. red.; YUNOVICH, A.E., red. izd-va; TIKHOMIROVA, S.G., tekhn. red.

[Surface characteristics of semiconductors]Poverkhnostnye svoistva poluprovodnikov. Moskva, Izd-vo Akad. nauk SSSR, 1962. 231 p. (MIRA 15:12)

1. Soveshchaniye po poverkhnostnym svoistvam poluprovodnikov, Moscow, 1961. 2. Chlen-korrespondent Akademii nauk SSSR (for Rzhanov).
(Germanium--Electric properties) (Transistors)
(Selenium--Electric properties)

"APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3
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RZHANOV, A. V.

"A Study of the Surface States of Germanium (a copy typed from the handwritten text--spelling and grammer unchanged-- as well as the original handwritten copy)"

Report presented at the Massachusetts Institute of Technology (MIT) Physical Electronics Conference. Cambridge, Massachusetts, 21-23 March 62.

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L 17926-63 EWT(1)/EWG(k)/EWP(q)/EWT(m)/BDS AFFTC/ASD/ESD-3/IJP(C) Pg-4
ACCESSION NR: AT3002445 AT/JD S/2935/62/000/000/0101/0114 67 66

AUTHOR: Rzhanov, A. V.

TITLE: Investigating some electron processes on the real germanium surface [Report at the Conference on Surface Properties of Semiconductors, Institute ofElectrochesmistry, AN SSSR, Moscow, 5-6 June 1961]

SOURCE: Poverkhnostny*ye svoystva poluprovodnikov, Moscow, Izd-vo AN SSSR, 1962, 101-114

TOPIC TAGS: germanium, germanium surface

ABSTRACT: A review is offered of experimental results relating to surface recombination and capture on Ge surface; the results are compared with theoretical notions. All steps of surface treatment of Ge specimens were standardized which brought about good reproducibility of experimental results. To analyze recombination and capture phenomena, additional experiments with injection level, temperature, concentration and other properties of surface centers were staged; also various crystallographic orientations of Ge surface were used and spectrum-photoconductivity relations were studied. On the strength of the above experi-

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ACCESSION NR: AT3002445

ments the old assumption that only one type of recombination centers predominates was abandoned. Ozonated oxygen and vacuum heating up to 700K were used to study variations in recombination concentrations and capture; these studies permitted important conclusions about the nature of surface recombination centers and capture. The crystallographic orientation (110) yielded recombination curves much different from those at the orientations (100) and (111). Energy topography of surface levels was studied on the basis of infrared-spectrum / photoconductivity relations. A modified theory of surface recombination offered by Soviet researchers differs from the conventional theory in the interpretation of the effective sections of capture of carriers by the recombination center. Generally accepted methods of treating Ge surface were found inadequate as the resulting film had unstable characteristics; entirely different methods are suggested. Orig. art. has: 6 figures and 2 formulas.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Institute of Physics, AN SSSR)

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SUB CODE: PH NO REF SOV: 012 OTHER: 004

RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3

37938

S/181/62/004/005/029/055
B108/B112

24.7400

AUTHORS: Rzhanov, A. V., and Arkhipova, I. A.

TITLE: Surface recombination on germanium with a large quantity of water adsorbed

PERIODICAL: Fizika tverdogo tela, v. 4, no. 5, 1962, 1274 - 1278

TEXT: The changes in the character of the recombination curves during gradual drying of p-type germanium were examined. Conclusions: Virtually no quantitative relationship exists between the changes in the maximum surface recombination rate of germanium with adsorbed water and the slope of the capture curves. Recombination is accomplished at discrete levels as well as on continuous energy levels in the surface forbidden band. As a first approximation it is assumed that the effective capture cross sections of the discrete and continuous levels are determined only by the donor or acceptor character of the respective centers and that they are independent of the energy position of the level. An approximately linear increase of the recombination rate on the side of positive surface potentials was observed on the p-type specimens (resistivity ~20 ohm.cm).

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Surface recombination on ...

A detailed description of the experiments will follow later. There are 3 figures.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva (Physics Institute imeni P. N. Lebedev) Moscow

SUBMITTED: January 2, 1962

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24.7400

S/181/62/004/005/030/055
B108/B112

AUTHOR: Rzhanov, A. V.

TITLE: Surface recombination and capture through a continuous surface level spectrum

PERIODICAL: Fizika tverdogo tela, v. 4, no. 5, 1962, 1279 - 1284

TEXT: Theoretical expressions are derived and discussed relating to capture and surface recombination rate in donor-acceptor semiconductors with continuous surface level spectrum. Comparison between theory and experimental data on germanium led to the following conclusions: The half width of the calculated recombination curves is less than that of the experimental curves. This argument against the significance of the continuous surface level systems is not, however, decisive. It may be well possible that comparable contributions to surface recombination are added by those systems of levels that are continuous in the forbidden band and by discrete surface levels. A number of experimental features can be explained on the assumption that the ratio of their concentrations to be such that the shape of the major part of the experimental capture curve is

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S/181/62/004/007/013/037
B102/B104

AUTHORS: Paramonova, R. A., and Rzhanov, A. V.

TITLE: Investigation of the volume recombination in copper-doped germanium crystals

PERIODICAL: Fizika tverdogo tela, v. 4, no. 7, 1962, 1820-1825

TEXT: The temperature dependence of the volume (recombinative) lifetime of carriers in p-type Ge with copper concentrations of $0.6\text{-}2.0\cdot10^{14}$ cm^{-3} and with resistivities of 1.4-2.3 ohm·cm at 300°K was measured. The carrier lifetime was found to decrease with temperature throughout the range of concentrations. This agrees with FTT, 1, 1294, 1959 but not with Schultz in Phil. Res. Rept., 16, 182, 1961 who found the dislocation density to be very low ($\lesssim 100$ cm^{-2}) and attributed to surface recombination. To examine the question more closely the Cu impurity in some specimens was compensated by Sb ($\lesssim 2\cdot10^{14}$ cm^{-3}). The ... was still $10^3\text{-}10^4$ cm^{-2}, and the $\tau(1/T)$ curves showed

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Investigation of the volume ...

a distinct maximum. In addition the carrier lifetime and the cross section for carrier trapping by Cu^{4+} ions were investigated for low-ohmic n-type specimens. The specimens had a Cu concentration of $1 \cdot 10^{14}$ cm^{-3}, a resistivity of 0.14-6.8 ohm·cm at 300°K, and a dislocation density of $\approx 10^3$ cm^{-2}. At low temperatures, the lifetime was $\sim T^{2.5}$ and the hole trapping cross section was proportional to T^{-3}. The third copper level is 0.26 ev below the bottom of the conduction band. At 300°K the trapping cross section is $1 \cdot 10^{-16}$ cm^{-2}. The electron lifetime at first increases rapidly from ≈ 10 μsec with decreasing temperature, tending to saturation. Though unable to account for the different trends of the $\tau(1/T)$ curves, the authors do not think these are due to the different effects of surface recombination as Schultz suggested, but rather to the different positions of the copper impurities (in the lattice or at dislocations). This assumption, however, remains to be proved. There are 5 figures.

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Investigation of the volume ...

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva
(Physics Institute imeni P. N. Lebedev AS USSR, Moscow)

SUBMITTED: December 23, 1961 (initially)
February 23, 1962 (after revision)

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

S/181/62/004/012/014/052
B104/B102

AUTHORS: Guro, G.M., and Rzhanov, A.V.

TITLE: Kinetics of the nonequilibrium conductivity in the case of high generation levels

PERIODICAL: Fizika tverdogo tela, v. 4, no. 12, 1962, 3441-3445

TEXT: How the period that the carriers are trapped in a recombination center affects the kinetics of the nonequilibrium conductivity in the case of high generation levels is studied. For the case of low generation levels, the effect of the carrier lifetime on the excited levels of the recombination centers in stationary processes was investigated by A.V. Rzhanov (FTT, 3, 3691, 1961) as an extension of the recombination theory by W. Shockley and W. Read (Phys.Rev., 87, 835, 1952). G.M. Guro (ZhETF, 33, 158, 1957) derived an attenuation law of the carrier equilibrium concentration at arbitrary deviations from thermodynamic equilibrium, assuming, however, that recombination takes place via the ground state of the recombination center. The same conception is adopted here, but a more general expression for the recombination rate is taken as initial equation, whereby the effect of the

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

ACCESSION NR: AT3012119 S/2504/63/020/000/0003/0125

AUTHOR: Rzhanov, A. V.

TITLE: Investigation of some electronic processes on the surface of germanium

SOURCE: AN SSSR. Fizicheskiy institut. Trudy*, v. 20, 1963, 3-125

TOPIC TAGS: germanium, semiconductor, germanium semiconductor diode, surface recombination, surfaces space charge, surface potential barrier, surface conductivity, surface energy level, surface defects

ABSTRACT: This is a doctoral dissertation devoted to surface recombination and its influence on the characteristics of certain type of germanium diodes and transistors. The topics covered are: 1. Effect of surface recombination on the saturation current of low-power germanium diodes. 2. Effect of surface recombination on the characteristics of low-power germanium transistors. 3. Surface electronic processes occurring on semiconductors (equilibrium between surface and volume of the semiconductor, surface space charge layer, surface potential barrier and work function, surface conduc-

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tivity, field effect and fast and slow surface states, and surface recombination. 4. Surface recombination and capture as a method for investigating surface defects of a structure (combined investigations of the surface conductivity, recombination, and carrier capture character of the experimental results and their reproducibility and interpretation). A procedure is described for determining the surface levels from the spectral dependence of photoconductivity outside the region of the main absorption of light by germanium. The experimental data indicate that the rate of surface recombination on a real germanium surface depends on the injection level, the temperature, the state of the gaseous medium (ozone content and dryness), and the crystallographic orientation and finish of the surface. The data can also be useful in the construction of various types of germanium devices. Further developments in the theory of surface recombination are discussed, with emphasis on the kinetics of the capture and recombination processes. "The author is sincerely grateful to the director of the Laboratoriya fiziki poluprovodnikov (Semiconductor Physics Laboratory), B. M. Vul, for interest in

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the work and for help, to E. I. Adirovich for many fruitful discussions, and to V. S. Vavilov for collaboration in individual measurements. Participating in the work were the scientists from the Group of Surface Phenomena in Semiconductors I. A. Arkhipova, T. I. Galkina, I. G. Neizvestny'y, Yu. F. Novototskiy-Vlasov, N. M. Pavlov, S. V. Pokrovskaya, and M. A. Selezneva, engineer Ye. V. Gorskin and laboratory assistants G. A. Balandina, O. A. Gry*zlova, V. S. Maksimkin. The author is sincerely grateful to all his colleagues for collaboration and also takes the opportunity to thank engineer B. D. Kopy*lovskiy, graduate student A. F. Plotnikov, mechanics Yu. A. Kolotov and A. F. Zinov'yev and the entire staff of the Semiconductor Physics Laboratory for help with individual problems." Orig. art. has: 54 figures, 75 formulas, and 14 tables.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Physics Institute, AN SSSR)

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LAVRENT'YEV, A.M., akademik; RABOTNOV, Yu.N., akademik; RZHANOV, A.V.; VOROB'YEV, A.A., prof.; KUZNETSOV, Yu.A.; SOKOLOV, V.A., prof.

Vladimir Dmitrievich Kuznetsov, 1887-1963; an obituary. Izv. SO AN SSSR no.2. Ser. tekh. nauk no.1:142-143 '64. (MIRA 17:8)

1. Chleny-korrespondenty AN SSSR (for Rzhanov, Kuznetsov).

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APPROVED FOR RELEASE: Thursday, September 26, 2002 CIA-RDP86-00513R001446520006-3"

KRAVCHENKO, A.F.; REZHANOV, A.V.; SARDARYAN, V.S.

Longitudinal Hall effect in cubic crystals. Dokl. AN SSSR 164 (MIRA 18:10)
no.5:1016-1018 O '65.

1. Institut fiziki poluprovodnikov Sibirskogo otdeleniya AN SSSR.
2. Chlen-korrespondent AN SSSR (for Rezhanov).

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L 22914-66 EWT(m)/EWP(t) IJP(c) JD/JG

ACC NR: AP6009657 SOURCE CODE: UR/0181/66/008/003/0758/0766

64
B

AUTHORS: Rzhanov, A. V.; Svitashev, K. K.; Filatova, Ye. S.; Shepel', V. M.

ORG: Institute of Semiconductors, SO AN SSSR, Novosibirsk (Institut poluprovodnikov SO AN SSSR)

TITLE: Investigation of the surface photoconductivity of germanium 27

SOURCE: Fizika tverdogo tela, v. 8, no. 3, 1966, 758-766

TOPIC TAGS: germanium, photoconductivity, surface property, semiconductor conductivity, semiconductor impurity, forbidden band, spectral energy distribution

ABSTRACT: This is a continuation of earlier work (FTT v. 3, 1557, 1961) dealing with impurity photoconductivity and the concentration of photoactive surface defects. The present investigation was made with p-type germanium doped with gallium, and having a specific resistivity 20 -- 30 ohm cm and a carrier lifetime ~800 μsec. The samples were placed in a cryostat in vacuum 5×10^{-7} torr and exposed

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ACC NR: AP6009657

to monochromatic radiation from the IKS-12 instrument. Measurements were made of the temperature and spectral dependences of the surface photoconductivity and also of its time lag. The impurity photoconductivity of a thin sample of germanium was measured with light modulated at 12 cps. No impurity photoconductivity was observed at room temperature and at dry ice temperature, but was observed at liquid nitrogen temperature (- 170C), at which all other measurements were made. The results demonstrated once more the existence of a specific photoconductivity in germanium, connected with excitation of surface defects. The experimental reasons for this conclusion are presented in detail. The results also show that it is possible in principle to obtain data on the energy levels of the photoactive surface defects in the forbidden band of the semiconductor by analyzing the surface-photoconductivity spectra. Further data can be expected from these results if the surface potential can be determined by an independent method and the spectral resolution is improved. Work is continued in this direction. Orig. art. has: 12 figures, 3 formulas, and 1 table.

SUB CODE: 20/ SUBM DATE: 20Jul65/ ORIG REF: 003/ OTH REF: 005

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ACC NR: AP6018576 SOURCE CODE: UR/0181/66/008/006/1955/1957

AUTHOR: Rzhanov, A. V.; Svitashev, K. K.; Shepel', V. M.

ORG: Institute of Physics of Semiconductors, SO AN SSSR, Novosibirsk (Institut fiziki poluprovodnikov SO AN SSSR)

TITLE: Influence of capture of nonequilibrium carriers by surface defects on the spectrum of the intrinsic photoconductivity of a thin sample of germanium

SOURCE: Fizika tverdogo tela, v. 8, no. 6, 1966, 1955-1957

TOPIC TAGS: photoconductivity, germanium semiconductor, capture cross section

ABSTRACT: The authors compare the pulses of intrinsic photoconductivity of thick and thin samples of p-type germanium at liquid-nitrogen temperature. The shape of the photoconductivity pulse of the thin sample exhibited singularities characteristic of the presence of traps. It is shown that the total change of the conductivity of the sample under the influence of the light consists of three factors (photoconductivity proper, change in surface conductivity as a result of change in carrier density, and change in surface conductivity as a result of change of the surface charge), and in the region of 1.64 μ the contribution of the third process is comparable in magnitude with the contributions of the first two. The additional illumination, which normally eliminates adhesion of nonequilibrium carriers on the germanium surface at low temperatures, reduced the photoconductivity of the thin germanium to approximately the same value as that of thick germanium (5 vs. 0.5 mm) and eliminated the peak at 1.64 μ.

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USSR.

Rotation levels and rotation spectra of heavy nuclei. S. G. Ryzhanov. *Zhur. Eksptl. i Teoret. Fiz.*, 23, 417-24 (1953); *Science Abstr.*, 56A, 731(1953).—A new scheme of α- and γ-spectra of naturally radioactive nuclei is proposed: the parent nucleus undergoing α-decay in the ground state imparts energy to 2 or 3 rotators; and γ-radiation is detd. by transition of each rotator, subject to selection rules. The γ-intensities can be obtained, by using the correspondence principle, from elec. quadrupole, together with some magnetic dipole, emission. K. L. C.

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PLAKSIN, S.A.; GOTOVTSEVA, L.A.; ZERNOVA, K.N.; RYZHAKOVA, T.S.

Peroxide bleaching of back grey. Tekst.prom. 20 no.2: 45-48 F '60. (MIRA 13:6)
(Textile printing--Equipment and supplies)
(Bleaching) (Textile fabrics)

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ANDREYENKO, G.V.; BAZAZ'YAN, G.G.; SMYSLOVA, S.N.; RYZHAKOVA, V.G.

Comparative study of the methods of the determination of heparin in the blood. Lab. delo no.2:102-105 '65. (MIRA 18:2)

1. Laboratoriya fiziologii i biokhimii svertyvaniya krovi (zaveduyushchiy - prof. B.A. Kudryashov) Moskovskogo gosudarstvennogo universiteta.

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RYZHANOV, S.G.

Rotation levels and rotation spectra of nuclei. Uch. zap. Kish. un. 75:12-17 '64. (MIRA 18:10)

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L 26486-65 EWT(l)/EWT(m) DIAAP/IJP(c) S/0058/64/000/011/V014/V014

ACCESSION NR: AR5004846

SOURCE: Ref. zh. Fizika, Abs. 11V120

AUTHORS: Ryzhanov, S. G.

TITLE: Role of K-forbiddenness in alpha spectra of transuranic elements

CITED SOURCE: Uch. zap. Kishinevsk. un-t, v. 69, 1964, 19-22

TOPIC TAGS: alpha spectrum, transuranic element, alpha decay, forbidden transition, half life

TRANSLATION: On the basis of the scheme of radioactive alpha decay of the transuranic elements Am^{241}, Cm^{245}, and Cf^{249}, proposed in earlier papers (RZhFiz, 1962, 9V318; 1963, 3B52), it is shown that forbidden E1 transitions exist between crossing levels of opposite parity, and that there are no E2 or M1 transitions between levels of equal parity. The average lifetime of such levels is estimated and found to be larger than the half lives of the indicated nuclei. S. Ryzhanov.

SUB CODE: NP ENCL: 00

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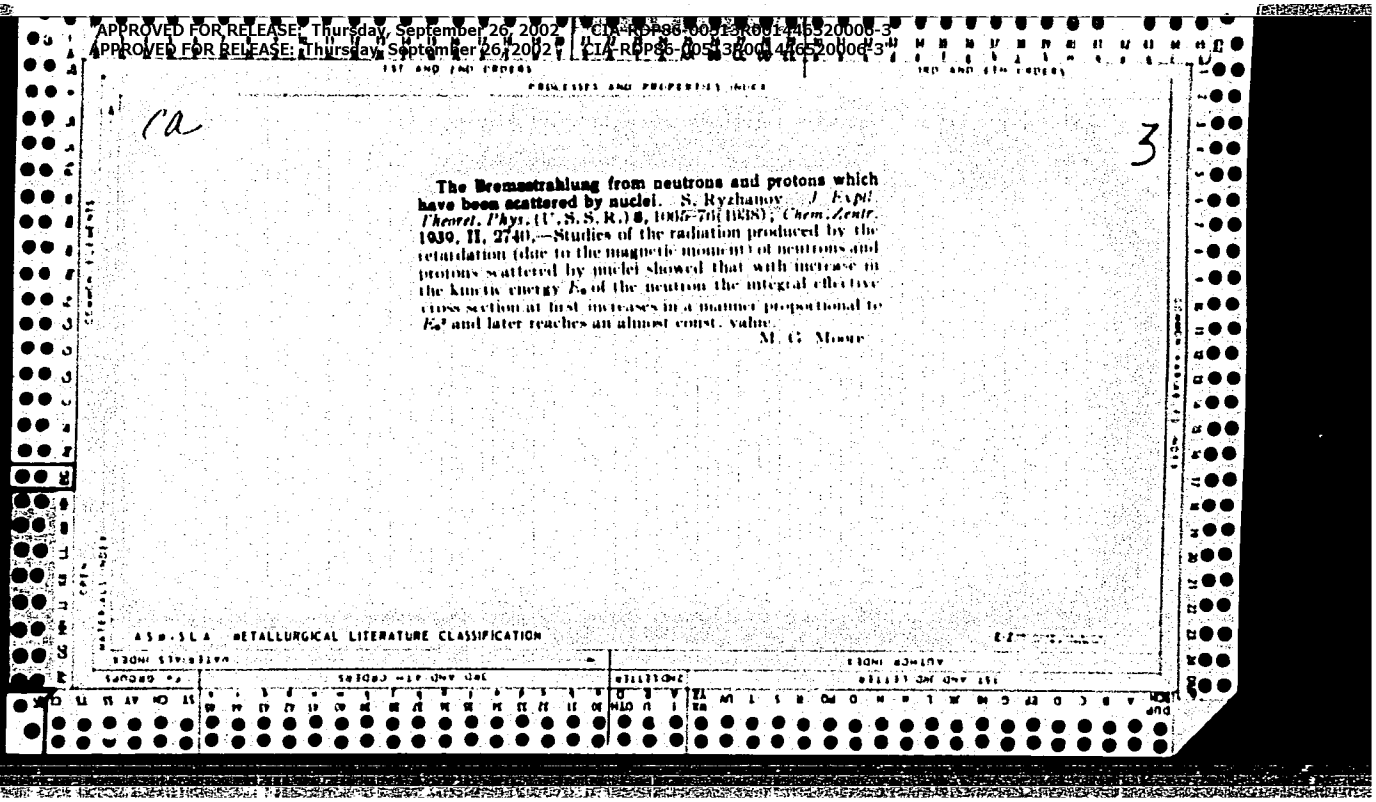

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The Bremsstrahlung from neutrons and protons which have been scattered by nuclei. S. Ryzhanov. *J. Exptl. Theoret. Phys.* (U.S.S.R.) **8**, 1005–7(1938); *Chem. Zentr.* **1939, II**, 2740.—Studies of the radiation produced by the retardation (due to the magnetic moment) of neutrons and protons scattered by nuclei showed that with increase in the kinetic energy E_0 of the neutron the integral effective cross section at first increases in a manner proportional to E_0^2 and later reaches an almost const. value.

M. G. Mason

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

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Theory of the diffraction of electrons from crystals. Ya. Frenkel and S. Ryabinin. *J. Exptl. Theoret. Phys.* (U. S. S. R.) **8**, 1255-60(1938). — F. and R. show that the discrepancy between the exptl. data of Davisson and Germer (cf. *C. A.* **23**, 29) and the theoretical values calcd. by Bethe and Kikuchi (B., *C. A.* **23**, 332, and K., *C. A.* **24**, 5003) can be satisfactorily explained by a consideration of noncoherent collisions which cause an electron absorption and widen the diffraction max.

F. H. Rathmann

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

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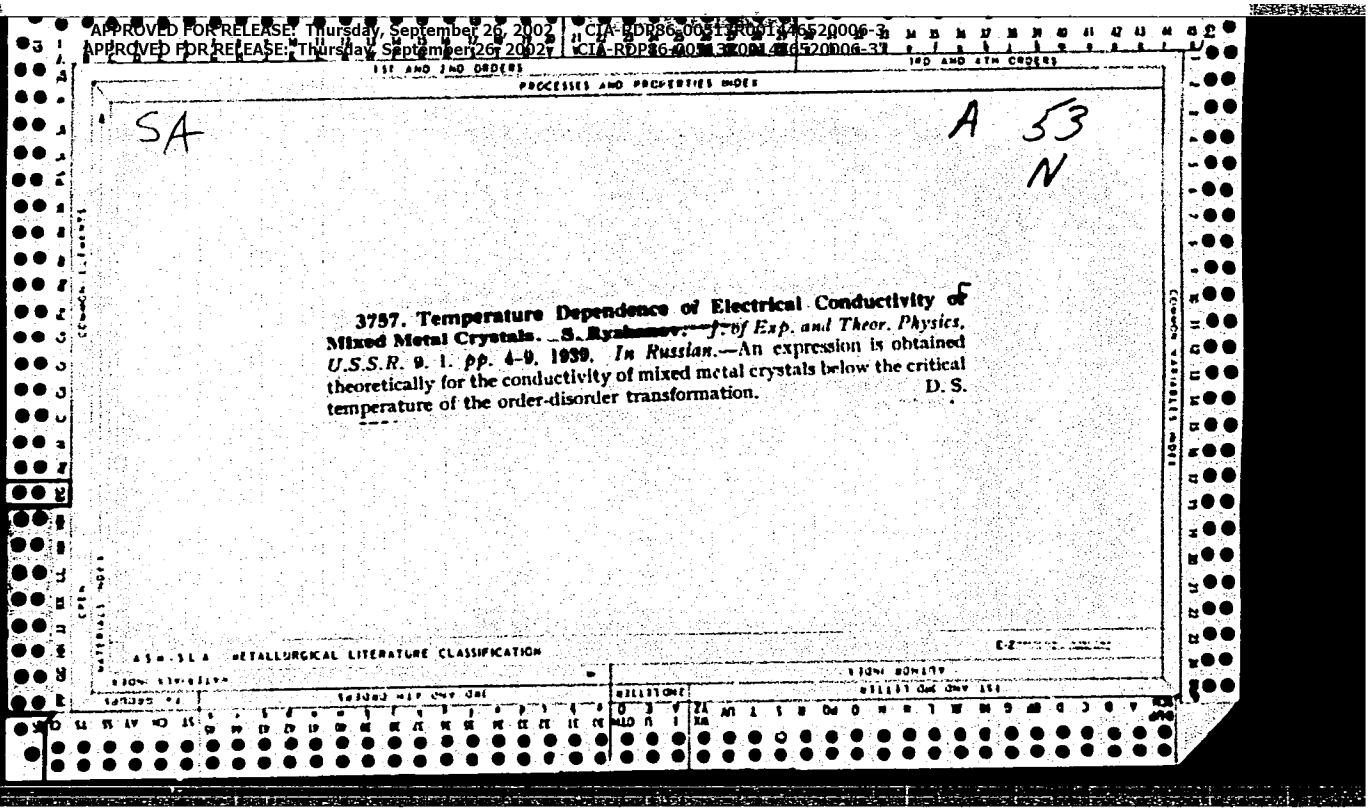

SA

A 53
N

3757. **Temperature Dependence of Electrical Conductivity of Mixed Metal Crystals.** S. Ryabinov. *J. of Exp. and Theor. Physics, U.S.S.R.* 9. 1. *pp.* 4–9. 1939. *In Russian.*—An expression is obtained theoretically for the conductivity of mixed metal crystals below the critical temperature of the order-disorder transformation. D. S.

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Photoelectric effect from photoelectrically sensitized active cathodes. S. Ryzhanov, *J. Exptl. Theoret. Phys.* (U. S. S. R.) 9, 38–45(1939).—Theoretical-mathematical. The surface effect is highly selective; the vol. effect increases with decreasing wave length, with layer thickness up to a certain max., and is practically independent of polarization. The photoelec. yield is $^1/_{100}$ electrons per quantum. These results agree with those obtained by Fowler from statistic considerations, as well as those found experimentally by Ives (*C. A.* 26, 903). F. H. R.

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CA

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Interaction between barytrons and electromagnetic field in the presence of heavy particles. S. Ryzhanov. *J. Exptl. Theoret. Phys.* (U.S.S.R.) 10, 129-38(1940).—Using Bhabha's theory of mesons (cf. *C. A.* 33, 8487*) (mesotrons, barytrons, heavy electrons, etc.) in which their wave functions are represented by four-dimensional vectors, R. calcs. effective cross sections for the following processes: (1) formation of meson pairs by the high-energy radiation in the neighborhood of heavy nuclei; (2) photo emission resulting from the scattering of mesons by heavy nuclei; (3) formation of single mesons resulting from the transformations of heavy elementary particles under the action of high-energy radiation. R. G.

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