"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

PROCESSES AND PROPERTIES INDEX

2

7

Sampling of air for the chemical determinations of aero dispersoids. V. G. Gurevich and I. B. Kogan. *Zavod. Lab.* 10, 183-4(1941).--For the detn. of dust and aerosols it is permissible to sample the air by trapping it in an evacuated vessel. The results of these tests were compared with those in which the dust-laden air was passed through a tube contg. absorbent cotton. Data are given for calcg. the max. size and wt. of the particles which will enter the evacuated vessel along with the air.

B. Z. Kanesh

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

1ST AND 2ND ORDERS

PROCESSES AND PROPERTIES INDEX

Determination of oxidizability in the analysis of air V. G. Gurevich, E. M. Rudinskaya, and V. P. Protopopova. *Zavodskaya Lab.* 12, 122-30(1946). The oxidizability of air can be used as a criterion of its purity. The oxidizability of air is defined as the no. of mg. of O consumed in the oxidation by KIO_3 in H_2SO_4 soln. of all reducing substances in 1 l. of air under standard conditions. An evacuated flask (especially designed for the analysis) is filled with the air sample, the contaminated air is oxidized in the flask by means of KIO_3 in concd. H_2SO_4. In the absence of reducing agents this mixt. does not decomp. at 195° (only 0.1-0.2% is decompd.), but it oxidizes at this temp. nearly all org. substances, except CH_4 and some heterocyclic compds. of N; the oxidation proceeds nearly completely to CO_2, without the formation of CO. The quantity of O consumed is detd. by the quantity of I liberated in the presence of reducing agents according to $I_2O_5 = I_2 + 5O$. The I is detd. colorimetrically by the intensity of the yellow-brown color of its solns. in mixts. with dil. H_2SO_4 and KIO_3. The I reacts with the oxidizing mixt. with the formation of the green of $I_2O_5.SO_3$-type compds. On diln. with water, this compd. decomp. rapidly according to $5I_2O_5.SO_3 + 8H_2O = 2I_2 + 6HIO_3 + 5H_2SO_4$. W. R. Henn

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

CA

7

Determination of tetraethyllead in air. V. G. Gurevich and L. E. Karlson. *Zavodskaya Lab.* 13, 168-71(1947).—$PbEt_4$ is best absorbed from air and oxidized by aqua regia. When this soln. is evapd. some lead is lost by adsorption on the walls of the evapg. dish. In nephelometric detn. of the Pb (by adding 0.1 ml. of a soln. contg. 0.5% K_2CrO_4 and 10% NaOAc to 3 ml. of salt soln.), this adsorption causes a max. error of 25%; most results are within 15% of the truth. E. H.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V. G.

Gurevich, V. G. and Sigalovskaya, K. K. "Chemical processes of removing harmful gases from the air," (reference), Soobshch. o nauch. rabotakh chlenov Vsesoyuz. khim. o-va im. Mendeleyeva, 1948, Issue, 2, p. 32-34

SO: U-2888, Letopis Zhurnal'nykh Statey,No. 1, 1949

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V. G. (Co-author)

See: SIGALOVSKAYA, K. K.

Gurevich, V. G. and Sigalovskaya, K. K. "The determination of fixed nitrogen in steel", (Report), Soobshch. o nauch. rabotakh chlenov Vsesoyuz, khim. o-va im. Mendeleyeva, 1949, Issue 1, p. 10-11.

SO: U-4630, 16 Sept. 53, (Letopis 'Zhurnal 'nykh Statey, No. 23, 1949).

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

USSR/Chemistry-Air, Purification Jan 49
Microclimate

"Chemical Methods of Extracting Noxious Gases From the Air," V. G. Gurevich, K. K. Sigalovskaya, Ukrainian Cen Inst of Labor Hygiene and Occupational Diseases, 11 pp

"Zhur Priklad Khim" Vol XXII, No 1

For certain noxious gases, some gaseous substances may be selected which will combine noxious gases into solid substances. These solids may be removed from the air stream by filtration, sedimentation, or other methods. Acid gases may be removed from the air by using

[redacted] 49/49T19

PA 49/49T19

USSR/Chemistry-Air, Purification (Contd) Jan 49

a chamber sprayed with weak ammonium water. Amount of ammonium used should be slightly less than that needed for complete transformation of acid gases into ammonium salts. In certain cases when the solid substances forming are harmless, air may be purified without removing it from the location by adding a gas to the air. For acid gases, this may be accomplished by various methods, e.g., blowing out the source of the acidic gases using air with a mixture of ammonium, and for blasting operations by adding to the nitrogen-containing explosive mixtures substances which release ammonium in the explosion. Submitted 9 Oct 47.

[redacted] 49/49T19

GUREVICH, V. G.

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

Gurevich, V.G.

MD

2

USSR

A rapid method for the determination of carbon monoxide in the air. V. G. Gurevich, L. I. Belkina, and A. V. Nenartovich. ~~Gigiena i Sanit.~~ 1952, No. 23, 62-4.—As a result of a review of the literature and personal experience a substance was prepd. of a small grainy consistency and of a greenish yellow color. The method of prepn. of this substance and its chem. nature are not divulged. When CO in different concns. is passed through a U-shaped tube contg. this substance, the color changes to green, bluish green, and blue.

B. S. Levine

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V.G.; KAZARNOVSKIY, L.S.; KARAVAY, N.Ya.

Preventing scale formation in distillation apparatus during the production of distilled water in pharmacies. Apt.delo 7 no.2:43-44 Mr-Ap '58. (MIRA 11:4)

1. Iz Khar'kovskogo farmatsevticheskogo instituta.
(DISTILLATION APPARATUS)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GOL'TMAN, A.D.; GUREVICH, V.G.

Study of the colorimetric curcumin determination of microquantities of boron. Ukr. khim. zhur. 24 no. 2:244-250 '58. (MIRA 11:6)

1. Khar'kovskiy farmatsevticheskiy institut.
(Curcumin)
(Boron)
(Colorimetry)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

YER'EMINA, Z.I. [IEr"omina, Z.I.]; GUREVICH, V.G. [Hurevych, V.H.], prof.

Application of vanadometry to determining organic pharmaceutical preparations. Report No.1: Dependence of the potential of some reduction-oxidation systems on the concentration of sulfuric acid. Farmatsev. zhur. 15 no.6:6-10 '60. (MIRA 14:11)

1. Kafedra analiticheskoy khimii Khar'kovskogo farmatsevticheskogo instituta.
(VANADOMETRY) (SULFURIC ACID)
(OXIDATION-REDUCTION REACTION)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

YER'OMINA, Z.I. [Yer'omina, Z.I.]; GUREVICH, V.G. [Hurevych, V.H.]

Using vanadometry to determine organic pharmaceutical preparations. Farmatsev. zhur. 16 no.1:13-18 '61. (MIRA 17:8)

1. Kafedra analiticheskoy khimii Khar'kovskogo farmatsevticheskogo instituta.

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

YEREMINA, Z.I.[IEr'omina, Z.I.]; GUREVICH, V.G. [Hurevych, V.H.]

Use of vanadatometry for the determination of organic pharmaceutical preparations. Report No. 3: Determination of tannic acid and pyramidon. Farmatsev. zhur. 16 no. 2:17-20 '61. (MIRA 14:4)

1. Kafedra analitychnoy khimii Kharkovskogo farmatsevticheskogo instituta.
(VANADOMETRY) (TANNINS) (ANIMOPYRINE)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V.P., inzh.

Standard design of gravel-sorting plant. Stroi. mat. 11 no.1:32-34 Ja '65. (MIRA 18:6)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V. I.

GUREVICH, V. I. Adjusting Air Circuit-Breakers (Naladka Raboty Vozdushnykh Vyklyuchateley), pp. 27-31

Adjustment, reconstruction and improvement of 110 and 220kv air circuit-breakers of various manufacturers (Brown-Boveri, Slavyansky Plant, AEG) are discussed in detail.

SO: ELEKTRICHESKIYE STANTSII, No. 12, Dec. 1952, Moscow (1614306)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V.I.

Distribution of boron in sedimentary rocks of the northern Russian Platform. Trudy VNIIG no.40:303-306 '60. (MIRA 14:11)

(Russian Platform--Boron)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V.I.

Distribution of bromine in chloride waters. Razved. i okh. nedr 27 no.1:37-39 Ja '61. (MIRA 17:2)

1. Severo-Zapadnoye geologicheskoye upravleniye.

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V.I.

Potassium in the waters of the Northern Dvina artesian basin. (MIRA 17:9)
Trudy VSEGEI 101:218-238 '63.

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V.I.

Discussions on the origin of calcium brines. Reply to Professor E. V.Posokhov. Sov.geol. 6 no.8:150-158 Ag '63. (MIRA 16:9)

1. Leningradskiy gornyy institut.
(Saline waters) (Water, Underground)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V.I.

Influence of temperature on the content of bromine in underground brines. Dokl. AN SSSR 158 no.3:638-640 S '64. (MIRA 17:10)

1. Predstavleno akademikom N.M.Strakhovym.

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

Capture of [illegible] with energies of the order of [illegible] million electron [illegible]

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

Gurevich, V. L.

Category : USSR/Nuclear Physics - Nuclear Reactions C-5

Abs Jour : Ref Zhur - Fizika, No 3, 1957, No 6028

Author : Gurevich, V.L.
Inst : [redacted],
Title : Capture of Neutrons with Energies of Several Mev by Nuclei.

Orig Pub : Zh. eksperim. i teor. fiziki, 1956, 30, No 5, 961-962

Abstract : The cross sections of the capture of a particle (neutron) upon excitation of volume oscillations of the nucleus, are calculated in the first approximation of the perturbation theory. The wave function of the unperturbed problem is chosen in the following form

$$\Psi = \psi(r)\varphi(\alpha)$$

$$-(\hbar^2/2M)\nabla^2\psi + U_0\psi = E^{(0)}\psi, \quad (T+W)\varphi = \varepsilon\varphi$$

where U_0 is a spherical potential well, and T and W are the kinetic and potential energies of the oscillations. According to Araujou (Referat Zhur Fizika, 1955, 24053)

$$W = \frac{1}{2}\int (a\delta\rho_p^2 + 2b\delta\rho_p\delta\rho_n - a\delta\rho_n^2)\,d\tau,$$

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

PA - 2703

AUTHOR GUREVICH V.L., OBRAZTSOV Yu.N.,

TITLE The Influence of the Stripping of Electrons By Phonons on the Thermomagnetical Effects in Semiconductors.
(Vliyaniye uvlecheniya elektronov fononami na termomagnitnyye effekty v poluprovodnikakh -Russian)

PERIODICAL Zhurnal Eksperim. i Teoret.Fiziki, 1957, Vol 32, Nr 2, pp 390-392 (USSR)
Received 5/1957 Reviewed 6/1957

ABSTRACT The paper under review investigates the influence of this stripping on the transverse and the longitudinal Nernst-Ettingshausen effect (N.E.effect) in semiconductors. The authors of the paper assume that the function of the distribution of the electrons in the conduction zone has the form $n=n^0 + n'$, with n' denoting a small deviation from the value of equilibrium; In analogy hereto, we have for the phonons $N = N^0 + N'$. At low temperatures the electrons are stripped away, mainly by the acoustic phonons with the highest velocity w_1. As a matter of fact, these phonons have a much longer time of the free path (τ_{ph}) than the phonons belonging to the two other acoustic branches. Optical oscillations are not excited. The paper gives the explicit solution of the kinetic equation for the case that the electronshave a period of relaxation and that the effective mass of the electrons is isotropic. The above solution yields for the current intensity the following expression:

$$I = \sigma_1 \nabla + \sigma_2 \nabla T + \sigma_3 [\vec{H} \nabla T] + \sigma_4 [\vec{H} \nabla \mu]$$

. Here the coefficient σ_1 and σ_4 have the same form as also in the case without stripping. We furthermore

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V.L.

56-6-27/47

AUTHOR: Gurevich, V. L.

TITLE: The Skin Effect and Ferromagnetic Resonance (Skin-effekt i ferromagnitnyy rezonans)

PERIODICAL: Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 1957, Vol. 33, Nr 6 (12), pp. 1497 - 1504 (USSR)

ABSTRACT: The present paper investigates the normal and the abnormal skin effect in ferromagnetic metals in the case of ferromagnetic resonance. Ferromagnetic resonance absorption occurs if the frequency of the electromagnetic field impinging upon the surface of the ferromagneticum is near the eigenfrequency of the precession of the vector $\vec{M}$ of magnetization around the direction of the magnetic field $\vec{H}$. This phenomenon can be described by the equation of the motion of the vector $\vec{M}$ in a certain effective magnetic field. The significance of the individual terms of this equation is discussed in short. In ferromagnetic metals there exists another mechanism which leads to a finite width of the resonance line. This mechanism is of importance if the magnetization $\vec{M}$ in the skin layer is highly inhomogeneous. In pure metals the effects connected with the widening of resonance lines due to exchange are most marked at low tamperatures. With a decrease of temperature the inhomogeneity of

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56-6-27/47

The Skin Effect and Ferromagnetic Resonance

the magnetic moment in the skin layer grows. At a sufficiently low temperature the classical theory of the skin effect may become inapplicable. Therefore, the present paper also deals with anomalous skin effect, not taking account, however, of the part played by the exchange effect. The author here proceeds from the Maxwell equations and from the kinetic equation for the conduction electrons in metal. As a boundary condition the reflection-coefficient q of the electrons on the surface of the metal is given. The solution of this equation is followed step by step. In this way also the computation of surface impedance is made possible. The resonance Z_- depends on the magnetic field H_z in resonance-like manner. The exchange effects are able to play a noticeable rôle only near resonance. Next, the border case of the ultra-anomalous skin effect is dealt with. The surface impedances in this case do not depend on the free path l_0 of the electrons. Z_+ depends in a non-resonance-like manner on the magnetic field strength. In conclusion the bases of this paper are once more discussed. There are 14 references 5 of which are Slavic.

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

56-6-27/47

The Skin Effect and Ferromagnetic Resonance

ASSOCIATION: Institute for Semiconductors AN USSR (Institut poluprovodnikov Akademii nauk SSSR)

SUBMITTED: July 4, 1957

AVAILABLE: Library of Congress

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

SOV/57-28-10-39/40

24(6)

AUTHOR: Gurevich, V. L.

TITLE: Anomalous Skin-Effect in Ferromagnetic Substances (Anomal'nyy skin-effekt v ferromagnetikakh)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, Vol 28, Nr 10, pp 2352-2354 (USSR) 1958

ABSTRACT: This is an investigation of the anomalous skin-effect in ferromagnetic resonance. The complete system of equations specifying this problem consists of a system of Maxwell's equations, of a kinetic equation for the conduction electrons, and of the equation of motion of Landau-Lifshits for the vector of magnetization (Ref 2, formulae (1a), (1b), (2), and (3)). The third summand in the right part of equation (3) is a phenomenological term describing the attenuation processes. These processes are the cause for the finite width of the resonance line. The second summand in (3) represents the effective field of the interaction forces which are caused by the heterogeneity M in the skin layer. For reasons of simplicity the effective field of magnetic anisotropy was not incorporated in formula (3). These formulae yield formula (4). This equation is to be solved in compliance with the boundary conditions presented in the paper cited by

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

reference 5. This paper presents a study of a special case, where the field connected with the heterogeneity M can be eliminated from formula (5). The law describing the dispersion of the electrons is considered to be anisotropic. This study is limited to the case $\omega\tau \ll 1$, thus the formula (7) resulting. The deduction of this formula is based upon the assumption of a specular reflection of the electrons from the metal surface. ω denotes the frequency and τ the relaxation time. In experiments dealing with ferromagnetic resonance the frequency ω ordinarily remains constant, whereas the field H_z and hence also its functions ω_1 and ω_2 vary. In this transition from the resonance ($\omega = \omega_1$) to the antiresonance case ($\omega = \omega_2$) the quantity $|\mu|$ may vary through two or even more orders of magnitude, μ - formula (6). This offers a possibility of varying only the field H_z, while keeping the temperature constant, and of observing the normal as well as the anomalous skin-effect. B. Ya. Moyzhes discussed the work with the author. There are 4 references, 1 of which is Soviet.

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

SOV/56-35-3-17/61

24(3)

AUTHOR: Gurevich, V. L.

TITLE: ~~Oscillations~~ of the Conductivity of Metallic Films in the Magnetic Field (Ostsillyatsii provodimosti metallicheskikh plenok v magnitnom pole)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1958, Vol 35, Nr 3, pp 668-677 (USSR)

ABSTRACT: Already in 1950 Sondheimer (Zondkheymer) (Ref 1) investigated the dependence of the conductivity oscillations of metallic films on the size of the magnetic field which is vertical to the metal surface. For these (theoretical) investigations it had been assumed that the dispersion of electron energy is isotropic. In the present paper it is assumed that the dispersion law of the electron energy is a random one, and that also the field direction $\vec{H}$ is random (but not parallel to the metal surface). Measurement of the amplitudes and periods in the case of different orientations of $\vec{H}$ makes it possible to draw conclusions with respect to the shape of the Fermi surface in the metal. Two types of oscillations are investigated: the first depends on p_z, where $p_z \approx p_z^0$ (p_z^0 is the maximum value of

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Oscillations of the Conductivity of Metallic Films in the Magnetic Field

p_z on the Fermi surface, p_z is the quasimomentum component in the direction z, i.e. in the $\vec{H}$ direction); the second type is calculated on the simplified assumption that a point $p_z = p_{z1}$ exists in which du/dp_z changes its sign at zero. For the order of magnitude of the oscillation amplitude one here obtains $\Delta s_{\mu\nu} \approx e^2 an(m^* v_o)^{-1}(v_o T/a)^k \sim H^{-k}$, where n denotes the electron density, a the thickness of the film, e the electron charge, m^* the effective electron mass (according to Lifshits, Azbel', and Kaganov (Ref 2)), and where k = 4 (first oscillation type) or k = 5/2 (second oscillation type) apply. It is found that the oscillations are not a quantum effect but a result of the finite thickness of the film and of the fact that the electrons are diffusely reflected on the metal surface. Contrary to the Shubnikov-de Haas (de Gaaz) effect, conductivity oscillation in this case is proportional to H (and not $\sim 1/H$). There are 6 references, 3 of which are Soviet.

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APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V. L., Cand of Phys-Math Sci -- (diss) "On the Theory of the Influence of Characteristics of the Spectrum of Excitation on Kinetic Effects in Solids," Leningrad, 1959, 12 pp (Leningrad Physico-Tech Institute, Acad Sci USSR) (KL 4-60, 114)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

BHAGAVANTAM, S.; VENKATARAIDU, T.; GURKVICH, V.L. [translator]; BOGOLYUBOV, N.N., red.

[Theory of groups and its application to physical problems] Teoriia grupp i ee primenenie k fizicheskim problemam. Pod red. N.N.Bogoliubova. Moskva, Izd-vo inostr.lit-ry, 1959. 301 p. (MIRA 13:5)
Translated from the English.
(Groups, Theory of)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

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SOV/181-1-9-28/31

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~~24(3)~~

AUTHOR: Gurevich, V. L.

TITLE: On the Theory of the Thermal Conductivity of Dielectrics

PERIODICAL: Fizika tverdogo tela, 1959, Vol 1, Nr 9, pp 1474 - 1476 (USSR)

ABSTRACT: Normally, optical vibrations may be neglected in the investigation of thermal conductivity, as they do not occur at low temperatures, and at high temperature their contribution to the conductivity coefficient is irrelevant. In the present paper, the author points to a case, in which the optical phonons exert a considerable and direct influence upon the thermal conductivity; this case occurs if their path length is abnormally great. The figure illustrates the vibrational spectrum of a biatomic crystal, with vibrations along one of its crystallographic axes. An influence of the (longitudinal) optical phonons would be given, if their frequency were greater than the double frequency of other phonons, i.e. if nonequation $\Omega_l > 2\max(\omega_l, \Omega_t)$ is satisfied.

In a biatomic cubic dielectric the ratio of frequency limits of longitudinal and transversal optical vibrations must then

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On the Theory of the Thermal Conductivity of Dielectrics SOV/181-1-9-28/31

be equal to $\Omega_l^o / \Omega_t^o = \sqrt{\varepsilon_o / \varepsilon_\infty}$ (cf. Krivoglaz and Pekar). For number of substances this ratio is greater than 2 (TlCl, TlBr, PbS, LiF, et al). It is briefly shown that if these conditions are satisfied, the thermal conductivity of the longitudinal optical phonons can play such a part that at high temperatures ($T \gg T_l = \frac{\hbar \Omega_l^o}{k}$) the thermal conductivity is not proportional to T^{-1} or $T^{-4/5}$, but to T^{-2}. Finally the authors thank A. I. Ansel'm and L. D. Landau for their discussions and advice. Pomeranchuk is mentioned in the text. There are 1 figure and 4 references, 2 of which are Soviet.

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors of the AS USSR, Leningrad)

SUBMITTED: April 9, 1959

Card 2/2

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SOV/56-37-1-11/64

24(1)

AUTHOR: Gurevich, V. L.

TITLE: The Absorption of Ultrasonics in Metals in the Magnetic Field. I (Poglosheheniye ul'trazvuka v metallakh v magnitnom pole. I)

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 1 (7), pp 71-82 (USSR)

ABSTRACT: The present paper deals with a theoretical investigation of the absorption of ultrasonics in metals at low temperatures in strong magnetic fields (if the Larmor frequency of conduction electrons is much greater than collision frequency). The case of an arbitrary dispersion law of electrons and of an arbitrary orientation of the H-field with respect to the crystal axes and the direction of ultrasonic propagation is investigated. It has already been experimentally established (Refs 1-3) that the sound absorption coefficient Γ shows an oscillation effect if the field strength H is varied. Akhiyezer, Kaganov and Lyubarskiy (Refs 4, 5) developed a theory of the absorption of ultrasonics in metals (without a magnetic field). The present paper intends setting up such a theory that takes especially the magnetic field into account. Especially the shape of the Fermi surface is investigated as well as the periodic part of the function $\Gamma(H)$ at various orientations of

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The Absorption of Ultrasonics in Metals in the Magnetic Field. I

$\vec{H}$ with respect to the wave vector $\vec{k}$; the magnitude of Γ is evaluated according to the order of magnitude. Also the asymptotic behavior of Γ in strong magnetic fields is investigated for the case in which the electron orbits are considerably smaller than the sound wave lengths and in which the function Γ (H) develops monotonely. It is first stated that Γ may experience two types of periodic variation with respect to 1/H, viz. oscillation and increments (periodic changes of a given sign which commence periodically). For the purpose of establishing the electron distribution function in the sound field, the frequency condition of Lifshits, Azbel and Kaganov (Ref 7) is used. The oscillations of Γ are to be observed in the case of arbitrary mutual orientation of k and H, which is especially easy if k $\perp$ H, because then the periodic occurrence of the increment is lacking. Finally, the simple case is investigated in which the Fermi surface has a symmetry center. In the following, the quantitative part of the theory is dealt with, at first in a general manner, and then for the case in which k $\perp$ H. An approximated expression is deduced for the non-oscillating part of Γ, and the increment of Γ is specially investigated. The periodic part of Γ may

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SOV/56-37-1-11/64

The Absorption of Ultrasonics in Metals in the Magnetic Field. I

be represented for an arbitrary form of the collision operator. An experimental investigation of the increments makes it possible to determine the Gaussian curvature of the Fermi surface in all its elliptical points; an investigation of the oscillations permits a complete reconstruction of the Fermi surface if the latter has a symmetry center. The author finally thanks Academician L. D. Landau for discussions and valuable remarks. There are 1 figure and 11 references, 6 of which are Soviet.

ASSOCIATION: Institut poluprovodnikov Akademii nauk SSSR (Institute of Semiconductors of the Academy of Sciences, USSR)

SUBMITTED: December 16, 1959

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24.1800,24.1200,24.2100

76983
SOV/56-37-6-23/55

AUTHOR: Gurevich, V. L.

TITLE: Absorption of Ultrasound in Metals in a Magnetic Field. II

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1959, Vol 37, Nr 6, pp 1680-1691 (USSR)

ABSTRACT: The first part of this work was presented by the author in a previous issue of this journal (cf., 37, 71, 1959). In this second part, an analysis was made of the absorption of ultrasonic energy in a metal located in a strong magnetic field **H** so that the Larmor radius of the conductivity electrons was much smaller than the wave length of the sound. Various limiting cases corresponding to various relationships between these two lengths and the mean free path were considered. The absorption coefficient was derived by a simultaneous solution of the kinetic equation and the Maxwell equations. It was found that there are two absorption mechanisms in a

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Absorption of Ultrasound in Metals in a Magnetic Field. II

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SOV/56-37-6-23/55

magnetic field. One of these, a deformation mechanism, leads to absorption also in the absence of a magnetic field. The absorption coefficient in this case can be expressed in terms of the deformation potential, i.e., in terms of functions which determine the change in the electron energy caused by the deformation. At experimentally attainable ultrasonic frequencies and in a strong magnetic field, this relation was found to be quite simple in a number of cases. The magnitude of the deformation potential can be estimated with satisfactory accuracy on the basis of the absorption data. The induction absorption was found to be due to electric fields which are formed when the conductor deformed by the sound wave crosses the magnetic force lines. Absorption was determined by the Joule heat generated by the currents due to these fields. The induction absorption coefficient can be expressed in terms of certain combinations of the conductivity tensor components with compensation for their time and spatial dispersion and the dependence on **H**. Equations were obtained for the asymptotic value of the conductivity tensor in a strong magnetic

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Absorption of Ultrasound in Metals in a Magnetic Field. II

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field with compensation for spatial dispersions. The peculiarities of the deformation mechanism of absorption were as follows: (1) the weak dependence of the absorption coefficient on the direction of the sound polarization; (2) the absorption coefficient in a strong magnetic field reaching saturation; (3) the coefficient being proportional either to the second or the first power of the frequency (and in the latter case it is independent of temperature). The expression for the ultrasonic absorption coefficient can readily be adapted to the case where $\omega t_0 \gg 1$. However, the ultrasonic frequencies of this magnitude at the present time are experimentally unattainable. L. D. Landau participated in the discussion of this work. There are 8 references, 6 Soviet, 2 U.S. The U.S. references are: S. Rodrigues, Phys. Rev. 112, 80, 1958; D. H. Reneker. Phys. Rev. Lett. 1, 447, 1958.

ASSOCIATION: Inst. Semiconductors Acad. Sciences USSR (Institut poluprovodnikov Akademii nauk SSSR)

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89215

S/056/61/040/001/021/037
B102/B212

24.7700 (1043,1143,1144,1395)

AUTHORS: Gurevich, V. L., Firsov, Yu. A.

TITLE: Theory of electrical conductivity of semiconductors in a magnetic field. I

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 40, no. 1, 1961, 199-213

TEXT: A study has been made of the effect of inelasticity of electron scattering on kinetic phenomena in a semiconductor in a strong magnetic field. A strong field is such where the diagonal tensor component of the transversal conductivity is small compared with the off-diagonal component ($\sigma_{xx}/\sigma_{xy} < 1$). The authors have restricted their studies to the Boltzmann statistics and are considering two characteristic cases: 1) The little inelastic scattering by acoustic phonons which results in a small effect only; and 2) scattering by polarized optical oscillations, when consideration of inelasticity has an influence on all characteristic relations. The

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B102/B212

Theory of electrical conductivity...

authors proceed from a formula by Kubo (Ref. 3) which expresses σ_{xx} in terms of velocity operators of the center of mass of the Landau oscillator, i.e., in terms of a Green function for an electron in a magnetic field. This method permits very general calculations, e. g., to consider Coulomb interaction of electrons. The range of strong fields has a classical range, where $\alpha = \hbar\Omega/2kT \ll 1$ (Ω is the Larmor frequency and T is the temperature), and a quantum range, where $\alpha \gtrsim 1$. The quantum theory is applied in both ranges. A formula is first derived where conductivity is expressed in terms of an integral of the retarded two-particle Green function for the electron system in a magnetic field; that is in Born approximation with respect to electron interaction with scatterers. The formula is investigated for a case where electrons obey the Boltzmann statistics, and where their mutual Coulomb interaction is negligible. Results obtained by Kubo's formula for the classical range of the field strength are compared with values calculated with the help of the equation of motion. It is found that, practically, an equation of motion can be used over the total classical range with a collision operator independent of the magnetic field strength. The authors also present a solution of the equation of motion in the magnetic field for

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electron scattering by optical phonons at low temperatures. For this case the function $\sigma_{xx}(H)$ was found to consist of two horizontal and two parts with a steep slope. The quantum corrections to σ_{xx} in the classical range have also been calculated. It was found that these can oscillate in the case of scattering by optical phonons and always pass through a maximum if the limiting frequency ω_0 of the optical oscillations amounts to a multiple of the Larmor frequency. These oscillations differ from all other known types of oscillations of statistical conductivity because they appear when applying the Boltzmann statistics. When scattering by acoustic and optical phonons for the case $\Omega \gg \omega_0$, was considered, $\sigma_{xx}(H)$ functions were found in the quantum region which agreed with those found by Adams and Holstein after excluding the logarithmic factors. For the case $\omega_0 \gg \Omega$ a non-monotonic oscillation of $\sigma_{xx}(H)$ was found. Like in the classical region σ_{xx} passes through maxima if $\omega_0 = n\Omega$; the quantum corrections were relatively small in the classical range but quite considerable in the quantum region.

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B102/B212

Theory of electrical conductivity ...

These resonance oscillations of the conductivity, predicted by theory, which are periodic in 1/H and are due to electron scattering on optical phonons, might be observed in germanium-type atomic semiconductors. The authors thank A. I. Ansel'm for discussions; B. I. Davydov, I. M. Shmushkevich, M. A. Krivoglaz, S. I. Pekar, A. I. Larkin, Yu. B. Kumer, V. L. Bonch-Bruyevich, A. G. Mironov, V. G. Skobov, O. V. Konstantinov, V. I. Perel' and M. I. Klinger are mentioned. There are 14 references: 10 Soviet-bloc and 4 non-Soviet-bloc.

ASSOCIATION: Institut poluprovodnikov Akademii nauk SSSR (Institute of Semiconductors, Academy of Sciences USSR)

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22131
S/056/61/040/003/011/031
B102/B205

24.1200 1158, 1160, 1395

AUTHORS: Gurevich, V. L., Skobov, V. G., Firsov, Yu. A.

TITLE: Giant quantum oscillations of sound absorption by metals in a magnetic field

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 40, no. 3, 1961, 786-791

TEXT: A theoretical study has been made of low-temperature sound absorption by metals placed in a magnetic field. Supposing that $\hbar\Omega \gg kT$ (Ω - Larmor frequency of electrons), that the mean free path of conduction electrons is very large compared to the sonic wavelength, and that the latter is large compared to the Larmor radius of conduction electrons, sound absorption can be regarded as a direct absorption of phonons by metal electrons. In the absence of a magnetic field, those electrons will play the principal role in absorption, whose velocity component $v_\varkappa$ in the direction of the wave vector $\vec{\varkappa}$ of sound waves is equal to the phase velocity w_p of sound. This case has already been studied by A.I.Akhiyezer,

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Giant quantum oscillations...

M. I. Kaganov, and G. Ya. Lyubarskiy (ZhETF, 32, 837, 1957), and the present authors adopted a similar procedure. For the sake of simplicity, an isotropic quadratic dispersion law is assumed to hold for electrons; so, the electron energy in the magnetic field is given by $\varepsilon_n = \hbar\Omega(n+1/2) + p_z^2/2m$, where n indicates the oscillator quantum number according to Landau, $\Omega = eH/mc$ the Larmor frequency, m the effective mass, and p_z the projection of the quasi-momentum on the direction of the field $\vec{H}$ ($\equiv$ z-axis). Taking into account the theorems of conservation of energy and quasi-momentum, and $\varepsilon_{n'}(p_z+\hbar\varkappa_z) = \varepsilon_{n'}(p_z) + \hbar v_z\varkappa_z$, one obtains the condition $\Omega(n'-n) + w_p\varkappa = v_z\varkappa_z$ (5). If the magnetic field is strong enough and, thus, $\Omega > \varkappa_z v_F$ (v_F - Fermi velocity), then condition (5) will be satisfied only with $n = n'$. Then, the quasi-momentum of electrons participating in sound absorption is equal to $p_z^0 = mw_p/\cos\vartheta$, where ϑ symbolizes the angle between the vectors $\vec{\varkappa}$ and $\vec{H}$. However, if $w_p \ll v_F$, then those electrons will make the greatest contribution to sound

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Giant quantum oscillations...

absorption, for which $p_z \ll p_F$. On the other hand, only those electrons participate in absorption, the energies of which belong to a blurred Fermi distribution. The quasi-momenta corresponding to these energies are shown in the attached figure. $\varepsilon_n(p_z)$ are parabolas cutting the band of width kT. Its center line forms the level of the chemical potential ζ. The band width is smaller than the distance between the parabolas, in accordance with the condition $\hbar\Omega \gg kT$. The projections of the sections on the abscissa indicate the intervals of allowed and forbidden p_z values. The width of the intervals diminishes as one approaches p_F. Their position depends on $\vec{H}$. If $\vec{H}$ is such that p_z^o is in the interval of allowed p_z values, a particularly strong sound absorption will occur. The occurrence of giant oscillations of the coefficient of sound absorption is determined by the condition $\zeta \gg \hbar\Omega \gg kT$. This case is now investigated in greater detail. The contribution to absorption by transverse electric fields produced by deformation of the conductor by sound waves is neglected, and elastic electron scattering is assumed.

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$$\Gamma = \frac{\pi}{V_0 \rho u_0^2 w} \sum_{\alpha\alpha'} \frac{\partial F_\alpha}{\partial \zeta} |\langle \alpha | U | \alpha' \rangle|^2 \delta(\omega_{\alpha\alpha'} + \omega). \qquad (14)$$

is obtained for the coefficient of sound absorption. Here, ρ is the density of the crystal, u_0 the sound-wave amplitude, w the group velocity of sound, V_0 the volume of sound, $\langle \alpha | U | \alpha' \rangle$ a matrix element of the operator U ($U = \Lambda_{ik} u_{ik} \cdot e^{i\vec{\varkappa}\vec{r}}$; u_{ik} = amplitude of the deformation tensor in the sound wave; Λ_{ik} = tensor related to the quasi-momentum); the subscripts α and α' indicate the state of the free electron in the magnetic field; $\hbar\omega_{\alpha\alpha'} = \varepsilon_\alpha - \varepsilon_{\alpha'}$. In the simplest case where the components of Λ_{ik} are constant, the electron spectrum is quadratic and isotropic, and $\vec{\varkappa}$ and $\vec{H}$ are parallel, one has

$$\Gamma = \Gamma_0 \frac{\hbar\Omega}{8kT} \frac{\varkappa}{m} \sum_{n, s_z} \int dp_z \delta\left(\frac{\varkappa p_z}{m} + \frac{\hbar\varkappa^2}{2m} - \omega\right) \times$$
$$\times \mathrm{ch}^{-2}\left[\frac{\zeta - \hbar\Omega(n + 1/2) - \mu_0 s_z H - p_z^2/2m}{2kT}\right], \qquad (16)$$

where μ_0 is the Bohr magneton. $\Gamma_0 = m^2 |\Lambda_{ik} n_{ik}|^2 / 2\pi\hbar^2 \rho n_0^2 \varkappa\omega$ is the

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Giant quantum oscillations...

coefficient of sound absorption at H = 0. Integration with respect to p_z yields

$$\Gamma = \Gamma_0 \frac{\hbar\Omega}{8kT} \sum_{n, s_z} \mathrm{ch}^{-2}\left[\frac{\hbar\Omega(n + 1/2) + s_z\mu_0 H - \zeta}{2kT}\right]. \quad (18)$$

If $\hbar\Omega \ll kT$ and summation is performed over n, one obtains $\Gamma = (\Gamma_0/2) \int_0^\infty \frac{dy}{\mathrm{ch}^2(y - \zeta/2kT)} \approx \Gamma_0$. Finally, the experimentally interesting case $\hbar\varkappa^2/2m \ll \nu$; $\omega \ll \nu$ is discussed. Here, the δ-function can be replaced by $\nu/\pi[\nu^2 + (\hbar\varkappa p_z/m)^2]$, and by proceeding to the dimensionless integration variable y one obtains

$$\Gamma = \Gamma_0 \frac{\hbar\Omega}{2kT} \int dy \frac{1}{\pi} \frac{B}{1 + B^2y^2} \sum_{n, s_z} \frac{1}{4} \mathrm{ch}^{-2}\left(\frac{y - A_n}{2}\right). \quad (22)$$

$y = p_z(2mkT)^{-1/2}$; $B = (2kT/m)^{1/2}\varkappa/\nu$; $A_n = [\zeta - \hbar\Omega(n + \frac{1}{2}) - s_z\mu_0 H]/kT$. In the case of giant oscillation, the ratio between the maximum and the minimum absorption coefficients is given by $\Gamma_{max}/\Gamma_{min} \sim \varkappa l(\hbar\Omega/\zeta)^{1/2}\hbar\Omega/kT \gg 1$ (25). It is noted that classical computations are only possible if $\hbar\Omega \ll kT$; if

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B102/B205

Giant quantum oscillations...

$\hbar\Omega \gg kT$, sound absorption in a magnetic field must be treated in a quantum-theoretical manner. There are 1 figure and 4 Soviet-bloc references.

ASSOCIATION: Leningradskiy fiziko-tekhnicheskiy institut Akademii nauk SSSR (Leningrad Institute of Physics and Technology, Academy of Sciences USSR); Institut poluprovodnikov Akademii nauk SSSR (Institute of Semiconductors, Academy of Sciences USSR)

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27196

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B111/B212

24.7700

AUTHORS: Firsov, Yu. A., Gurevich, V. L.

TITLE: Theory of the electrical conductivity of semiconductors in a magnetic field. II

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 41, no. 2, 1961, 512-523

TEXT: In (Ref. 1: ZhETF, 40, 199, 1961) V. L. Gurevich and Yu. A. Firsov obtained an expression for the diagonal elements of the tensor (σ_{xx}) of transverse conductivity in semiconductors located in a strong magnetic field. Electron interaction was neglected. The present paper deals with the influence of this interaction on the conductivity for the case of an isotropic and quadratic electron spectrum. For systems with electron-electron interaction, σ_{xx} will be equal to zero, but it will differ from zero if there are interactions with other scatterers, e.g., phonons. The electron energy is calculated by quantum-mechanical methods and specialized for the case of Boltzmann statistics and a quadratic and

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B111/B212

Theory of the electrical...

isotropic spectrum. Electron-phonon interaction and consequently, scattering probability are found to increase abruptly if the phonon frequency is close to the eigenfrequency of the electron system. The authors construct precise theory, based on Kubo's formula for σ_{xx} (Ref. 4, see below) and σ_{xx} is expanded in a power series of the electron-phonon interaction. An exact formula is derived for σ_{xx}, and some graphs are discussed. The expression is examined for the case where the electrons obey a Boltzmann statistics and their scattering can be described in the Born approximation. As an example, the amplitude height of resonance conductivity oscillations is computed. A. I. Larkin (ZhETF, 37, 264, 1959), O. V. Konstantinov, V. I. Perel' (ZhETF, 39, 197, 1960), M. Born, Huang K'un (Dinamicheskaya teoriya kristallicheskikh reshetok - Dynamic theory of crystal lattices, IIL, 1958, chapter II, § 8) are mentioned. There are 1 figure and 11 references: 7 Soviet and 4 non-Soviet. The three most important references to English-language publications read as follows: Ref. 4: R. Kubo, J. Phys. Soc., Japan, 12, 570, 1957; Ref. 8: E. N. Adams, T. D. Holstein, J. Phys. Chem. Solids, 10, 254, 1959; Ref. 2: S. Doniach, Proc. Phys. Soc., 73, 849, 1959.

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Theory of the electrical...

ASSOCIATION: Institut poluprovodnikov Akademii nauk SSSR (Institute of Semiconductors of the Academy of Sciences USSR)

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S/056/61/041/004/014/019
B111/B112

24.2120(1049,1144,1160)

AUTHORS: Gurevich, V. L., Firsov, Yu. A.

TITLE: Theory of plasma diffusion in a magnetic field

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 41, no. 4, 1961, 1151 - 1167

TEXT: The transverse diffusion coefficient for particles in completely ionized plasma is determined by employing a graph technique. The Born parameter is assumed to be small, the magnetic field is assumed to be strong, and the Larmor frequency of electrons is assumed to be much higher than their collision frequency. The role of electrons and ions in the screening of the electron-ion interaction, the deformation of Debye clouds, and the inelastic scattering of electrons and ions are taken into account. The corrections to the diffusion coefficient for the effect of the magnetic field on electron-ion collisions are estimated. The case is studied, where the Debye radius is smaller than the Larmor radius of electrons but larger than the Larmor radius of ions, and where the magnetic field affects the collisions considerably. The general expression for the

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B111/B112

Theory of plasma diffusion in ...

electronic conductivity σ_{xx}^{ee} in the x-direction can be expanded in a series of $1/\Omega\tau$ (Ω denotes the Larmor frequency, τ the electron relaxation time). σ_{xx}^{ee} is calculated by the graph technique of O. V. Konstantinov and V. I. Perel' (Refs. 2 and 3: ZhETF, 39, 197, 1960), which is described here again. A formula for the overall contribution to the conductivity obtained by calculating the normalized electron-electron interaction is presented. The general expression for σ_{xx}^{ee} is given by

$$D_{xx}^{ee} = \frac{n}{8\pi^2}\left(\frac{c}{eH}\right)^2 \int d^3q\, q_y^2 \left(\frac{4\pi e^2}{q^2}\right)^2 \int_{-\infty}^{\infty} d\omega \frac{F_q^l(\omega)\, F_q^t(\omega)}{A^2(\omega, q) + B^2(\omega, q)} \equiv$$

$$\equiv [ne^4/\pi\sqrt{2}m^{1/2}(kT)^{1/2}\Omega^2]\,\mathcal{J}, \tag{33}$$

$$A(\omega, q) = 1 + \varkappa^2 q^{-2}\,[\mathrm{Re}\,P_q^t(\omega) + \mathrm{Re}\,P_q^l(\omega)], \tag{34}$$

$$B(\omega, q) = \varkappa^2 q^{-2}\,[\mathrm{Im}\,P_q^t(\omega) + \mathrm{Im}\,P_q^l(\omega)]. \tag{35}$$

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where $D_{xx}^{ee} = \sigma_{xx}^{ee} / ne^2\beta$, and

$$F_q^e(\omega) = \hbar\beta \frac{\operatorname{Im} P_q^e(\omega)}{2\pi \operatorname{sh}(\hbar\omega\beta/2)} = \frac{1}{nV_0} e^{\hbar\omega\beta/2} \sum_{\lambda\lambda'} |\langle\lambda| e^{iqr} |\lambda'\rangle|^2 n_\lambda \delta(\omega - \omega_{\lambda\lambda'}) \quad (31)$$

and

$$P_q^e(\omega) = \frac{2}{\hbar\beta} \int_0^\infty dt\, e^{-i\omega t} \sin\left(\frac{\hbar q_z^2}{2m} t + \frac{\hbar q_\perp^2}{2m\Omega} \sin \Omega t\right) \times$$
$$\times \exp\left(-\frac{q_z^2}{2m\beta} t^2 - \frac{\hbar q_\perp^2}{m\Omega} \operatorname{cth} \frac{\hbar\Omega\beta}{2} \sin^2 \frac{\Omega t}{2}\right), \quad (28)$$

The general formulas are simplified for $\varkappa R \gg 1$, $q_z \gg 1/R$, where $R = v_T/\Omega$.

$$D_{xx} = \frac{2}{3}\left(\frac{2\pi m}{kT}\right)^{1/2}\left(\frac{c}{eH}\right)^2 ne^4 \left\{\ln \frac{1}{2eC_1\xi^2} - \frac{1}{\sqrt{\pi}} \int_0^\infty e^{-x^2} \ln[a^2(x) + b^2(x)]\, dx - \right.$$
$$\left. - \frac{2}{\sqrt{\pi}} \int_0^\infty \left[\frac{a(x)}{b(x)} \operatorname{arctg} \frac{b(x)}{a(x)} - 1\right] e^{-x^2} dx\right\}, \quad (43)$$

holds theoretically for D_{xx}, where $C = 0.577$. However, the true expression is

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

28930 S/056/61/041/004/014/019
B111/B112

Theory of plasma diffusion in ...

$D_{xx} = \frac{2}{3} \cdot \left(\frac{2\pi m}{kT}\right)^{1/2} \cdot \left(\frac{c}{eH}\right)^2 \cdot ne^4 \cdot \ln(0.55\, q_T^2/\varkappa^2 \cdot \mathcal{J}$ at $1 \gg \varkappa R \gg 1/\gamma$ and $1/\gamma^2 \gtrsim q_c R$ (q_c - characteristic cut-off momentum) is given by $\mathcal{J} = \frac{8\pi^{3/2}}{3} \ln(q_T R) + 4\pi^{3/2} \ln\left(\frac{1}{\varkappa R}\right) \ln \gamma$. The only difference between this expression and that of S. T. Belyayev (Ref. 15: Fizika plazmy i problema upravlyayemykh termoyadernykh reaktsiy, 3, Izd. AN SSSR, 1958, str. 66) is that q_T is replaced by kT/c^2. This might mean that the small size of the Born parameter is only necessary for collisions with large momentum transfer, whereas in the case of small momentum transfers the contribution does not depend on - whether or not Born approximation is applied. The authors thank V. I. Perel'. V. G. Skobov (Ref. 12: ZhETF, 37, 1457, 1959; 38, 1304, 1960), L. D. Landau (Ref. 1: ZhETF, 7, 203, 1937) and O. V. Konstantinov, V. I. Perel' (Ref. 2: ZhETF, 39, 861, 1960) are mentioned. There are 10 figures and 15 references: 11 Soviet and 4 non-Soviet. The three most recent references to English-language publications read as follows: H. Brooks, Phys. Rev., 83, 879, 1951.

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

28930
S/056/61/041/004/014/019
B111/B112

Theory of plasma diffusion in ...

R. Kubo, J. Phys. Soc. Japan, 12, 570, 1957. E. N. Adams, T. D. Holstein, J. Phys. Chem. Solids, 10, 254, 1959.

ASSOCIATION: Institut poluprovodnikov Akademii nauk SSSR (Institute of Semiconductors of the Academy of Sciences USSR)

SUBMITTED: April 1, 1961

Card 5/5

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

33356
S/181/62/004/001/029/052
B123/B104

24,2140 (1072, 1147, 1164)

AUTHORS: Gurevich, V. L., Larkin, A. I., and Firsov, Yu. A.

TITLE: Possibility of semiconductor superconductivity

PERIODICAL: Fizika tverdogo tela, v. 4, no. 1, 1962, 185 - 190

TEXT: The authors discuss the possibility of a transition of a semiconductor into the superconducting state. Such a transition is found to be impossible in nonpolar semiconductors at a carrier concentration $n \ll 10^{19}$ since due to the low electron state density near the Fermi surface phonon attraction between the electrons is weaker than their Coulomb repulsion. Transition in polar, nonpiezoelectric semiconductors is possible only if the Fermi energy is much higher than the limit frequencies of the longitudinal optical vibrations. The authors obtained conditions for bringing about this transition which are the more favorable the more strongly the electron and lattice vibrations are coupled. These conditions are defined for InSb-type piezoelectric semiconductors with a nonpiezoelectric semiconductor being considered first. The results hold both for conduction electrons and donors, and for holes and acceptors.

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

S/181/62/004/001/029/052
B123/B104

Possibility of semiconductor...

The authors mention Abrikosov who studied the superconductivity of metals with high electron gas density, and N. N. Bogolyubov et al. who made calculations for metals (Novyy metod v teorii sverkhprovodimosti, izd. AN SSSR, 1958). The authors first consider a model with isotropic effective mass. They derive an equation for calculating the energy gap

$$\Delta(\omega) = -\frac{i\alpha}{\pi}\int\int\left(1-\frac{\varepsilon_\infty}{\varepsilon_s}\frac{\omega_l^2}{\omega_l^2-(\omega-\omega_1)^2}\right)\frac{\Delta(\omega_1)\,d\zeta_1\,d(\hbar\omega_1)}{(\hbar\omega_1)^2-\xi_1^2-\Delta^2-i\delta}. \quad (12)$$

$$\alpha = \frac{e^2}{4\pi\hbar v_F \varepsilon_\infty}\ln\frac{p_F^2}{\hbar^2\omega_l^2}; \quad (13).$$

v_F = electron velocity at Fermi surface, ε_s, ε_∞ = dielectric constants, $\xi^2 = (p - p_F)^2 v_F^2$, ω_l = frequency of longitudinal optical phonons, ζ -Fermi energy. For other denotations c.f. G. M. Eliashberg, ZhETF, 38, 966, 1960. It can be seen that the maximum gap width corresponds to the minimum velocity at the Fermi surface, i. e., to the maximum effective mass.

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

33356

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B123/B104

Possibility of semiconductor...

These formulas obtained for the model with isotropic effective mass also hold for the anisotropic case up to and including one numerical factor under the natural logarithm. In piezoelectric semiconductors the attractive force between the electrons contributes to the exchange of piezoacoustic phonons. Superconductivity can be the most favorably studied in those polar semiconductors in which the electrons in the conduction band are sufficiently concentrated and in which they are strongly coupled with the lattice vibrations. There are 1 figure and 4 references: 3 Soviet and 1 non-Soviet. The reference to the English-language publication reads as follows: J. Bardeen, L. Cooper, J. Schrieffer. Phys. Rev., 108, 1175, 1957.

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors AS USSR, Leningrad)

SUBMITTED: July 24, 1961

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

34242
S/181/62/004/002/036/051
B102/B138

7700 (1035, 1043, 1055, 1144)

AUTHORS: Gurevich, V. L., and Firsov, Yu. A.

TITLE: Theory of the entrainment of electrons by phonons in semiconductors of the rhombohedral system

PERIODICAL: Fizika tverdogo tela, v. 4, no. 2, 1962, 530-537

TEXT: When phonons of non-equilibrium distribution (due to a temperature gradient), collide with conduction electrons, the resulting electron flow causes a current. This effect of electron entrainment by phonons was first investigated by L. E. Gurevich (ZhETF, 16, 193, 1946), and the theory has been developed by C. Herring. The theoretical considerations of the present paper relate to the experiments carried out by I. N. Timchenko and S. S. Shalyt (FTT, 1961) with p-type tellurium. The order of magnitude and the temperature dependence of the thermo-emf are determined for various directions of temperature gradient to the crystal axis. The carrier concentration is assumed to be so low that the effect of the electrons on the non-equilibrium phonons is negligible. The problem consists of two parts: 1) Solution of the kinetic equation for

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the phonons which gives the non-equilibrium addition to the phonon distribution function; 2) Solution of the electron kinetic equation. a "force" proportional to this addition acts upon the electron. It is shown that if the isoenergetic surface of the carriers is in crystal symmetry, the estimate gives almost the same as would result from the isotropic spectrum. The hole spectrum of tellurium has these properties and consists; as L. I. Korovin and Yu. A. Firsov (ZhTF, 28, 11, 2417, 1958) have shown, of one or two ellipsoids of revolution with centers on the third order axis. The main role in the entrainment is that of the acoustic phonons of the branch with maximum frequency $\omega(\vec{q})$. For a rhombohedral crystal of class D_3 and $T \ll \Theta$, the relaxation time of longitudinal phonons contacting the vibrational branches is given by

$$\tau_1(q) = f^{-1}(\vartheta, \varphi)\frac{a_0}{w}\left(\frac{q_T}{q}\right)^2. \qquad (13)$$

$$q_T = \left(\frac{M\omega^2}{kT}\right)^{1/2}\left(\frac{\Theta}{T}\right)\frac{k\Theta}{\hbar\omega},$$

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and when they join it,

$$\tau_2 = f_2^{-1}(\theta, \varphi)\frac{a_0}{w}\left(\frac{q_p}{q}\right)^3, \quad q_p = \frac{k\theta}{\hbar w}\left(\frac{\theta}{T}\frac{Mw^2}{kT}\right)^{1/2}. \qquad (14).$$

M - mass of the crystal unit cell, w - mean sonic velocity, a_0 - lattice constant, θ - Debye temperature, $f_{1,2}(\ ,\ )$ are dimensionless functions of the angles, which tend to zero as φ^2 if $\varphi \to 0$. φ is the angle between q and the z-axis which coincides with one of the second-order axis. In these two cases

$$\alpha_{xx}^{(1)} = \frac{\eta_{xx}^{(1)}}{\sigma_{xx}} \simeq \frac{k}{e}\frac{a_0 E_0}{\hbar w}\frac{Mw^2}{kT}\left(\frac{\theta}{T}\right)^2\left(\frac{k\theta}{\hbar w}\right)^2\frac{E_0\bar{m}^2}{\hbar c(mkT)^{1/2}} \sim \frac{1}{T^{1/2}}, \qquad (15a)$$

$$\alpha_{xx}^{(2)} = \frac{\eta_{xx}^{(2)}}{\sigma_{xx}} \simeq \frac{k}{e}\frac{a_0 E_0}{\hbar w}\frac{Mw^2}{kT}\frac{\theta}{T}\frac{\bar{m}E_0}{\rho kT}\left(\frac{k\theta}{\hbar w}\right)^3 \sim \frac{1}{T^3}. \qquad (15b)$$

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hold. σ_{xx} is the component of the conductivity tensor, η_{xx} is given by

$$\eta_{xx} = \frac{neE_0^2 l}{kT^2\rho} \int_{\Omega} d^3\mathbf{q}\, q \sin^2\vartheta\, g_2(\vartheta, \varphi)\, \tau(\mathbf{q}). \qquad (5).$$

ρ is the crystal density and n the electron concentration, E_0 is the constant of the deformation potential. Some of the other characteristics of the phonon spectrum are also discussed. S. S. Shalyt and I. N. Timchenko are thanked for discussions. L. D. Landau and Ye. M. Lifshits (Mekhanika sploshnykh sred - Continuum mechanics - GITTL , 195) are mentioned. There are 2 figures and 12 references: 9 Soviet and 3 non-Soviet. The three references to English-language publications read as follows: C. Herring. Phys. Rev. 95, 954, 1954; 96, 1163, 1954; H. J. Fan, R. S. Caldwell. Phys. Rev. 94, 1427, 1954; Reports on Progress in Phys. XIX, 107, 1956.

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

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34242
S/181/62/004/002/036/051
Theory of the entrainment of electrons ... B102/B138

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors of the AS USSR, Leningrad)

SUBMITTED: October 7, 1961

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

35869
S/181/62/004/004/011/042
B104/B108

24.1200
24.2800

AUTHOR: Gurevich, V. L.

TITLE: The theory of sound absorption in piezoelectrics

PERIODICAL: Fizika tverdogo tela, v. 4, no. 4, 1962, 909 - 917

TEXT: The absorption of sound in piezoelectric semiconductors, caused by interaction between the electric fields resulting from the propagation of sound and the carriers was investigated. The velocity of sound in a piezoelectric cubic crystal along a third order axis is described with the three elastic moduli and the piezoelectric tensor which in this case is a plain scalar factor. At low acoustic frequencies, absorption is proportional to the square of the acoustic frequency and inversely proportional to the crystal conductivity. With the increase in acoustic frequency absorption passes through a maximum. The deformation absorption in a cubic crystal is compared with the absorption examined here. In the case of a nondegenerate band, the deformation absorption is small as compared with piezoelectric absorption. In cases of complex bands and in intrinsic

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

semiconductors it is considerably larger. To separate piezoelectric from lattice absorption, acoustic absorption is examined in a magnetic field. If $\Omega\tau \gg 1$ and if the magnetic field is perpendicular to the direction of sound propagation, the sound absorption coefficient rises with the square of the magnetic field strength. Ω is the Larmor frequency, τ is the relaxation time of the conduction electrons. The lattice absorption in this case is independent of H, and the velocity of sound can be studied from changes in the magnetic field strength. The induction absorption of sound in the presence of a magnetic field is examined. At high ultrasonic frequencies, the electroacoustic effect is easier to observe than absorption of sound.

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors AS USSR, Leningrad)

SUBMITTED: November 22, 1961

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37935

S/181/62/004/005/026/055
B125/B108

AUTHORS: Gurevich, V. L., Lang, I. G., and Firsov, Yu. A.

TITLE: The role of optical phonons in infrared absorption by free carriers in semiconductors

PERIODICAL: Fizika tverdogo tela, v. 4, no. 5, 1962, 1252-1262

TEXT: This is a study of infrared absorption by free carriers in semiconducting cubic crystals. The damping (caused by the anharmonic lattice forces) of the optical vibrations ($\gamma \ll \omega$) does not depend on electron concentration. In the case of weak interaction between electrons and optical vibrations, the dielectric constant $\varepsilon(\omega) = \varepsilon_L(\omega) + \varepsilon_e(\omega)$ consists of the lattice part ε_L and the electron part $\varepsilon_e = 4\pi i\sigma(\omega)/\omega = a_e(\omega) + ib_e(\omega)$. For $\omega\tau \ll 1$, σ is virtually independent of ω and equal to its statistical value. τ is the characteristic relaxation time. $a_e(\omega) = -4\pi ne^2/m\omega^2$ holds in the case of a square-law isotropic dispersion. The expressions

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$$\mathrm{Re}\,\sigma = \frac{2ne^2\alpha}{3m\omega_l}\left(\frac{\omega_l}{\omega}\right)^{5/2} F\left(\frac{\hbar\omega}{2kT}, \frac{\hbar\omega_l}{2kT}\right), \tag{17}$$

$$F(x, y) = \sqrt{\frac{2}{\pi}}\, x^{-1/2} \frac{\mathrm{sh}\, x}{\mathrm{sh}\, y} [|x-y| K_1(|x-y|) + (x+y) K_1(x+y)] \tag{18}$$

hold in the case of Boltzmann statistics where $K_1(z)$ is the MacDonald function of first order. In the limiting cases where $\hbar(\omega - \omega_1)/kT \gg 1$, $\hbar|\omega - \omega_1|/kT \ll 1$, and $\hbar(\omega_1 - \omega) \gg kT$ at sufficiently low temperatures, Eq. (17) assumes the forms

$$\mathrm{Re}\,\sigma = \left(\frac{2ne^2\alpha}{3m\omega_l}\right)\left(\frac{\omega_l}{\omega}\right)^{5/2}\left(1 - \frac{\omega_l}{\omega}\right)^{1/2} \tag{19}$$

$$\mathrm{Re}\,\sigma = \left(\frac{2ne^2\alpha}{3m\omega_l}\right)\left(\frac{2}{\sqrt{\pi}}\right)\left(\frac{\hbar\omega_l}{kT}\right)^{-1/2} \tag{20}$$

and

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$$\mathrm{Re}\,\sigma = \frac{2n^2\alpha}{3m\omega_l}\left(\frac{\omega_l}{\omega}\right)^{3/2}\left(\frac{\omega_l}{\omega}-1\right)^{1/2}\exp\left[-\frac{\hbar(\omega_l-\omega)}{kT}\right], \qquad (21)$$

respectively. Re $\sigma(\omega)$ increases rapidly at frequencies $\hbar\omega - \omega_l/kT \sim 1$ because of the threshold production of optical phonons. The dissipation of energy described by Re $\sigma(\omega)$ is caused by second-order effects.

$$\mathrm{Re}\,\varepsilon(\omega) = \varepsilon_\infty\left[\frac{(\omega_l^2-\omega^2)(\omega_t^2-\omega^2)}{(\omega_t^2-\omega^2)^2+\omega^2\gamma^2}-\frac{\omega_p^2}{\omega^2}\right], \qquad (22).$$

For $\omega < \omega_t$, the experimental absorption coefficient increases with frequency. For $\hbar\omega_l/kT \gg 1$, absorption decreases exponentially with decreasing temperature. In the case of Fermi statistics at T=0,

$$\mathrm{Re}\,\sigma = \frac{\alpha}{3\pi^2 2^{1/2}}\frac{e^2 m^{1/2}\omega_l^{1/2}}{\hbar^{5/2}}\left(\frac{\zeta}{\hbar\omega}\right)^2\left(\frac{\omega_l}{\omega}\right)f\left(\frac{\hbar\omega}{\zeta}\right). \qquad (23)$$

with

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$$\left.\begin{aligned} f(x)&=0 \qquad (\text{при } x<0);\\ f(x)&=2(\sqrt{1+x}-\sqrt{1-x})+x(\sqrt{1+x}+\sqrt{1-x})-\\ &-\left(\frac{x^2}{4}\right)\ln\frac{\left[\left(1-\frac{x}{2}\right)-\sqrt{1-x}\right]\left[\left(1+\frac{x}{2}\right)+\sqrt{1+x}\right]}{\left[\left(1+\frac{x}{2}\right)-\sqrt{1+x}\right]\left[\left(1-\frac{x}{2}\right)+\sqrt{1-x}\right]} \quad (\text{при } 0<x\leqslant 1); \end{aligned}\right\} \tag{24}$$

$$\left.\begin{aligned} f(x)&=(2+x)\sqrt{1+x}-\left(\frac{x^2}{4}\right)\ln\frac{1+\frac{x}{2}+\sqrt{1+x}}{1+\frac{x}{2}-\sqrt{1+x}} \quad (\text{при } x\geqslant 1);\\ x&=\frac{\hbar(\omega-\omega_l)}{\zeta}. \end{aligned}\right\} \tag{25}$$

is valid when $\hbar\omega_1/kT \gg 1$, $\hbar|\omega - \omega_1|/kT \gg 1$ and $p_F^2/2m \gg kT$. p_F is the Fermi momentum. There are 4 figures. The most important English-language reference is: R. Newman. Phys. Rev., 111, 1518, 1958.

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The role of optical phonons in infrared S/181/62/004/005/026/055
B125/B108

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors AS USSR, Leningrad)

SUBMITTED: January 2, 1962

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37951

S/181/62/004/005/054/055
B163/B138

24.7000

AUTHOR: Gurevich, V. L.

TITLE: Avalanche production of excitons in semiconductors

PERIODICAL: Fizika tverdogo tela, v. 4, no. 5, 1962, 1380-1382

TEXT: Exciton production in a strong electric field is investigated theoretically. If the phase velocity of the excitons is smaller than the drift velocity of the electrons, the electronic contribution γ_e to the damping constant γ can become negative. If in this case $|\gamma_e|$ exceeds the lattice contribution γ_L to the damping constant, the amplitude of an exciton wave will grow exponentially instead of being damped. This effect has been theoretically predicted for one type of exciton - the acoustic vibrations in piezoelectrics, by Hutson and co-workers (Phys. Rev. Lett., 7, 1961, 237), but it should exist for all types of lattice excitons whose energy and quasi-momentum are not too large compared with the average values of the corresponding electronic quantities. The special case of longitudinal excitons is treated where the mean free path l and the mean free time τ of one type of current carrier satisfy the conditions $ql \ll 1$,

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$\omega\tau \ll 1$. ω and q are frequency and wave number resp. of the exciton waves. Besides a direct observation of the avalanche production it may be possible to confirm the effect indirectly by observing the emitted electromagnetic radiation. Even if the condition $\gamma = \gamma_e + \gamma_L < 0$ is not satisfied, a reduction in the absorption coefficient for electromagnetic waves may become observable. Such a reduction may also be useful for the observation of other effects, which under normal conditions are masked by strong absorption.

ASSOCIATION: Institut poluprovodnikov AN SSSR, Leningrad (Semiconductor Institute of the AS USSR Leningrad)

SUBMITTED: February 10, 1962

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GUREVICH, V.L.; FIRSOV, Yu.A.; EFROS, A.L.

New type of magnetoresistance oscillations in semidonductors and semimetals. Fiz.tver.tela 4 no.7:1813-1819 Jl '62. (MIRA 16:6)

1. Institut poluprovodnikovAN SSSR, Leningrad.
(Magnetoresistance) (Semiconductors--Electric properties)

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V.L.; KAGAN, V.D.

Absorption of ultrasound in piezoelectric semiconductors. Fiz. tver. tela 4 no.9:2441-2446 S '62. (MIRA 15:9)

1. Institut poluprovodnikov AN SSSR, Leningrad.
(Absorption of sound) (Piezoelectric substances)

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43370

S/056/62/043/005/031/058
B102/B104

AUTHOR: Gurevich, V. L.

TITLE: Current fluctuations in semiconductors near the non-equilibrium steady state

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 43, no. 5(11), 1962, 1771 - 1781

TEXT: The author considers the electron gas in the conduction band of a semiconductor to which a strong stationary electrical field $\vec{E}$ is applied. The electron gas is characterized by the single-particle distribution function $\overline{F}_p$ that obeys the kinetic equation $e\left(\vec{E}+\frac{1}{c}[\vec{v}\vec{H}]\right)\frac{\partial}{\partial\vec{p}}\overline{F} = -\hat{S}\overline{F}$. Here $\vec{p}$, e, $\vec{v}$ are the electron quasimomentum, charge and velocity, and $\hat{S}$ is the collision operator, which, as Fermi degeneracy is neglected, is a linear one. The electrons will transfer their energy obtained from the field to scatterers (e.g. phonons) whose state is assumed as quasisteady. Then the above equation will have a time-independent solution; if the stationary distribution $\overline{F}$ is known, the mean current density $\vec{J}$, a nonlinear function

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

of $\vec{E}$, can be found. At any moment of time t, F_p and also $\vec{J}$ will fluctuate: $F_p = \bar{F}_p + \delta F_p(t)$ and $\vec{J} = \bar{\vec{J}} + \delta\vec{J}$ and the correlators $\overline{\delta J_i(r,t+\tau)\delta J_k(r',t)}$ will differ from zero. The bar denotes averaging over t. Since spatial correlations of current fluctuations are neglected

$$\overline{\delta J_i(\mathbf{r}, t+\tau)\,\delta J_k(\mathbf{r}', t)} \sim \delta^3(\mathbf{r} - \mathbf{r}').$$

$$\overline{\delta J_i(\mathbf{r}, t+\tau)\,\delta J_k(\mathbf{r}', t)} = \overline{\delta J_i(\tau)\,\delta J_k}\,\delta^3(\mathbf{r} - \mathbf{r}'); \tag{2}$$

$$\overline{\delta J_i(\tau)\,\delta J_k} = \int_{-\infty}^{\infty} (\delta J_i\,\delta J_k)_\omega\, e^{-i\omega\tau}\, d\omega.$$

$$(\delta J_i\,\delta J_k)_\omega = \frac{1}{2\pi}\int_{-\infty}^{\infty} d\tau\, e^{i\omega\tau}\,\overline{\delta J_i(\tau)\,\delta J_k}. \tag{2a}$$

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

The steady state is assumed as stable, so $\overline{\delta J_i(\tau)\delta J_k} \to 0$ for great τ and (2a) converges. The aim is now to derive a kinetic equation for studying the current fluctuations near the steady state:

$$-i\omega\gamma_p^k(\omega) + e\left(\mathbf{E} + \frac{1}{c}[\mathbf{vH}]\right)\frac{\partial}{\partial \mathbf{p}}\gamma_p^k(\omega) + \sum_{p'} S_{pp'}\gamma_{p'}^k(\omega) = \frac{1}{2\pi}\overline{\delta F_p \delta J_k}\,. \qquad (6)$$

where $S_{pp'}$ are the matrix elements of the collision operator, and

$$\gamma_p^k(\omega) = \frac{1}{2\pi}\int_0^\infty d\tau e^{i\omega\tau}\overline{\delta F_p(\tau)\,\delta J_k}. \qquad (5)$$

If $\bar{F}_p \ll 1$,

$$-i\omega\gamma_p^k + e\left(\mathbf{E} + \frac{1}{c}[\mathbf{vH}]\right)\frac{\partial}{\partial \mathbf{p}}\gamma_p^k + \sum_{p'} S_{pp'}\gamma_{p'}^k = \frac{ev_p^k}{2\pi}\bar{F}_p. \qquad (9)$$

$$(\delta J_i\,\delta J_k)_\omega = 2e\sum_p [v_p^i\gamma_p^k(\omega) + v_p^k\gamma_p^i(-\omega)] \qquad (11)$$

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follow. The diagonal elements of this tensor are

$$(\delta J_i^2)_\omega = 4e \operatorname{Re} \sum_p v_p^i \gamma_p^k (\omega). \qquad (11a).$$

For a variable electrical field $\mathcal{E}^k = \mathcal{E}_0^k e^{-i\omega t}$.

$$-i\omega g_p^k + e(E + \frac{1}{c}[\vec{v}\vec{H}]) \frac{\partial}{\partial p} g_p^k = -\sum_{p'} S_{pp'} g_{p'}^k - e \frac{\partial \bar{F}}{\partial p_k} \qquad (12)$$

where $j_i = \Lambda_{ik} \mathcal{E}_k$ and $\Lambda_{ik} = 2\sum_p v_p^i g_p^k(\omega)$. In this way also fluctuations of other parameters can be considered. These fundamental formulas are now applied to investigating the current fluctuations in atomic semiconductors with strong $\vec{E} \| z$ and $\vec{H}=0$, the electron and phonon dispersion laws being $\varepsilon_p = p^2/2m$ and $\omega_q = wq$. From (9)

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$$-i\omega\gamma_{\mathbf{p}}^{k}+e\mathbf{E}\frac{\partial}{\partial\mathbf{p}}\gamma_{\mathbf{p}}^{k}+\frac{2\pi}{\hbar}\sum_{\mathbf{q}}|c_{\mathbf{q}}|^{2}\times$$
$$\times\{\gamma_{\mathbf{p}}^{k}(N_{\mathbf{q}}+1)\,\delta(\varepsilon_{\mathbf{p}-\hbar\mathbf{q}}-\varepsilon_{\mathbf{p}}+\hbar\omega_{\mathbf{q}})+\gamma_{\mathbf{p}}^{k}N_{\mathbf{q}}\delta(\varepsilon_{\mathbf{p}+\hbar\mathbf{q}}-\varepsilon_{\mathbf{p}}-\hbar\omega_{\mathbf{q}})-$$
$$-\gamma_{\mathbf{p}-\hbar\mathbf{q}}^{k}N_{\mathbf{q}}\,\delta(\varepsilon_{\mathbf{p}-\hbar\mathbf{q}}-\varepsilon_{\mathbf{p}}+\hbar\omega_{\mathbf{q}})-\gamma_{\mathbf{p}+\hbar\mathbf{q}}^{k}(N_{\mathbf{q}}+1)\,\delta(\varepsilon_{\mathbf{p}+\hbar\mathbf{q}}-\varepsilon_{\mathbf{p}}-\hbar\omega_{\mathbf{q}})\}=$$
$$=ev_{\mathbf{p}}^{k}\bar{F}_{\mathbf{p}}/2\pi. \qquad (14)$$

$$|c_{\mathbf{q}}|^{2}=E_{0}^{2}\hbar q/2V_{0}\rho w, \qquad (15)$$

follows and

$$-i\omega y^{k}+\frac{v}{l}y^{k}=\frac{ev^{k}}{2\pi}F_{0}(\varepsilon_{\mathbf{p}})-eEv_{\mathbf{p}}^{z}\frac{\partial x^{k}}{\partial z_{\mathbf{p}}}. \qquad (22)$$

with $y^{k}(\vec{p})=\vec{p}\vec{y}^{k}/p$ or

$$-i\omega x^{k}(\varepsilon)\int d^{3}p\delta(\varepsilon-\varepsilon_{\mathbf{p}})+e\mathbf{E}\int d^{3}p\delta(\varepsilon-\varepsilon_{\mathbf{p}})\frac{\partial}{\partial\mathbf{p}}\gamma_{\mathbf{p}}^{k}=$$
$$=\int d^{3}p\delta(\varepsilon-\varepsilon_{\mathbf{p}})\hat{S}x^{k}(\varepsilon_{\mathbf{p}})+\frac{e}{2\pi}\int d^{3}p\delta(\varepsilon-\varepsilon_{\mathbf{p}})v_{\mathbf{p}}^{k}f(\mathbf{p}). \qquad (23)$$

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$$\int d^3p\delta(\varepsilon - \varepsilon_p) = 4\pi\sqrt{2}\, m^{3/2}\varepsilon^{1/2}, \tag{24}$$

$$\frac{e}{2\pi}\int d^3p\delta(\varepsilon - \varepsilon_p)\, v_p^k f(p) = -\frac{4e^2 E l m\varepsilon}{3} F_0'(\varepsilon). \tag{25}$$

from which finally

$$-i\omega\tau_s\left(\frac{\varepsilon}{\varepsilon_E}\right)^{1/2} x^k(\varepsilon) + \varepsilon_E \frac{d}{d\varepsilon}\left(\varepsilon \frac{dx^k}{d\varepsilon}\right) + \\ + \frac{1}{\varepsilon_E}\frac{d}{d\varepsilon}\left[\varepsilon^2\left(x^k + T\frac{dx^k}{d\varepsilon}\right)\right] = \varepsilon_E \frac{\delta_{k2}}{2\pi E} F_0(\varepsilon), \tag{30}$$

$$\tau_s = (T/2\sqrt{2}\, m w^2)\, l\, (m/\varepsilon_E)^{1/2}.$$

results. E_0 is the deformation potential and V_0 is put equal 1. The results are now applied to the frequency ranges $\omega\tau_s \gg 1$ and $\omega\tau_s \ll 1$. In the

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first range $\delta\vec{J} \sim E^{1/2}$. In the second case $(\delta J_z^2)_\omega$ and $(\delta J_k^2)_\omega$ are also $\sim E^{1/2}$ but with different proportionality factors. If, in addition, $1/\bar{v} \sim 1$, then $\delta\vec{J} \sim E^{3/2}/\omega^2$. The spectral densities of the current fluctuations parallel to $\vec{E}$ show a considerable dispersion even in the rf range the transverse fluctuations show no dispersion at low frequencies.

ASSOCIATION: Institut poluprovodnikov Akademii nauk SSSR (Institute of Semiconductors of the Academy of Sciences USSR)

SUBMITTED: May 22, 1962

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GUREVICH, V. L.

V. L. Gurevich and L. E. Gurevich, "Plasma Effects in Semiconductors."

report submitted for the Conference on Solid State Theory, held in Moscow, December 2-12, 1963, sponsored by the Soviet Academy of Sciences.

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

S/181/63/005/004/046/047
B102/B186

AUTHOR: Gurevich, V. L.

TITLE: Limitation of sound amplification in piezoelectric semiconductors

PERIODICAL: Fizika tverdogo tela, v. 5, no. 4, 1963, 1222 - 1225

TEXT: Piezoelectric semiconductors in a constant electric field whose strength exceeds a critical value ($E_c = w/\mu$, w the sonic phase velocity and μ the carrier mobility) become unstable and amplify sonic travelling waves propagated along E. For large crystals and large amplification factors the amplitudes of the sonic waves may play the role of non-linear effects, thus stopping further amplification. These effects are calculated for the case of weak supercriticality ($e\Delta E/qT \ll 1$). From the equations of motion $\rho \frac{\partial^2 u}{\partial t^2} = c \frac{\partial^2 u}{\partial x^2} - \beta \frac{\partial^2 \varphi}{\partial x^2}$, $\frac{\partial^2 \varphi}{\partial x^2} = -\frac{4\pi\beta}{\varepsilon}\frac{\partial^2 u}{\partial x^2} - \frac{4\pi e}{\varepsilon} n'$, (2) and

$$n = n_0\left[\exp\left(-\frac{e\varphi}{T}\right) - \left\langle \exp\left(-\frac{e\varphi}{T}\right)\right\rangle\right]\left\langle \exp\left(-\frac{e\varphi}{T}\right)\right\rangle^{-1}$$ (8), which holds in

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first approximation, the correction to the phase velocity is obtained:

$$\delta w = \frac{2\pi\beta^2}{\rho\varepsilon\omega_k^2}\left(\frac{4\pi\beta}{\varepsilon}\right)^2 \frac{e^2a^2}{127^2}\,\frac{\varkappa^3 q^6}{(q^2+\varkappa^2)^4}\,w_k, \quad (9)$$

and the phase velocity in harmonic approximation is obtained as

$$w_k = \sqrt{\frac{c}{\rho}\left(1+\frac{4\pi\beta^2}{\varepsilon c}\,\frac{q^2}{q^2+\varkappa^2}\right)} \quad (10).$$

ρ is the density of the crystal, c and β are the elastic and piezoelectric modulus, u is the displacement vector, w is the displacement amplitude, $-\partial\varphi/\partial x$ is the periodic part of the electric field, n' is the surplus carrier concentration, $n = n_0 + n'$, $\langle n\rangle = n_0$, the symbol $\langle\cdots\rangle$ denotes averaging over all wavelengths. Thus the wave amplitudes will be limited by the condition $\mu E - w_h - \delta w = 0$ and is proportional to $\sqrt{\mu E - w_h}$.

ASSOCIATION: Institut poluprovodnikov AN SSSR Leningrad (Institute of Semiconductors AS USSR, Leningrad)

SUBMITTED: December 28, 1962

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L 13841-63 EWT(1)/EWG(k)/BDS/EEC(b)-2 AFFTC/ASD/ESD-3 Pz-4
AT/IJP(C)/JXT(IJP)
ACCESSION NR: AP3003149 S/0056/63/044/006/2131/2141

66
64

AUTHOR: Gurevich, V. L.; Efros, L. A.

TITLE: On the theory of the acoustoelectric effect 21

SOURCE: Zhurnal eksper. i teor. fiziki, v. 44, no. 6, 1963, 2131-2141

TOPIC TAGS: sound absorption, conductor, semiconductor, acoustoelectric effect

ABSTRACT: A theoretical study is made of the acoustoelectric effect, which consists in the occurrence of direct current under the influence of a traveling sound wave propagating in a conductor, with the aim of constructing a phenomenological theory which would be valid in the limiting case of low sound frequencies. In this theory the effect is regarded as being of second order in the deformation. The frequency dependence of the effect and its tensor characteristics are derived. The concepts of even and odd acoustoelectric effects are introduced, depending on whether the sign of the direct current remains the same or reverses when the direction of sound wave propagation is reversed. It is shown that the even effect can exist only in crystals without symmetry centers. The general considerations are illustrated with several examples, such as a piezoelectric

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semiconductor, a semiconductor with many energy minima, and a conductor with electrons and holes. The absorption of sound is calculated in the last two cases. The Mandelshtam-Leontovich theory is used to calculate the absorption coefficient. Other mechanisms which lead to the absorption of sound and to the acoustoelectric effect are also treated briefly. Orig. art. has: 49 formulas.

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

SUBMITTED: 08Feb63 DATE ACQ. 23Jul63 ENCL: 00

SUB CODE: 00 NO REF SOV: 004 OTHER: 009

Card 2/2

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GANTSEVICH, S.V.; GUREVICH, V.L.

Theory of giant oscillations in ultrasound absorption. Zhur. eksp. i teor. fiz. 45 no.3:587-594 S '63. (MIRA 16:10)

1. Institut poluprovodnikov AN SSSR.
(Absorption of sound) (Oscillations)

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V. L.; PARFENYEV, R. V.; FIRSOV, Yu. A.; SHALYT, S. S.

"The investigation of a new type oscillations in the magneto-resistance"[sic.]

report submitted for Intl Conf on Physics of Semiconductors, Paris, 19-24 Jul 64.

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V. L.; KAGAN, V. D.; LAYCHTMAN, B. D.

"The growth of fluctuations and non-linear effectsin the case of acoustical instability of semiconductors."

report submitted for Intl Conf on Physics of Semiconductors, Paris, 19-24 Jul 64.

APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3"

"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

GUREVICH, V.L.; KAGAN, V.D.

Form of volt-ampere characteristics of piezoelectric substances in the case of sonic instability. Fiz. tver. tela 6 no.7:2212-2214 Jl '64. (MIRA 17:10)

1. Institut poluprovodnikov AN SSSR, Leningrad.

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L 6828-65 EWT(1) ASD(a)-5/AFETR/AEDC(a)/AS(mp)-2/ESD/ESD(gs)/ESD(t)

ACCESSION NR: AP4044974 S/0181/64/006/009/2871/2873

AUTHORS: Gantsevich, S. V.; Gurevich, V. L.

50
49

TITLE: Acousto-electric effect and magnetophonon resonance

SOURCE: Fizika tverdogo tela, v. 6, no. 9, 1964, 2871-2873

TOPIC TAGS: electron spectrum, phonon spectrum, transition probability, acoustoelectric effect, magnetophonon resonance, phonon resonance, sound absorption coefficient, phonon scattering, impurity scattering

ABSTRACT: The purpose of the investigation was a study of certain types of phonon resonances in n-Ge and n-Si, in which the probability of transition between the energy minima has a maximum as a function of the magnetic field when the resonance condition is satisfied. This probability can be determined experimentally by measuring the sound absorption coefficient or the acoueto-electric current, which

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ACCESSION NR: AP4044974

should oscillate as functions of the magnetic field. The calculations are based on formulas derived by V. L. Gurevich and A. L. Efros (ZhETF v. 44, 2131, 1963). The results indicate that the transition probability is an oscillating function of the magnetic field, the type of oscillation depending on the orientation of the magnetic field relative to the crystallographic axes. In the case of n-Ge, the oscillations are periodic in the reciprocal field and not strongly pronounced when the magnetic field is directed along the four-fold axis. If elastic scattering by impurities predominates, the probability has a monotonic dependence on the magnetic field, but oscillates as a function of its direction. It is also shown that a study of this effect yields information on the electron and phonon spectrum and makes it possible to separate in the transition probability the contributions from the phonon and the impurity scattering. Orig. art. has: 7 formulas.

ASSOCIATION: Institut poluprovodnikov AN SSSR, Leningrad (Institute

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ACCESSION NR: AP4044974

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

L 7002-65 EWT(1)/EPA(s)-2/EEC(b)-2 Pt-10 IJP(c)/AEDC(a)/AS(mp)-2/SSD/AFETR/
ASD(a)-5/AFWL/ESD(t)/RAEM(t)

ACCESSION NR: AP4044980 S/0181/64/006/009/2884/2886

AUTHORS: Gurevich, V. L.; Laykhtman, B. D.

TITLE: On the excitation of standing sound waves in piezoelectrics

SOURCE: Fizika tverdogo tela, v. 6, no. 9, 1964, 2884-2886

TOPIC TAGS: sound wave, standing wave, sound reflection, sound amplification, piezoelectric effect

ABSTRACT: The authors calculate the dependence of a stationary standing sound wave in a piezoelectric on the applied constant electric field. The possible production and amplification of such sound waves was first pointed out by D. L. White (J. Appl. Phys. v. 33, 2547, 1962). Under the assumption that the energy acquired by the wave in the forward direction exceeds the sum of the losses in the backward direction and the reflection losses, and that the reflection from both ends of the semiconductor is almost specular, the authors

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ACCESSION NR: AP4044980

arrive ultimately at an expression

$$h(L)=\frac{96}{47}\chi\kappa^2 L\tau_M(V-V_c) \qquad (9)$$

where h is the square of the dimensionless amplitude, L the length of the crystal, $\chi = 4\pi\beta^2/\varepsilon c$, β -- piezoelectric modulus, ε -- dielectric constant, c -- modulus of elasticity, κ -- reciprocal Debye-Huckel radius, τ_M -- Maxwellian relaxation time, $V = \mu E$, μ -- mobility. The approximations under which the formula is derived are indicated. Orig. art. has: 10 formulas.

ASSOCIATION: Institut poluprovodnikov AN SSSR (Leningrad) (Institute of Semiconductors AN SSSR)

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

ACCESSION NR: AP4012563 S/0056/64/046/001/0354/0367

AUTHOR: Gurevich, V. L.

TITLE: Growth of fluctuations in an unstable system. I.

SOURCE: Zhurnal eksper. i teoret. fiz., v. 46, no. 1, 1964, 354-367

TOPIC TAGS: hydrodynamic fluctuations, nonstationary fluctuations, inhomogeneous fluctuations, low frequency fluctuations, spatial growth of fluctuations, convective instability, convective system instability, fluctuating oscillator, acoustic fluctuations in semiconductor, piezoelectric semiconductor, light scattering by sound, electron density fluctuations, semiconductor electron density fluctuations, differential conductivity

ABSTRACT: Nonstationary and inhomogeneous low-frequency hydrodynamic fluctuations are investigated for the case when the nonstationarity and inhomogeneity are small. A simple equation is derived for

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the simplest problem of a fluctuating oscillator under nonstationary external conditions, from which a theory is developed and used to investigate the spatial growth of the fluctuations associated with the convective instability of a system. Several applications of interest are treated by way of examples. These include the growth of acoustic fluctuations in piezoelectric semiconductor situated in a constant electric field, the scattering of light by an acoustic wave, and fluctuations of the electron density inside a semiconductor with negative differential conductivity. Orig. art. has: 67 formulas.

ASSOCIATION: Institut poluprovodnikov AN SSSR (Semiconductor Institute, AN SSSR)

SUBMITTED: 27Jun63 DATE ACQ: 26Feb64 ENCL: 00

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"APPROVED FOR RELEASE: 03/20/2001 CIA-RDP86-00513R000617420017-3

ACCESSION NR: AP4019226 S/0056/64/046/002/0598/0611

AUTHORS: Gurevich, V. L.; Laykhtman, B. D.

TITLE: Nonlinear effects limiting the amplification of sound in piezoelectrics

SOURCE: Zhurnal eksper. i teor. fiz., v. 46, no. 2, 1964, 598-611

TOPIC TAGS: piezoelectric, piezoelectric semiconductor, sound propagation in piezoelectric, nonlinearity, electronic nonlinearity, elastic nonlinearity, constant electric field, stationary wave, wave growth, wave attenuation, stationary wave stability

ABSTRACT: A semiconductor with carriers of only one polarity (assumed for concreteness to be electrons) is considered and the case when lattice absorption in sound is negligibly small is analyzed qualitatively. The method of iteration is used to investigate the stationary modes and the stability of the corresponding waves against

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