TOLPYGO, K.B.

Non-electrostatic forces in rock-salt type ionic crystals. Trudy
Inst.fiz. AN URSR no.5:29-47 '54.   (MLRA 7:12)
    (Crystallography) (Electrostatics) (Quantum theory)

TOLPYGO, K. B.

USSR/Physics - Solid state

FD 403

Card 1/1

Author   : Liberberg, I. I., and Tolpygo, K. B.

Title   : Many-electron treatment of the motion of an electron (hole) in an excited crystal

Periodical : Zhur. eksp. i teor. fiz. 26, 35-41, Jan 1954

Abstract   : Discuss the motion of an electron (or hole) introduced extra into a dielectric in a field of any defect. Employ the many-electron equation approximated for the case of strongly bound electrons. Take into account here the deformation of atoms (ions) by the field of the extra charge added. Utilizing Hardy's approximation the authors succeed in reducing the problem to the solution of a partial derivative equation for one particle. This equation turns out to be convenient also for the case of the "hole". Treat special cases of very narrow and very wide potential wells created by the defect. Establish a connection with the potential of the defect. Thank Prof S. I. Pekar for his critical comments.

Institution : Kiev State University and Zhitomir Pedagogic Institute

Submitted   : March 18, 1953

ТОЛПЫГО, К.Б.

Category   : USSR/Solid State Physics - Solid State Theory. Geometric E-2
              Crystallography

Abs Jour : Ref Zhur - Fizika, No 3, 1957, No 6499

Author   : Tolpygo, K.B.
Title   : Natural Frequencies and Normal Oscillations of Alkali-Halide
            Crystals for Extremely Long Waves

Orig Pub : Tr. In-ta fiziki AN USSR, 1955, vyp. 6, 102-131

Abstract : A quantitative investigation was made of the dependence of
            natural frequencies and amplitudes of oscillations on the
            wave vector $\underline{k}$ in the a^2k^2 approximation (a is the lattice
            constant). The numerical calculations were performed for
            LiF, NaCl, KCl, and KBr, and their results are given in the
            form of tables listing the coefficients of arrangement of the
            above quantities relative to powers of ak. As in earlier
            articles by the same author, account is taken of the deform-
            ability of the ions and of the electronic portion of the
            polarization (Zh. eksperim. i teor. fiziki, 1950, 20, 497;
            Referat. Zhur Fizika, 1955, 21713). It is shown that both
            double refraction as well as a negative group velocity of the
Card   : 1/2

tion is made of the absorption of light by the crystal, in view of
temperatures with allowance for the specific heat of the above crystals at low
the velocity of sound, and the non-isotropic nature of
experiments. The dipole and the results are
in the $(ak)^2$ approximation of the acoustic oscillations

Card   : 2/2

TOLPYGO K. B.

USSR/Physics - Semiconductors

FD-3102

Card 1/2   Pub. 153 - 1/24

Author   : Tolpygo, K. B.; Zaslavskaya, I. G.

Title   : Bipolar diffusion in semiconductors in the case of considerable
                currents

Periodical   : Zhur. tekh. fiz., 25, No 6 (June), 1955, 955-977

Abstract   : The authors solve the equations describing bipolar diffusion in
                a semiconductor in which there is an inversion in the sign of
                conductivity thanks to the contact field or to the inhomogeneous
                composition of the admixture (impurity). They consider the ad-
                missible direction of the current in the case of planar or semi-
                spherical contact. They show that in the case of considerable
                currents the essential role is played by the penetration of current
                carriers of one sign into the region of the semiconductor with
                current carriers of the opposite sign, in addition to the familiar
                "flooding" of the blocking layer by current carriers. As a result
                the total resistance of the system turns out to be considerably
                less than the resistance of a homogeneous semiconductor of the
                same thickness but without the blocking (valve) layer. The authors
                present sample volt-ampere characteristics for direct currents.

Card 2/2   FD-3102

They thank Professor V. Ye. Lashkarev, Active Member of Academy of
Sciences of Ukrainian SSR, who posed the problem. Six references:
e.g. N. F. Deygen, V. Ye. Lashkarev, Trudy IFAN USSR, No 4, 3;
~953.

Institution   :

Submitted   : February 8, 1954

FD-3215

USSR/Physics - Semiconductors

Card 1/1   Pub. 153-24/28

Authors   : Rashba E. I. and Tolpygo K. B.

Title   : Static volt-ampere characteristic of the stopping layer formed on the
              boundary of electron and hole semiconductors in the reverse direction.

Periodical : Zhur. Tekh. Fiz., 25, No 7, 1335-1338, 1955
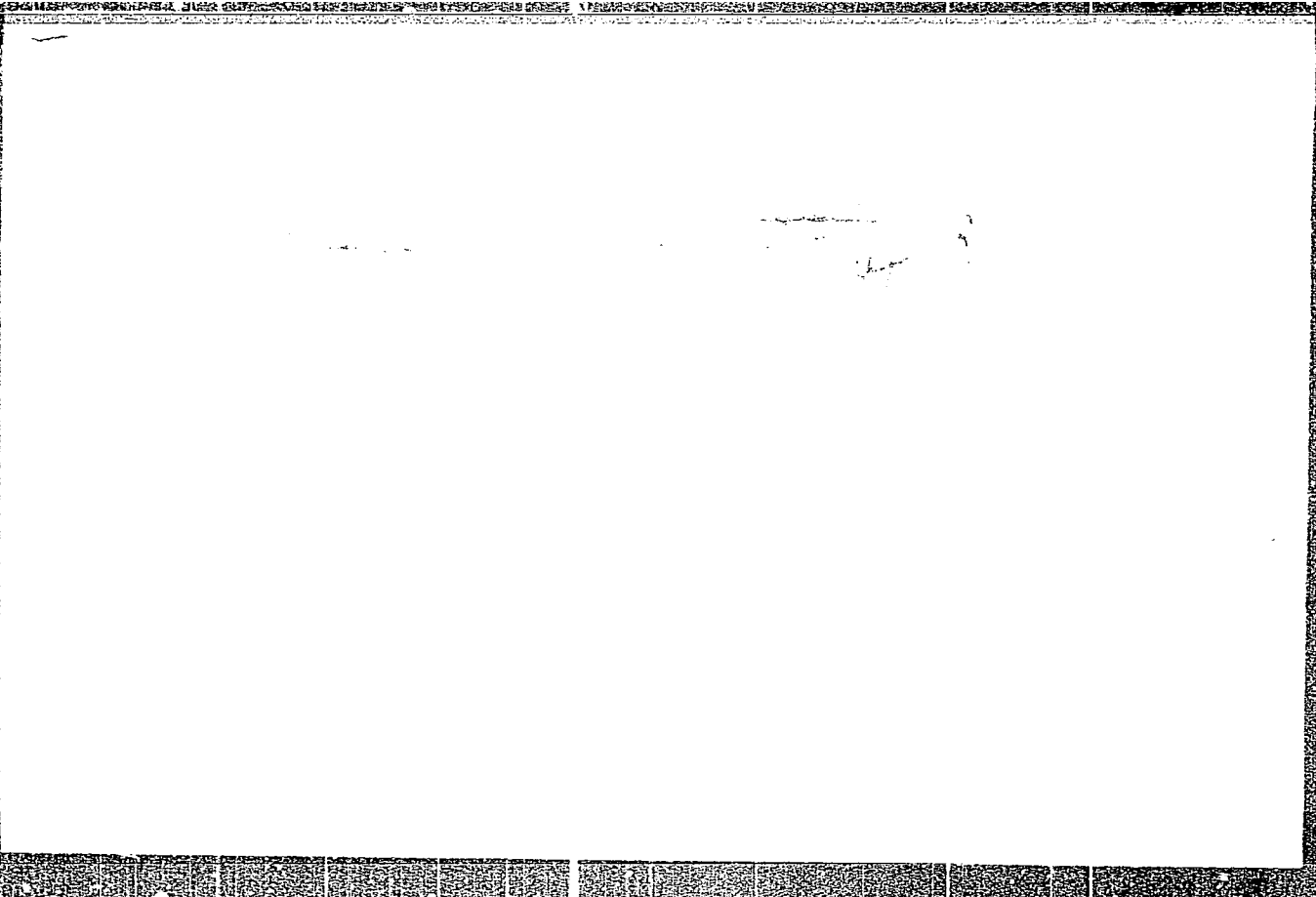
Abstract   : Attempt is made to improve known relations on rectification by semiconductors
              with (p - n) transitions. Criticized are results by W. Shockley (Bell Syst.
              Tech. J., 28, 435 (1949)) and by A. I. Gubanov (ZhTF, 22, 381, (1952)). In-
              debted for initiative to Prof. V. Ye. Lashkarev.

Institution: --

Submitted : March 28, 1955
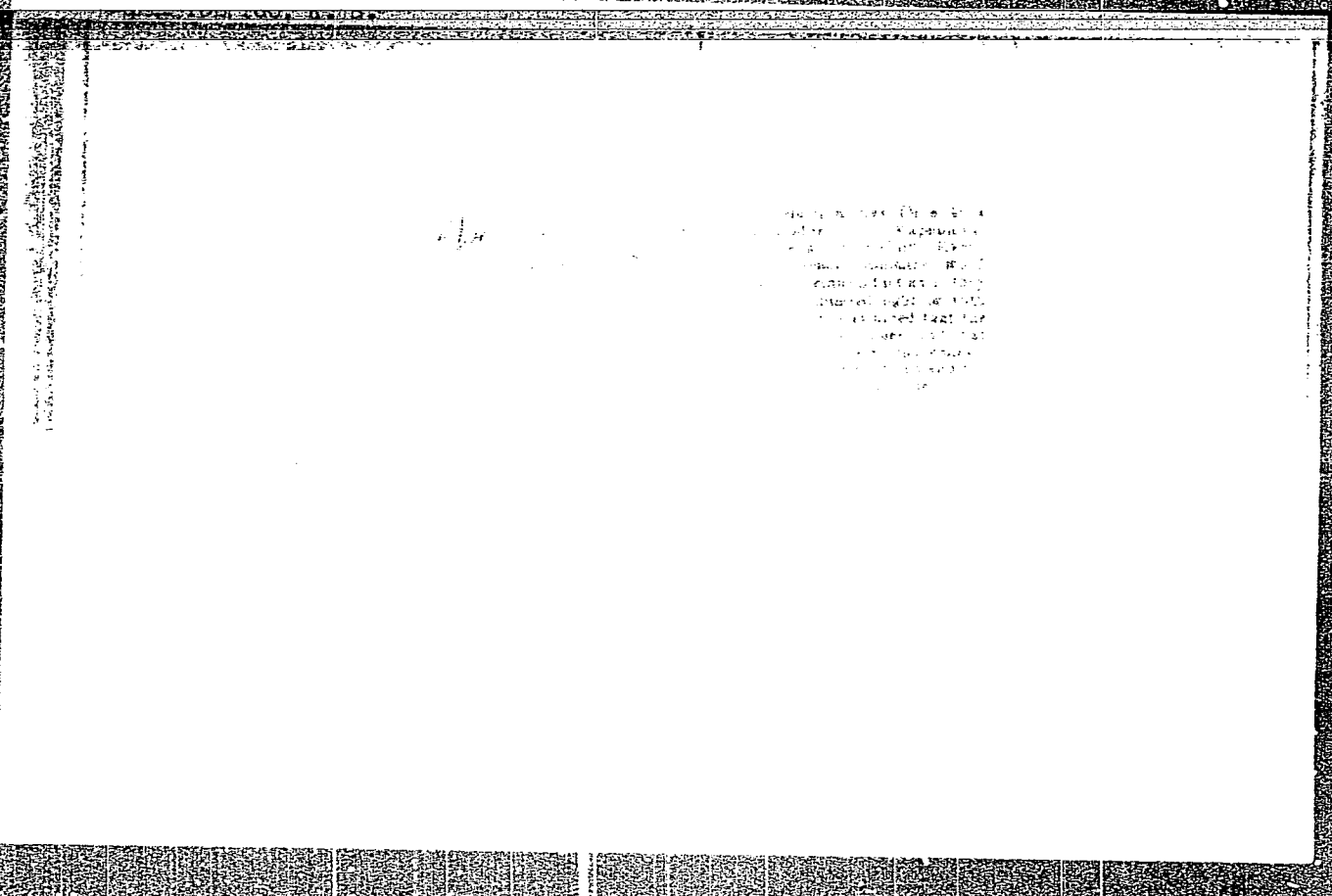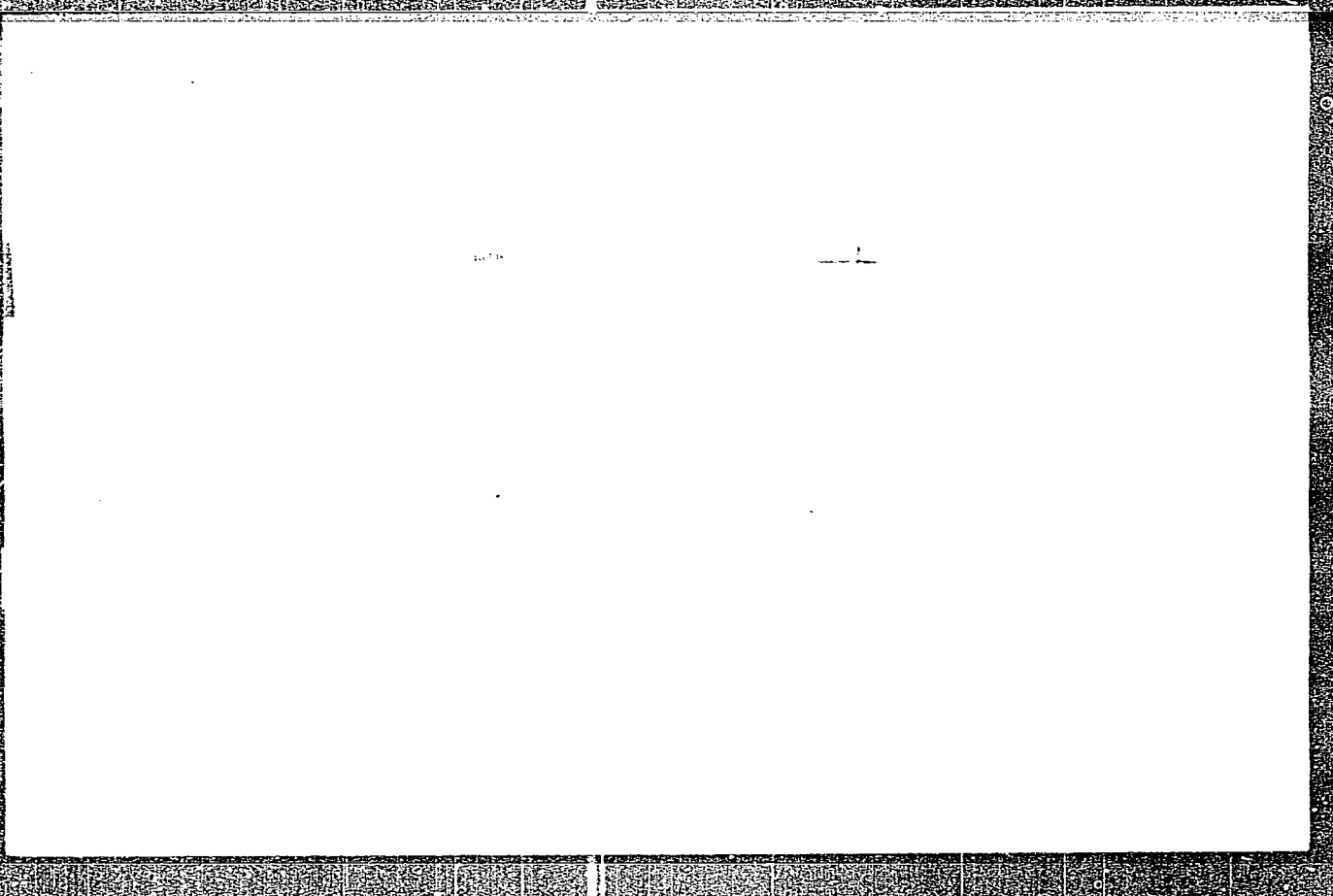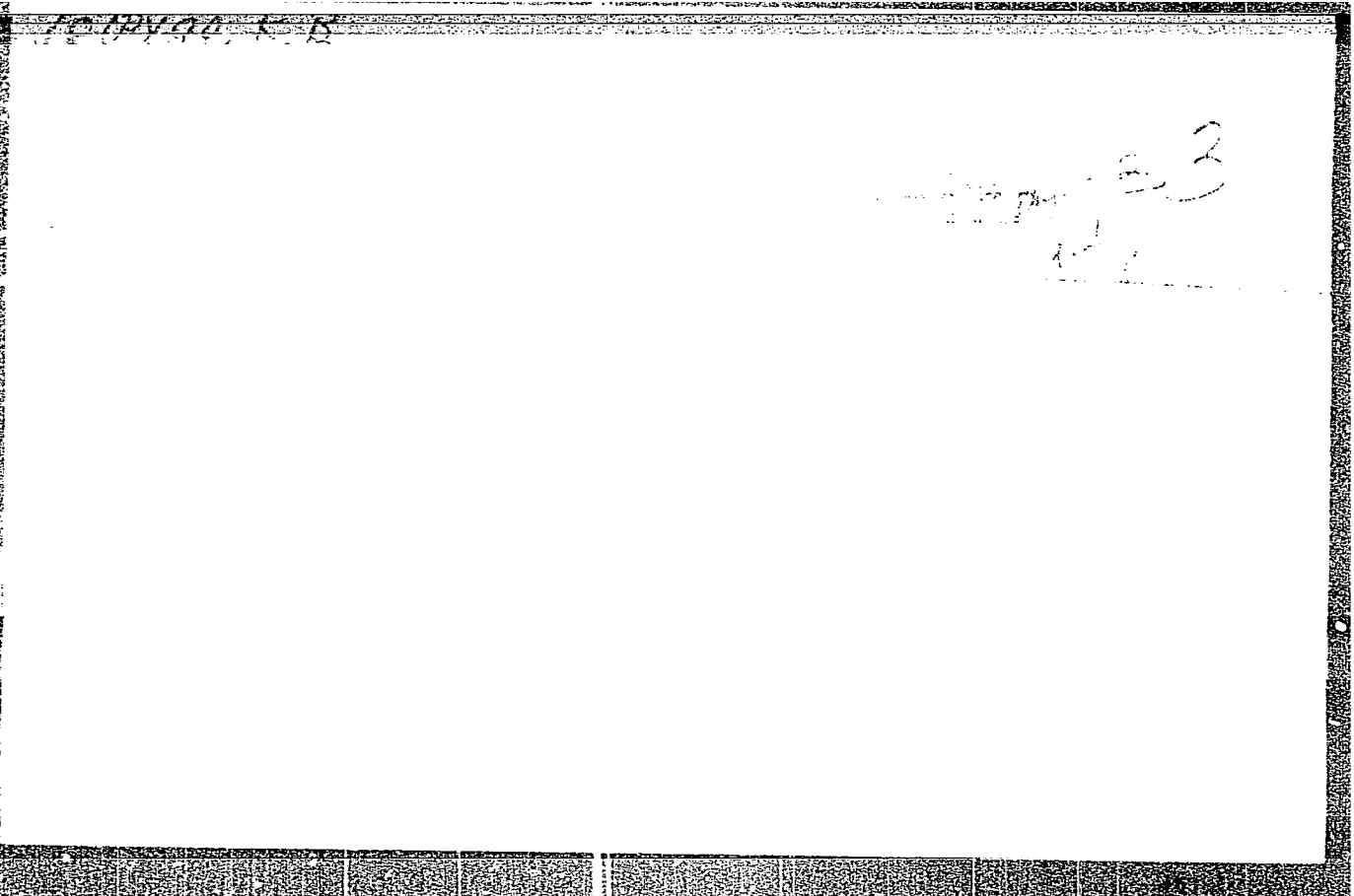
RASHBA, E.I.; TOLPYGO, K.B.

Theory of the photoelectric method for determining the lifetimes
of current carriers in semiconductors. Agrobiologiia no.5:29-43
S-O '56.   (MLRA 9:11)

1. Institut Fiziki Akademii nauk URSR.
   (Semiconductors) (Electrons) (Photoelectric measurements)

TOLPYGO, K. B., and FOMENKO, V. A.

"Investigation of the Rectifying Properties of Point-Contact Germanium Diodes," by K. B. Tolpygo and V. A. Fomenko, Radio-tekhnika i Elektronika, No 8, Aug 56, pp 1093-1105

The results of a theoretical and experimental investigation of point-contact semiconductor diodes are considered, wherein the difference of their properties from the properties of junction diodes was studied.

It was proved that, at low voltages, diodes of low-resistance germanium with weak molding possess good conduction characteristics and a greater detection efficiency than high-resistance germanium with strong molding.

Tolpygo made reference to his previous works appearing in Zhurnal Tekhnicheskoy Fiziki, 25, 1955, pp 955 and 1335, and to an article, still at the typographer to appear in the same periodical.

Sum 1258

Tolpygo, K B

G

USSR / Electricity

Abs Jour   : Ref Zhur - Fizika, No 4, 1957, No 9699

Author   : Tolpygo, K.B.
Inst   : Not given
Title   : Emission Ability of an Abrupt p-n Junction and its Effect
             on the Conductivity of a Semiconductor.

Orig Pub   : Zh. techn. fiziki, 1956, 26, No 2, 293-309

Abstract   : Under the condition that the impurity levels are almost
             fully ionized and that the dimensions of the region of va-
             riable concentration of impurities is less or of the same
             order as the length of the screening, an approximate solu-
             tion is given for the system of equations that describe the
             forward direction of the current in p-n junctions. An in-
             vestigation is made of the variation in the conductivity of
             the semiconductor as a result of injection of holes through

Card   : 1/2

USSR / Electricity

G

Abs Jour : Ref Zhur - Fizika, No 4, 1957, No 9699

Abstract : the p-n junction from a hole-type semiconductor into an
electronic one and vice versa, and unlike in preceding in-
vestigations by other workers, the most actual case is ana-
lyzed, when the concentrations of the minority and majority
carriers are comparable in magnitude and the recombination
of the carriers is bimolecular. The dependence of the emis-
sion ability γ^0 (where γ^0 is the fraction of the current car-
ried by the minority carriers on the boundary of the p-n
junction) on the current is ascertained and conditions are
formulated under which the current is carried primarily by
minority carriers. An estimate is made of the depth of the
region of increased conductivity.

Card   : 2/2
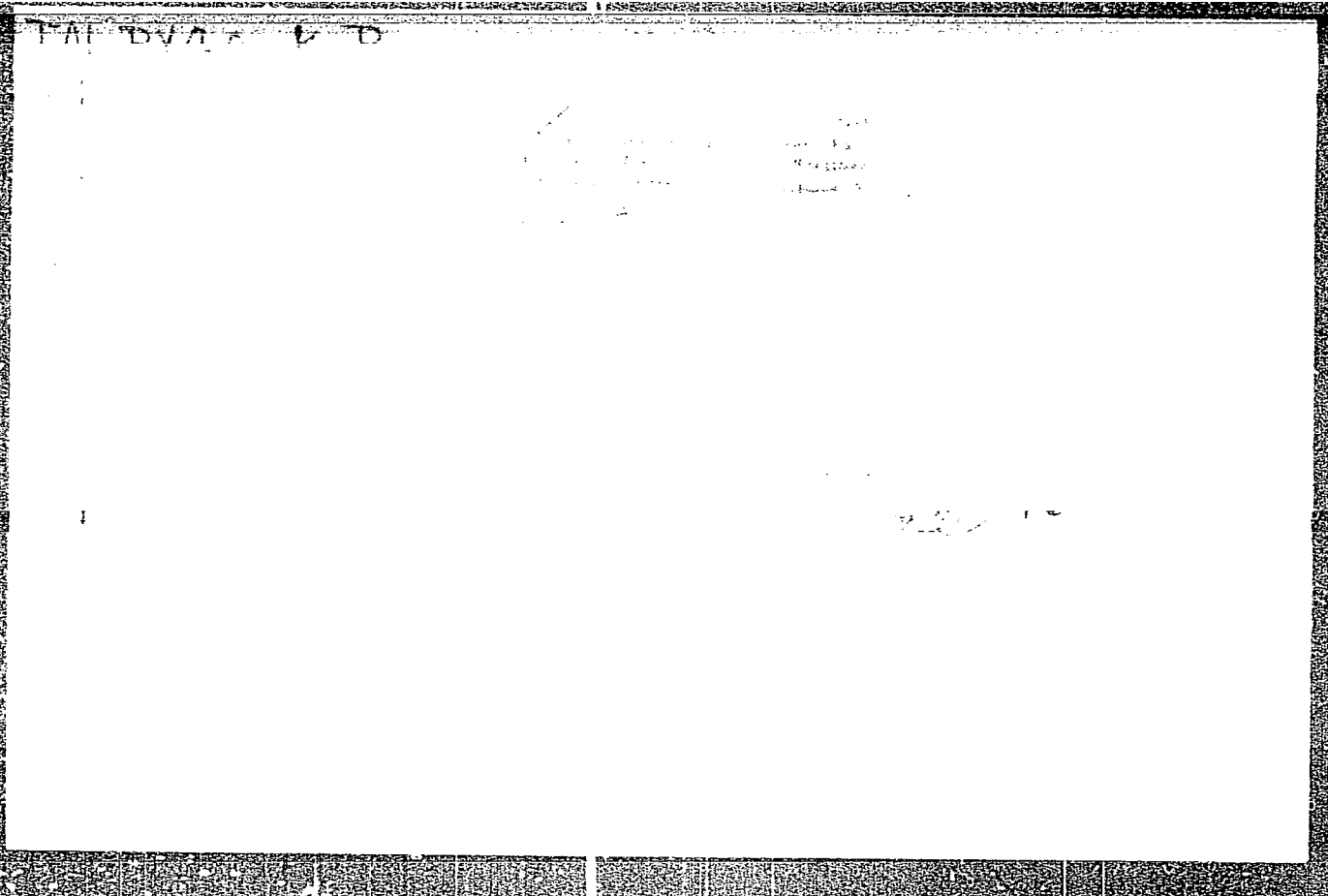
ToLpYGO, K.B.

USSR/Crystals.   B-5

Abs Jour   : Referat Zhur - Khimiya, No 6, 1957, 18353

Author   : K.B. Tolpygo.
Inst   :
Title   : Remarks to The Letter of Gubanov and Makovskiy in
              Connection with The Work of Tolpygo and Zaslavskaya
              "Bipolar Diffusion in Semiconductors at Considerable
              Currents."

Orig Pub   : Zh. tekhn. fiziki, 1956, 26, No 9, 2127-2128

Abstract   : See the foregoing abstract.

Card 1/1   - 113 -

SUBJECT   USSR / PHYSICS   CARD 1 / 2   PA - 1557
AUTHOR   KAPLUNOVA,E.I., TOLPYGO,K.B.
TITLE   The Kinetics of the Bipolar Photoelectromotoric Force in a Semi-
             conductor with Metallic Electrodes.
PERIODICAL   Zurn.techn.fis, <u>26</u>, fasc.10, 2165-2169 (1956)
             Issued: 11 / 1956

Here the theory of photoelectromotoric forces occurring in such a semiconductor
in the case of an unsteady illumination is developed in linear approximation.
The semiconductor is assumed to be fully homogeneous, and its contacts with the
metal are determined solely by effective "transparences" for holes and electrons.
The theory is intended to explain the idealized form of the impulse which was
attained in the course of experiments carried out by I.P.POTAPENKO, dissertation
and auto-review, KGU (State university, KIEV ?) during constant illumination.

In linear approximation the theory of the photoelectromotoric force is reduced to
the integration of a system of partial differential equations (which express the
modifications of the numbers of electrons and holes in the zones and on local
levels), and to the integration of POISSON'S equations at certain boundary con-
ditions. For certainty's sake an electron semiconductor is investigated here and
the thermal excitation of the holes is neglected. Light is assumed to be
sinusoidally modulated. With rectangular light impulses (length T and height L_0)
the photoelectromotoric force is obtained by the summation of "replies" for
all components of FOURIER'S series.

Žurn.techn.fis, 26, fasc.10, 2165-2169 (1956) CARD 2 / 2   PA - 1557

The photoelectromotoric force was computed for two different schemes of photo transitions: In a scheme a quantum produces a free electron and a hole, and the hole recombines immediately with the electron and also by means of the filled-up donor electrons. The linearized system of equations and the linearized boundary conditions are written down for this case. Next, the computation of the photoelectromotoric force for the rectangular impulses is described. In the case of a not valve-like photoelectromotoric force the contact for unreal carriers is little impenetrable, and these carriers diffuse into the interior of the semiconductor. In the case of a valvelike photoelectromotoric force the impulse has a different shape. The experiments made by POTAPENKO with Cu_2O

are here explained on the basis of the mechanism of the interior photoeffect. The solution of the aforementioned system of equations is then explicitly given. POTAPENKO'S experiments are, by the way, a new and independent argument in favor of the exiton mechanism of photoconductivity in Cu_2O. The theory

suggested thus provides a simple method for the determination of the exiton photoeffect from the form of the impulse of the photoelectromotoric force and for the evaluation of the transmission coefficients.

INSTITUTION:

/ o L P Y G O, K, B,

SUBJECT   USSR / PHYSICS   CARD 1 / 2   PA - 1838
AUTHOR   DYKMAN,I.M., KAPLUNOVA,E.I., TOLPYGO,K.B.
TITLE   The Field Mass of the Polarizing Exitons in Ion Crystals.
PERIODICAL   Žurn.techn.fis, 26, fasc. 11, 2459-2466 (1956)
             Issued: 12 / 1956

The present work investigates the comparatively slow motion of an exiton as a
whole. In this case the velocity of the displacement of the "center of mass" of
the "polarization trough" is to be understood (in the exiton- as well as in the
polaron theory), which agrees with the motion of an electron and hole. It is then
possible, when developing the exiton energy according to the powers of the
velocity v, to content oneself with the quadratic term. The coefficient near

$v^2/2$ is then the effective mass of the exiton.
The macroscopic computation of the effective mass of the exiton: Several previous
works are cited, whereupon the formula for the effective mass M, which was derived
by L.G.LANDAU and S.I.PEKAR (Žurn.eksp.i teor.fis, 18, 419 (1948)), is given and
specialized for the spherical-symmetric states of the exitons (particularly for
the lowest 1s-state). Finally, the definite formula for M is given without follow-
ing the entire course of computation. Under certain conditions the value

$M \sim 10^5 - 10^6$ electron masses is obtained for NaCl, KCl and other alkali halide
crystals. However, so large effective masses of the exiton apparently do not
correspond to the actual values for these materials. Therefore, the microscopic
structure of the crystals must be taken into consideration in this connection.

. Žurn.techn.fis, <u>26</u>, fasc. 11, 2459-2466 (1956) CARD 2 / 2   PA - 1838

<u>The microscopic computation of the effective mass of the exiton:</u> For the com-
putation of the displacement of the ions the potential energy of the inter-
action between the crystals with an electron and a hole is written down. The
induction $\vec{D}(\vec{r})$ occurring in this formula is computed as the induction of a
multipole with the usual formulae for electrostatics. The displacements and the
dipole moments of all ions can easily be determined after transition to the
normal coordinates. The deformation in the distribution of the exiton charge
and the modification of the forces acting upon the surrounding ions (if the
displacement of the ions is less than the lattice constant), are neglected.
When computing the forces brought to bear by the exitons onto the ions, the
field of the exiton is considered to be the field of a system of seven charges
which move with progressive uniformity within the space. The formula for the
effective mass M found under these and other conditions is given.

<u>The numerical values of the effective mass of the exiton in KCl- and NaCl-crystals,</u>
which are discussed at the end, show that the effective mass of the exiton has
essentially a fieldlike character.

INSTITUTION:
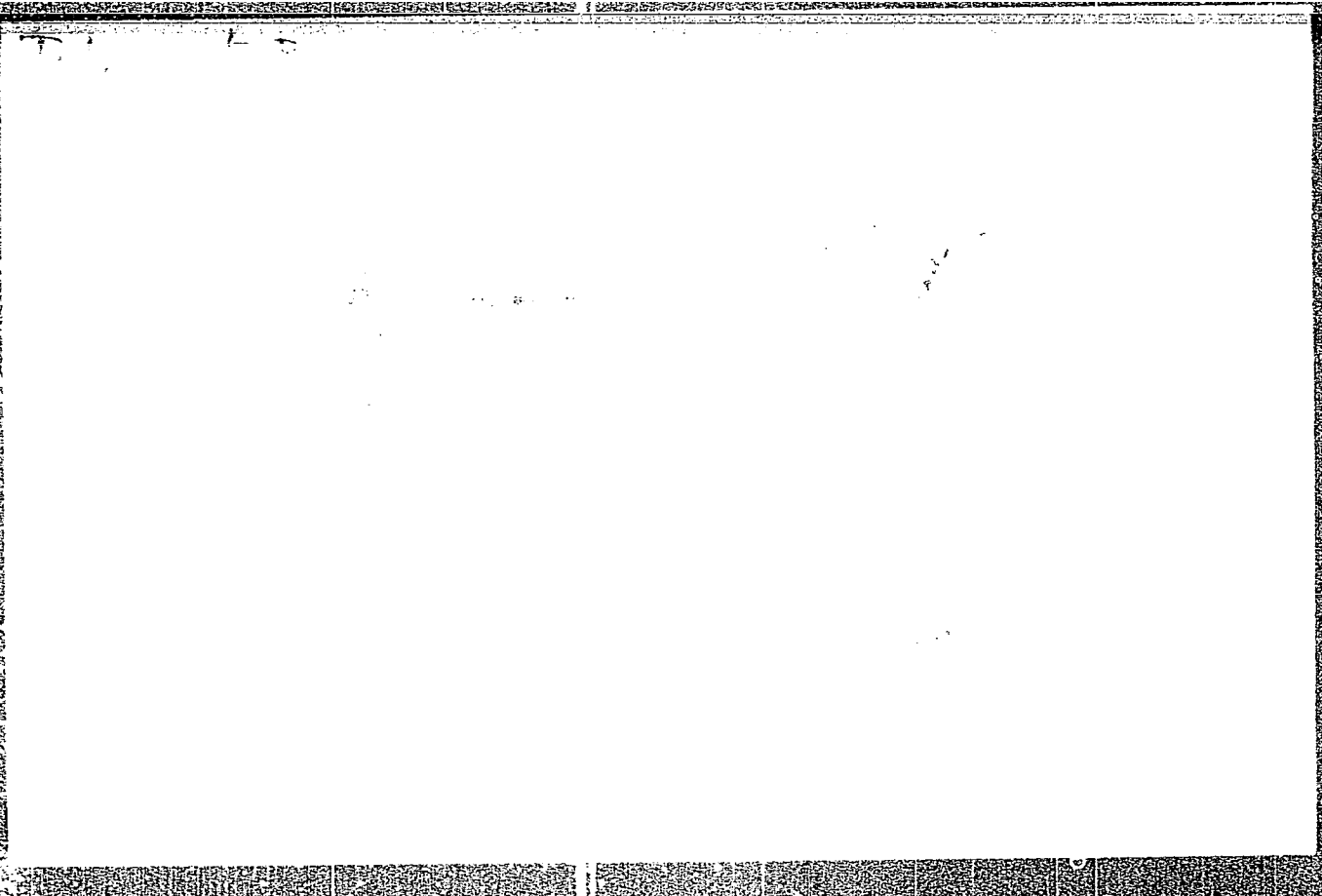
PA - 1967

CARD 1 / 2

A.M.FEDORČENKO in his work for his diploma, computed the wave function and the
energy of a crystal if an electron is lacking (hole) at one of the bindings. On
this occasion the smallest possible deformation of a crystal was taken into
account. The present work deals with the results of these computations and the
discussion of the consequences of the found interaction between the hole and
the oscillations of the lattice.

The authors investigated a diamond crystal, because for Si, Ge and α-Sn the
structure of the lattice and the configurations of valence-electrons and
bindings are quite uniform. The wave function of the crystal is set up in form
of an antisymmetric product of the wave functions of the bindings of each pair
of atoms a,b. The wave functions of the electrons and the various nuclei are
assumed to be approximatively orthogonal. Also for the energy of the system
which holds in this case an expression is given. In the approximation used
here this expression is composed of the sum of the average energies of indi-
vidual bindings. Next, the wave function and the energy of the crystal with a
removed electron are computed. In the case of the presence of a hole the wave
function of the system must be set up in form of a linear combination of anti

Žurn.eksp.i teor.fis,31,fasc.5,845-853 (1956)   CARD 2 / 2   PA - 1967

symmetric products of the aforementioned type. Here one of the functions Ψ_{ab} of the binding must be replaced by the function of an electron with in- definite spin direction. With the aid of a variation principle a system of linear equations is obtained and by putting equal to zero the corresponding determinant the eigenvalues of energy are obtained. A diagram shows the posi- tion of the zones. This does not explain the peculiar features observed in hole-germanium. For this purpose it is apparently necessary to retain the ex- change integrals for the functions which do not overlap to such an extent. This leads to a splitting up of the levels into four zones. Now the local hole- combinations with large radius are investigated, on which occasion the following result is obtained: The existence of states with large radius (which are similar to polarone-states) is only little probable. Also the local hole- states with small radius are discussed. In conclusion the interaction between the hole and the lattice is discussed by the disturbance method. At high temperatures scattering in optic oscillations probably predominates, which leads to the following temperature dependence of mobility: $u \sim T^{-5/2}$. At low temperatures the previous formula $u \sim T^{-3/2}$ must be ob- tained.

INSTITUTION: State University Kiev.

SUBJECT	USSR / PHYSICS	CARD 1 / 2	PA - 1881

AUTHOR KUCER,T.I., TOLPYGO,K.B.

TITLE The Multielectronic Investigation of the Motion of an Electron (Hole) in a Deformed Crystal. II.

PERIODICAL Zurn.eksp.i teor.fis,31,fasc.6, 1002-1011 (1956)
Issued: 1 / 1957

For the consistent computation of the deformation of a crystal(which must necessarily occur near the local state of the electron and must influence its energy considerably) the multielectronic investigation of the problem must also make it possible to take exchange forces into consideration. Therefore the problem must be based on the antisymmetric function of the crystal, i.e. on FOK'S approximation. It is to this generalization that the present work is devoted.

The basic simplifying conditions: A binary cubic ion crystal with a vacant node is investigated in the origin of coordinates. Let it be assumed that in the crystal there is a surplus electron (hole) if a negative (positive) ion is removed. The function of the crystal is chosen in form of a linear combination of the antisymmetric products Ψ_s^1 of the wave functions of the individual ions. The electron is assumed to move along the positive, and the hole along the negative ions. The influence exercised by the position of the electron (hole) on the wave functions of the remaining ions is taken into account, it is reduced, in the case of the free motion of an electron, above

Žurn.eksp.i teor.fis,31,fasc.6,1002-1011 (1956) CARD 2 / 2   PA - 1881

all to the inertialess polarization of the rotation, and leads to a reduction of the level of the conductivity zone.
Next, the wave functions of the system of adiabatic approximation are defined for any position of the anomalous node. For this purpose a variation principle, the minimum condition of the averaged HAMILTONIAN, is used. Dipole-dipole interaction of ions is taken into account. The determination of the dipole moments of the ions is then discussed. In dipole approximation the influence exercised by the position of the anomalous node on the shape of the Ψ functions of the remaining ions is taken into account. In conclusion the determination of the potential and of the kinetic energy of the surplus charge and the determination of the selfconsisting state of the electron (or hole) is dealt with.
The method suggested here is also suited for the computation of the hole states with small radius, for which there has hitherto been no theory at all.

INSTITUTION: State University Kiev
             Pedagogic Institute Zitomir

SUBJECT   USSR / PHYSICS   CARD   1 / 2   PA - 1985
AUTHOR   MASKEVIC,V.S., TOLPYGO,K.B.
TITLE   The Interaction between Oscillations of Nonpolar Crystals and
              Electric Fields.
PERIODICAL   Dokl.Akad.Nauk $\underline{111}$, fasc.3, 575-577 (1956)
              Issued: 1 / 1957

The authors computed the energy U of a homoeopolar lattice of the diamond
type in the function of the displacements $\vec{u}_s^l$ and the dipole moments $\vec{P}_s^l$. On
this occasion such states in the crystal were considered to be basic states
in which the valence electrons form σ-couplings. The result for U which was
found in harmonic approximation is explicitly given. The terms which are bi-
linear with respect to displacements and dipole moments lead to a coupling
of displacements and dipole moments of the atoms. In adiabatic approximation
the states of the electron shells follow inertialessly the displacements of the
atoms and are determined in accordance with a variation principle by a mini-
mum condition for U. The equations for the oscillations of the atoms and for
the case $\vec{E}_s^{ol} = 0$ (where $\vec{E}_s^{ol}$ denotes the exterior electric field in the node l_s)
are solved by means of exponential ansatzes and by a development according to
the powers of the lattice constant. Besides three acoustic and three optic
branches there are two solutions (the so-called light oscillations), for which
$\vec{u}_1 = \vec{u}_2 = 0$, $\vec{P}_1 = \vec{P}_2 \neq 0$ and $\omega = c|\vec{k}|/n$ applies. Here n denotes the refrac-
tion index connected with polarizability by the usual formula, c - the veloc-

Dokl.Akad.Nauk <u>111</u>,fasc.3, 575-577 (1956)   CARD 2 / 2   PA - 1985

ity of light, $\vec{u}_1$ and $\vec{u}_2$ - development coefficients in the exponential an-
satzes for the displacement of nuclei, $\vec{P}_1$ and $\vec{P}_2$ - analogous development
coefficients for the dipole moments. In first and second approximation with
respect to $|\vec{k}|a$ (where a denotes the lattice constant) it is possible to find
the dependence of ω $(\vec{k})$, $\vec{u}_g$ and $\vec{P}_g$ for all branches. On the basis of the
experimental values of n and ω_0 (RAMAN frequency) the parameters of the
theory were determined. A special investigation is necessary in the case of
the equality of optic- and light oscillations $c|\vec{k}|/n = \omega_0$. By methods based
on the perturbation theory it is possible to show that in the neighborhood of
$|k_0| = n\omega_0/c$ there exist four mixed oscillations with non-vanishing $\vec{u}_1$, $\vec{u}_2$
and $\vec{P}_1 + \vec{P}_2$ instead of two optic and two light oscillations. Therefore a
marked dispersion occurs near the light point ω_0 in the case of light oscil-
lations. On the basis of the results obtained the absorption of light of the
first order by homoeopolar crystals can be explained. The exterior field of
light causes a polarization $\vec{P}_1 + \vec{P}_2$ of the crystal. This polarization leads to
a transition of electric energy into oscillation energy. Further investigations
confirm all qualitative results of the theory, particularly the optic ani-
sotropy of cubic crystals mentioned here.

INSTITUTION: State University KIEV.

TohPy Go, K iS
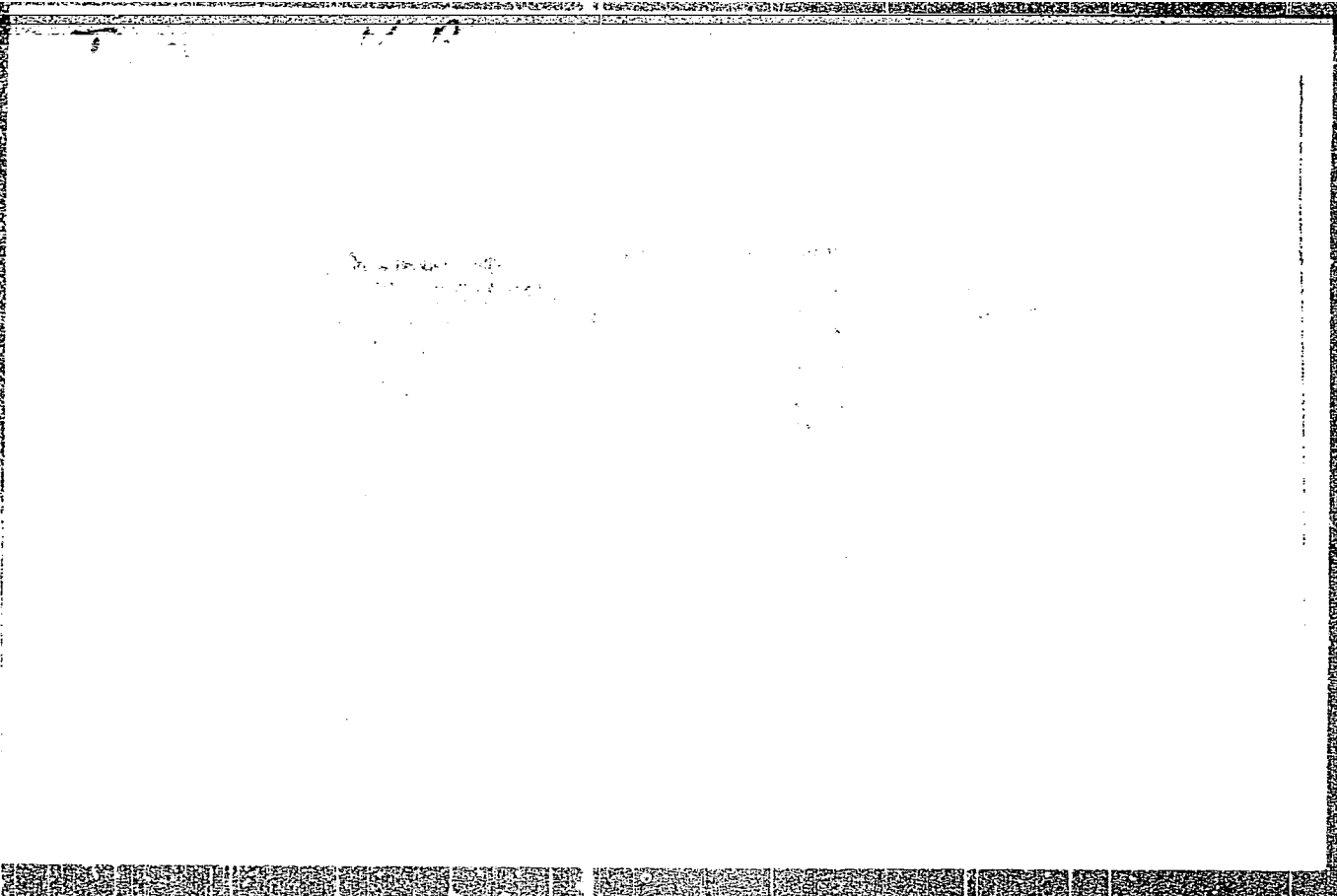
AUTHOR: TOLPYGO,K.B.   PA - 2342
TITLE: Investigations on the Microtheory of Crystals. (Issledova-
               niya po mikroteorii kristallov, Russian).
PERIODICAL: Izvestiia Akad. Nauk SSSR, Ser. Fiz., 1957, Vol 21, Nr 1,
               pp 48 - 64 (U.S.S.R.).
               Received: 4 / 1957   Reviewed: 5 / 1957

ABSTRACT:

The present work gives a general survey on investigations in this
direction undertaken by the author and his pupils as well as some
results obtained.

At first the bases of the microtheory of ion lattice are dealt
with in short. Next follows a report on eigenfrequencies and the
thermal capacity of NaCl, KCl, and KBr.

On the theory of homoepolar crystals: In cooperation with V.S.
MASHKEVICH the author carried out a special computation of electron
energy for crystals of the type of the diamond. The connection
found on this occasion between the shifting and the dipole moments
p^l_s is considered by MASHKEVICH as the cause of the absorption
of light and the scattering of conduction electrons on the
oscillations of the lattice. Herefrom the exact order of magni-
tude for the absorption coefficient and for the mobility of the
electrons is obtained, and for this mobility we also obtain the
exact course of temperature.

The theory of the not perfectly polar crystals: A careful com-

Card 1/2

PA - 2342

Investigations on the Microtheory of Crystals.

parison of the theory with the experiment shows that the assumption of a total heteropolarity of the crystals of LiF, NaCl, KCl, KBr does not correspond to facts. The same applies for CsCl, CrBr, TlCl, TlBr, AgCl, AgBr, and especially for MgO, where, besides ion binding, also a covalent binding may exist. Such a form of the ψ-function of the electrons can be expected here in which the charges of the different atoms are fraction numbers. In this case the purely homoepolar binding is probably only a limiting case.

Next, the multi-electronic investigation of the motion of a surplus electron (hole) in an ion crystal is discussed. In homoepolar crystals the removal of one of the valence electrons destroys the binding between the atoms which causes a special type of interaction between the hole and the optical oscillations.

In conclusion a report is given on the production of lattice oscillations by fast polarons and on the widths of the forbidden zones in the theory of the polarons. (12 illustrations).

ASSOCIATION: Physical Institute of the Academy of Science of the Ukrainian SSR.
PRESENTED BY:
SUBMITTED:
AVAILABLE: Library of Congress.
Card 2/2

ToLPYGO, KB

AUTHOR   GRIBNIKOV, Z.S., TOLPYGO, K.B.,   PA - 2786
TITLE   Injection Coefficient and Direct Voltampere Characteristic of Sperical
          Contact.
          (Koeffitsiyent in"yektsii i pryamaya vol'tampernaya khrakteristika
          sfericheskogo kontakta - Russian)

PERIODICAL   Zhurnal Tekhn. Fiz.,1957, Vol 27, Nr 4, pp 625-629, (U.S.S.R.)
              Received 5/1957   Reviewed 6/1957

ABSTRACT   The most important characteristic property of the emitter of a semicon-
            ductor-triode, is the injection-coefficient of the p-n transition γ i.e.
            the part of the current which is conducted by hole conduction through
            the p-n transition. The symmetric contact investigated in this paper is
            a idealized model of the point contact, which neglects the phenomena on
            the surface. In order to compute γ, a system of 4 equations has to be sol-
            ved. These four equations relate to the hole concentration z, the elec-
            trons N, the field strenght $\frac{\partial}{\partial r}$, and the part of current caused by elec-
            trons as a function of the radius ρ with the boundary conditions for $\rho = \infty$
            and $\rho = \rho_0$ (ρ_0 denotes the radius of the metallic contact area). The se-
            miconductor is divided into two domains to obtain the solutions of the
            system of equations. 1) A narrow domain with space charge $\rho_0 \leqslant \rho \leqslant \rho_k$,
            which is adjacent to the contact or the chemical p-n transition, 2) The
            remaining quasi neutral domain $\rho > \rho_k$. All cases, for low and heavy cur-
            rents are investigated, and the efficiency of emission of the various
            p-n transitions is analyzed. These investigations show that the injec-
Card 1/2   tion-coefficient of the spherical contact is higher in all other cases

PA - 2786

Injection Coefficient and Direct Votampere Characteristic of Spherical Contact.

than that of plane contact, but the decrease of γ as a function of the current for $\gamma \simeq 1$, takes place at a much smaller rate. These effects are related with the relatively greater importance of the diffusion-current compared with the field-currents. This predominance is caused by the dissipation of the hole-conductors over a large surface with the growth of ς and a corresponding increase of the gradient of concentration $\frac{dz}{d\varsigma}$. (With 5 citations from Slav Publications).

ASSOCIATION   State University of Kiev,(Gosuniversitet Kiyev).
PRESENTED BY
SUBMITTED   23.10.1956.
AVAILABLE   Library of Congress.
Card 2/2

TOLPYGO - K.B.

AUTHOR: TOLPYGO,K.B.   PA - 3536
TITLE: Dependence of Emission Power of p-n-Junction on its Structure
               and Operation Conditions. (Zavisimost' emissionnoy Sposobnosti
               p-n-perekhoda ot yego struktury i usloviy raboty, Russian)
PERIODICAL: Zhurnal Tekhn. Fiz., 1957, Vol 27, Nr 5, pp 884 - 898 (U.S.S.R.)

ABSTRACT: The dependence of the injection coefficient at the boundary of a
               flat p-n-junction γ_o upon the character of the concentration
               modification of the admixtures in the adjoining domains of the
               semiconductors are investigated. The paper deals with the linear-
               and the exponential concentration modification of the acceptors at
               constant donator concentration as well as with the barrier layer
               caused by a contact. The possible influence of the acceptors upon
               the life of the unequal weight of the current carriers is taken
               into account. The conception of the emission quality of the p-n-
               transition is established the high value of which garantees a high
               value of γ_o even in the case of high current powers. The method of
               measuring γ_o is criticized and an interpretation for the empirically
               worked-out instruction for the production of crystal triodes and
               indications for the selection of an optimum mode of operation are
               given. (2 illustrations and 5 Slavic references)
Card 1/2

Dependence of Emission Power of p-n-Junction on its Structure $\quad$ PA - 3536
and Operation Conditions.

ASSOCIATION: State University T.G.SHECHENKO, Kiev.
PRESENTED BY:
SUBMITTED:
AVAILABLE: Library of Congress

Card 2/2

TOLPYGO, K.B.

AUTHORS: Deygen, M. F., Dykman, I. M., Tolpygo, K. B.   57-27-7-40/40

TITLE: All-Union Conference on the Theory of Semiconductors
              (Vsesoyuznoye soveshchaniye po teorii poluprovodnikov).

PERIODICAL: Zhurnal Tekhnicheskoy Fiziki, 1957, Vol. 27, Nr 7,
              pp. 1628-1642 (USSR)

ABSTRACT: The conference took place in Kiyev on October 9-13, 1956.
              40 lectures were held. They comprised the following branches
              of knowledge: multielectron-theory of the solid body,
              exiton-processes in semiconductors, interaction between
              current-carriers and lattice, theory of the polarons, theory
              of the local states of the electron in semiconductors, zonal
              structure of the semiconductors, magnetic properties of the
              semiconductors, phenomenological theory of the semiconductors.
              There are 16 references, 12 of which are Slavic.

SUBMITTED: December 30, 1956

AVAILABLE: Library of Congress

              1. Conferences-Theory of semiconductors-Kiyev   2. Semiconductors-Theory
Card 1/1

. *Tolpy Go, K. B*

AUTHORS: Gribnikov, Z. S., and Tolpygo, K. B.   57-10-5/33

TITLE: Note on the Emission of a Spherical Contact in a Drawing Electric Field (Emissiya sfericheskogo kontakta v tyanushchem elektricheskom pole).

ABSTRACT: In this paper, an exact computation of the injection-coefficient γ for a spherical contact in an drawing electric field is executed, Its purpose is to interpret the experiments of the type performed by C. A. Hogarth (Proc. Phys. Soc. B 66, 845, 1953) correctly and to obtain correct characteristics from those experiments. At the outset the distribution of the potential in the absence of current through the emitter contact is given. Afterwards it is assumed, that a certain potential is supplied to the spherical contact, which is positive with respect to the medium and which assures the injection of holes into the semiconductor. By this process a certain concentration of holes Z is produced in the region, where the space charge is compensated. The boundary conditions are laid down and the injection coefficient is deduced. The computations are executed here under the assumption of negligible Z, of a negligible surface combination and thickness - effect of the rod, which was used in the experiments.

Card 1/2

Note on the Emission of a Spherical Contact in a Drawing Electric Field.   57-lo-5/33

> In this respect the computations in this paper differ from the conditions of the experiment. The equation obtained for Z can be applied immediately to measurements, if they take place at a relatively short distance from the contact.
> There are 3 figures and 8 Slavic references.

ASSOCIATION: Ukrainian Scientific Research Institute for Road Transport, Kiyev (Ukrainskiy dorozhno-transportnyy nauchno-issledovatel'skiy institut. Kiyev).

SUBMITTED: March 4, 1957.

AVAILABLE: Library of Congress.

Card 2/2

$TOLPYGO, K. B.$

AUTHORS: Kaplunova, Ye. I., and Tolpygo, K. B.

57-10-7/33

TITLE: Note on the Temperature Dependence of the Hall-Coefficient in Semiconductors with Constant Concentration of Carriers (Temperatur- naya zavisimost' koeffitsiyenta Kholla v poluprovodnikakh s postoyan- noy kontsentratsiyey nositeley).

ABSTRACT: A method is proposed to determine a number of semiconductor para- meters from the dependence of the Hall coefficient on the tempera- ture. This method makes it possible to elaborate experimental data in a very simple manner and to compare it with theory. Just like in the former publication of the author (Tolpygo) in IFAN USSR, Nr 3, 52, 1952, here also the simplest case of an isotropic quadratic dependence of the carrier energy on the velocity in homeopolar semiconductors with great mobility is investigated, if the dipper- sion is essential in acoustical vibrations and in charged admixtures at the same time. Formulae for the dependence of the mobility on temperature are deduced and it is shown, that $u(T)/T^{3/2}$ must be an universal function $f(a)$ of a dimensionless quantity $a = a_0 T^3$ with

Card 1/3   an accuracy. $u(T)$ represents the temperature dependence of the

Note on the Temperature Dependence of the Hall-Coefficient in   57-lo-7/33
Semiconductors with Constant Concentration. of Carriers.

mobility. Next the equation for the Hall coefficient R_x is deduced
and it is shown, that R_x as a function of temperature possesses a
minimum, which was not to be expected from the formula obtained
in the earlier paper. This is connected with the fact, that R_x
is represented by the ratio of two functions growing at an unequal
rate. The carrier concentration N and the quantity a_o can be found
from the shift displacement of the curve $\ln R_x$ of $\ln T^3$ with respect
to the standard curve $\ln \phi$ of $\ln a$. A combination with measurements
of conductivity furnishes the mobility of the electrons as a function
of temperature. It is shown, that it is possible to determine from
the difference between N and the concentration of singly ionized
admixtures, to what degree the admixtured donators are compensated
by acceptors. The method of elaborating experimental data proposed
here makes it possible to remove the indeterminacy from distinguishing
between the Hall-mobility and the drift mobility and permits to de-
termine the magnitude of the carrier concentration and the concentra-
Card 2/3   tion of singly ionized admixtures with much greater exactitude.

Note on the Temperature Dependence of the Hall-Coefficient in   57-1o-7/33
Semiconductors with Constant Concentration of Carriers.

There are 2 figures, 1 table and 2 Slavic references.

ASSOCIATION: Institute for Physics AN Ukrainian SSR, Kiyev (Institut fiziki AN USSR, Kiyev).

SUBMITTED: March 4, 1957.

AVAILABLE: Library of Congress.

Card 3/3

ABSTRACT: Taking account of the deformability of atoms results in a delayed
               interaction for homoeopolar crystals caused by the reciprocal
               dependence of exchange integrals and dipole moments, so that opti-
               cal, electrical, and elastic properties of the crystal may be dealt
               with from a uniform point of view. Further, the order of magnitude
               of lattice oscillation absorption, which was found experimentally
               by M.LAX and E.BURSTEIN (Phys.Rev. 97, 39, 1955), can be pre-
               dicted without introducing free parameters. The energy of the crystal
               is written down as a function of the displacements and dipole
               moments of the atoms. As restriction to central forces has been
               abandoned, four interaction parameters result (instead of three
               in the case of ion crystals). As the necessary wave functions are
               not known sufficiently well, these parameters must be determined
               experimentally.

Card 1/2

Kiev State Univ.

Electrical, Optical and Elastic Properties of Diamond Type   PA - 2965
Crystals. I.

The present part I ends with the equations of motion derived from
the energy expression, which also contain the required dependence
of the shifting of the atoms and their polarization. The above
mentioned effects resulting from this dependence will be in-
vestigated more closely in the following part II. (Zhurnal Eksperim.
i Teoret.Fiziki, 1957, Vol 32, Nr 4). (7 Citations from Published
Works).

ASSOCIATION:
PRESENTED BY: State University Kiev
SUBMITTED:
AVAILABLE: 18.7.1955
                 Library of Congress

CArd 2/2

56-4-30/52

AUTHOR	GITERMAN, M.Sh., TOLPYGO, K.B.
TITLE	The Zone Structure of the Energy Spectrum of a Polaron (Zonnaya struktura energeticheskogo spektra polyarona. Russian)
PERIODICAL	Zhurnal Eksperim. i. Teoret. Fiziki, 1957, Vol 32, Nr 4, pp 874 - 882 (U.S.S.R.)

ABSTRACT

First of all the paper under review comments on the state of investigations with respect to the above problem and refers to some relevant previously published papers. This paper, according to their authors, is the first attempt of a quantitative computation of the deepest zones of a polaron.

The approximate method. - Because of the extremely complicated nature of the general problem, the authors investigate in the paper under review a relatively slow motion of the polaron, where it is possible to neglect the transmission of its energy to the crystal. Also the radius of the state of the polaron ($r_p \gg a$) is assumed to be sufficiently great in order to enable a consideration of the results of the macroscopic theory by Pekar as zeroth approximation. Even the investigation of a motionless polaron with small radius is an independent and relatively difficult problem. The question under consideration in this paper is reduced to the determination of the explicit dependence $J(\xi)$ and to the integration of the equation $-(\hbar^2/2M) \nabla^2 \psi + J[\psi] \psi = E\psi$. In this context, $J[\psi]$ denotes the energy of a crystal with a motionless polaron,

Card 1/2

The Zone Structure of the Energy Spectrum of a Polaron   56-4-30/42

ξ stands for the coordinate of the center of mass of the polaron, M denotes the effective mass of the polaron. This dependence is connected with the discrete structure of the crystal. The paper under review solves the Schrödinger equation for the polaron in zeroth approximation. Also the solution of first approximation is given. All self-oscillations of the binary crystals have a certain dipole moment, but as far as the polaron with great radius are concerned, the longitudinal optical branch yields the greatest contribution to the coefficients of expansion in the Fourier expansion of the inertia dipole moment. The paper under review contains formulae for the mean potential energy of the electron, for the potential energy of the deformed crystal and for the energy of a crystal with a polaron.

Subsequent chapters of this paper deal with the dependence of the energy of a crystal with a polaron on the position of the center of mass of the polaron, and they also consider the widths of the polaron zones for concrete crystals. (2 charts).

ASSOCIATION   State University Kiyev (Kiev)
PRESENTED BY
SUBMITTED   21 April 1956
AVAILABLE   Library of Congress
Card 2/2

TOLPYGO, K. B.

Gorkun, Yu. I. and K.B. Tolpygo. [Institut fiziki AN USSR (Physics Institute of AS UkrSSR)] Polaron Theory of the Breakdown of Ionic Dielectrics

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

This volume publishes reports presented at the All-Union Conference on the Physics of Dielectrics, held in Dnepropetrovsk in August 1956, sponsored by the "Physics of Dielectrics" Laboratory of the Fizicheskiy institut imeni Lebedeva An SSSR (Physics Institute imeni Lebedev of the AS USSR), and the Electrophysics Department of the Dnepropetrovskiy gosudarstvennyy universitet (Dnepropetrovsk State University).

TOLPYGO, K.B. [Tolpyho, K.B.]; TOMASEVICH, O.F. [Tomasevych, O.F.]

Wave functions and energy of zonal electrons in NaCl crystals
[in Ukrainian with summary in English]. Ukr. fiz.zhur. 3 no.2:
145-167 Mr-Ap '58.   (MIRA 11:6)

1.Kiivs'kiy derzhavniy universitet.
          (Sodium chloride) (Crystal lattices)

GRIBNIKOV, Z.S. [Hrybnykov, Z.S.]; TOLPYGO, K.B. [Tolpyho, K.B.]

Emissivity of a spherical contact between metals and semiconductors.
Part 1: Case of small currents [in Ukrainian with summary in English].
Ukr. fiz.zhur. 3 no.2:168-177 Mr-Ap '58.   (MIRA 11:6)

1.Kiivs'kiy derzhavniy universitet im. T.G. Shevchenka.
              (Semiconductors)

DEMIDENKO, A.A. [Demidenko, O.A.]; DEMIDENKO, Z.A. [Demidenko, Z.O.];
TOLPYGO, K.B. [Tolpyho, K.B.]

Heat capacity and natural frequencies and amplitudes of KBr.
Ukr. fiz. zhur. 3 no.6:728-742 N-D '58.

(MIRA 12:6)

1. Institut fiziki AN USSR.
(Potassium bromide crystals—Vibration)
(Heat capacity)

AUTHOR: Tolpygo, K.B.   SOV/109-3-8-1/18

TITLE: Special Features of the Saturation Transition in
           Semi-conductor Thermionic Cathodes (Osobennosti
           perekhoda k nasyshcheniyu v poluprovodnykh
           termokatodakh)

PERIODICAL: Radiotekhnika i Elektronika, 1958, Vol 3, Nr 8,
           pp 980 - 989 (USSR)

ABSTRACT: It is known that the current of a thermionic tube in
           the saturation region can be explained by the Schottky
           effect. For some time, it has been believed that the
           current is primarily due to the external Schottky effect
           but it was shown by Zingerman (Ref 1) that this effect
           is comparatively unimportant. Morgulis (Ref 2) showed
           that the saturation current is primarily dictated by the
           external Schottky effect and gave an approximate,
           theoretical explanation of it. In this work, the theory
           of the internal Schottky effect is considered in more
           detail, in particular, the effect of the surface charge
           σ_0 is taken into account. It is assumed that the
           potential between the anode and the cathode in a parallel
           electrode system is expressed by Eq.(1), so that the

Card1/5

Special Features of the Saturation Transition in Semi-conductor
Thermionic Cathodes

integration of the Poisson equation leads to Eq.(2),
where :

$$A = 8\pi i = \sqrt{\frac{2m}{e}}$$

and d is the distance between the anode and the
cathode. If the notation defined by Eqs.(3) and (4) is
adopted, Eq.(2) can be written as Eq.(5), where
$u = x^{1/2}p^{3/2}$. The relationship expressed by Eq.(5)
is illustrated in Figure 1. The universal curve $x(p)$
of Figure 1 gives a single-value expression for U_a in
terms of E_o and i . A similar problem should be
solved for the semi-conductor layer of the cathode and
this would determine the current-voltage characteristic
of the system. Under the assumption that the donor
levels are weakly ionised, the current density and the
Poisson equation can be written as:

Card2/5

Special Features of the Saturation Transition in Semi-conductor Thermionic Cathodes   SOV/109-3-8-1/18

$$\lambda = -\frac{dz}{d\xi} + zy; \qquad \frac{dy}{d\xi} = z - \frac{1}{z} \qquad (7)$$

where $z = n/n_\infty$ is the relative concentration of the conductivity electrons $\xi = \varkappa r$ is the normalised co-ordinate, y is the normalised field and λ is the normalised current. Eqs.(7) can be solved analytically for various special cases. For $\lambda \ll 1$, z and y are given by Eqs.(8), while for $zy \ll \lambda$, they are expressed by Eq.(9). In the region where $yz \gg \lambda$, y is given by Eq.(11). The density of the thermionic current in the saturation regime is expressed by Eq.(14), where $\bar{v}$ is the thermal velocity of the electrons, χ is the external work function and $\tilde{D}$ is the transparency coefficient. Eq.(14) can be written as Eq.(15) if the normalised co-ordinates λ and z are adopted. If it is assumed that $\sigma_0 = 0$, Eqs.(15) and (16) result in Eqs.(17), where

Card3/5

Special features of the Saturation Transition in Semi-conductor
Thermionic Cathodes

ε is the permittivity of the semi-conductor. Equations
for the electron concentration and the saturation current
can be written as Eqs.(18), provided $\lambda_0 \ll 1$. The equations
were used to evaluate λ_0 and z_0 for various values of
σ_0 and B. The results are given in the table on p 984
and in Figures (3) and (4). Figure 3 shows λ_0 as a
function of temperature, while the curves of Figure 4
represent the voltage-current characteristics. Similarly,
the voltage current characteristics for various values
of the saturation current λ_0 are given in Figures 5,
6, 7 and 8. If the surface concentration of charges σ_0
is taken into account, the boundary conditions (which
were expressed by Eq.(16)) should be written as Eq.(27)
where m_0 is defined by Eqs.(25) in which M and L'
denote the concentrations of the upper and the lower
energy levels of the electrons. The parameter p for the

Card4/5

.Special Features of the Saturation Transition in Semi-conductor Thermionic Cathodes

SOV/109-3-8-1/18

current-voltage characteristic can be expressed by Eq.(28). Eqs.(27) and (28) were used to plot the current voltage curves for the case of $\sigma_0 \neq 0$ and these are shown in Figures 4, 5, 6, 7 and 8 ('dashed' curves). The author thanks Professor N.D. Morgulis for his valuable remarks and A.M. Fedorchenko and Ye.I. Kaplunova for carrying out various calculations. There are 8 figures and 4 references, 2 of which are Soviet and 2 English.

SUBMITTED: January 29, 1958

Card 5/5
1. Electron tubes--Electrical properties   2. Cathodes (Electron tubes)--Performance   3. Thermionic emission--Analysis   4. Semi-conducting films--Electrical effects   5. Mathematics

AUTHORS: Novosil'tsev, N. S., Tolpygo, K. B.,   48-22-3-5/30
            Skanavi, G. I.

TITLE: Discussions of Reports Submitted   by: G. I. Skanavi,
            Ya. M. Ksendzov, V. A. Trigubenko and V. G. Prokhvatilov;
            G. G. Smolenskiy, V. A. Isupov, A. I. Agranovskaya and
            Ye. D. Sholokhova; Ya. M. Ksendzov; N. S. Fastov and B. N.
            Finkel'shteyn (Preniya po dokladam: G. I. Skanavi, Ya. M.
            Ksendzova, V. A. Trigubenko i V. G. Prokhvatilova; G. G.
            Smolenskogo, V. A. Isupova, A. I. Agranovskoy i Ye. D.
            Sholokhovoy; Ya. M. Ksendzova; N. S. Fastova i B. N.
            Finkel'shteyna)

PERIODICAL: Izvestiya Akademii Nauk SSSR,Seriya Fizicheskaya, 1958,
            Vol. 22, Nr 3, pp. 252-253 (USSR)

ABSTRACT: Novosil'tsev makes the following statements in connec=
            tion with the report submitted   by G. I. Skanavi and
            his collaborators on the manufacture of new dielectrica
            with high permeability, but without piezoelectric proper=
            ties'. The idea of a real crystal with defects 'of different
Card 1/4   origin is increasingly applied with the treatment of struc=

Discussions of Reports Submitted   by: 48-22-3-5/30
G. I. Skanavi, Ya. M. Ksendzov, V. A. Trigubenko and
V. G. Prokhvatilov; G. G. Smolenskiy, V. A. Isupov, A. I.,
Agranovskaya and Ye. D. Sholokhova; Ya. M. Ksendzov;
N. S. Fastov and B. N. Finkel'shteyn

tural sensitive dielectric properties. In the years
from 1950 to 1951 (Reference 1) he obtained crystals of
barium barium titanate with a sole eroded maximum of
dielectric constant. When investigating them (Reference 2)
it was found that the lattice of these crystals can gra=
dually be equilibrated by means of a sustable thermal
treatment. The piezoelectric properties are developed -
also gradually - in this connection. The disturbance of
the regularity and the deviation from the ideal lattice,
both at the expense of the dislocated ions and at the ex=
pense of the penetration of foreign ions into the lattice
(in the case of solid solutions) must lead to equal results
with such sensitive properties as piezoelectricity, viz.
to the fusion of all phase transitions and to the forma=
tion of an eroded maximum. The comparison of a series of
X-ray structural data which were determined in the labora=
tory of Fesenko, Slabchenko, Mozgovoy and others leads one
Card 2/4   to assume that no phase conversion takes place when the

Discussions of ReportsSubmitted   by:
G. I. Skanavi, Ya. M. Ksendzov, V. A. Trigubenko   48-22-3-5/30
and V. G. Prokhvatilov; G. G. Smolenskiy, V. A.
Isupov, A. I. Agranovskaya and Ye. D. Sholokhova;
Ya. M. Ksendzov; N. S. Fastov and B. N. Finkel'shteyn

maximum is exceeded and that the cubic lattice is con=
served. K. B. Tolpygo objects to the model proposed by
Ksendzov which explains the increase of the dielectric
constant of TiO_2 by the addition of a small quantity of
Nb_2O. The problem of the behavior of the ions which are
introduced in form of traces into a crystal and which are
of another valence was frequently raised in the physics of
semiconductors and was most carefully investigated. Tol-
pygo agrees with the qualitative considerations of the
lecturer, yet they can be submitted to a more accurate
qualitative control when the formulae by S. I. Pekar are
applied. A quantitative control is urgently needed. From
the standpoint of theoretical considerations, this model,
need, however, not cause any criticism. G. I. Skanavi
comments on the report submitted   by N. S. Fastov and

Card 3/4

Discussions of Reports Submitted   by: 48-22-3-5/30
G. I. Skanavi, Ia. M. Ksendzov, V. A. Trigubenko
and V. G. Prokhvatilov; G. G. Smolenskiy, V. A. Isupov,
A. I. Agranovskaya and Ye. D. Sholokhova; Ya. M. Ksendzov;
N. S. Fastov and B. N. Finkel'shteyn

> B. N. Finkel'shteyn. The formulae for $\mathcal{E}'$ and $\mathcal{E}''$, which
> were determined by the author, correspond to the known
> formulae by Debya and are analogous to them. It is essen=
> tial that these formulae, which were derived without the
> application of model-considerations, obtain a constant
> of time which differs from the relaxation time by the co=
> efficient $t_o/\mathcal{E}_\infty$. In the model theories this coefficient
> depends on the form of the inner field. The question,
> what originated this difference, ought to be investigated.
> There are **2 Soviet references.**

AVAILABLE: Library of Congress

1. Dielectrics--Production   2. Crystals--Dielectric properties
3. Dielectrics--Properties

Card 4/4

AUTHORS: Tolpygo, K. B., Skanavi, G. I.   48-22-3-8/30

TITLE: Discussions on the Reports Submitted by: A. Ye. Glauberman;
              A. Ye. Glauberman and I. M. Spitkovskiy (Preniya po dokladam:
              A. Ye. Glaubermana; A. Ye. Glaubermana i I. M. Spitkovskogo)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, 1958,
              Vol. 22, Nr 3, pp. 262-262 (USSR)

ABSTRACT: <u>K. B. Tolpygo</u> commented on the lecture delivered by A. Ye.
              Glauberman as follows: The question was raised whether the
              dipole energy in the external field is correctly written down
              and whether the external field should not be replaced by the
              effective field. Since the effective field includes also part
              of the interaction of the molecules, - whilst this interaction
              is apparently taken into consideration in the developed theory -
              it cannot be taken into account twice. The lecturer entered
              the energy of the particles quite correctly into the external
              field. This attitude, however, does not make it possible to
              advance far in direction of the interactions. In the method
              developed by Bogolyubov the correlation in the orientation of
              various molecules is not taken into account in zeroth approxi-
Card 1/2   mation. It would be advisable to combine the method developed

Discussions on the Reports Submitted   by: A. Ye. Glauberman; 48-22-3-8/30
A. Ye. Glauberman and I. M. Spitkovskiy

by Bogolyubov with the introduction of the effective field.
In this case, the forces exercising a remote effect between
the molecules could be taken into account by means of the
effective field and their deviation from the averaging of the
forces. The forces exercising a short-distance effect could
also be included in the common potential energy. The
dissociation required by the method developed by Bogolyubov
ought to be applied only with respect to this part of the
interaction. This attitude would make it possible to advance
in the direction of the substances with higher ε -values.
G. I. Skanavi with respect to the lecture delivered by
Glauberman: The application of the method developed by
Bogolyubov would be of great interest if it would lead to
any new concrete results. When applying the theory developed
for polar liquids, it is not to be understood, however, in
what way it is more advantageous in comparison with the
theory developed by Kirkvud, especially since model
considerations will eventually have to be taken into account
for the determination of numeric results.

AVAILABLE: Library of Congress
Card 2/2

1. Crystals--Polarization   2. Crystals--Dielectric properties

48-22-3-29/30

AUTHORS: Mikhaylov, G. P., Skanavi, G. I., Tolpygo, K. B.

TITLE: Discussions on the Reports Submitted   by: K. V. Filippova,
              I. S. Zheludev and V. M. Fridkin (Preniya po dokladam: K. V.
              Filippovoy, - I. S. Zheduleva i V. M. Fridkina)

PERIODICAL: Izvestiya Akademii Nauk SSSR Seriya Fizicheskaya, 1958,
              Vol. 22, Nr 3, p. 358   (USSR)

ABSTRACT: G. P. Mikhaylov: The results experimentally obtained by K. V.
              Filippova are of great interest. The tests were carried out
              thoroughly and accurately. The molecular explanation of the
              electret state, however, does not result from the report.
              G. I. Skanavi: The assertions by Filippova with respect to
              the responsibility of the dipole groups for the electret effect
              should be agreed with. These groups are connected with greater
              formations, e.g. with segments. The orientation of the latter
              again causes optic anisotropy. The period of desorientation
              of the segments is longer than that of the dipole groups at
Card 1/2   room-temperature. Contrary to the assertion by Mikhaylov, the

48-22-3-29/30

Discussions on the Reports Submitted   by: K. V. Filippova, I. S. Zheludev
and V. M. Fridkin

interpretation in the actual state of work is absolutely
possible and does not contradict the experimentally obtained
data.

K. B. Tolpygo spoke on the lecture delivered by I. S. Zheludev
and V. M. Fridkin: It seems that experimental work attained
already such a stage as to allow the risk of suggesting a cer-
tain model and an energetic scheme of the electron level. The
presence of basic impurity levels and levels of adhesion must
apparently be assumed. The experimentally obtained results and
especially the energetic distances between the local level and
the zone of conductivity could be determined on the basis of a
certain model. Concluding, attention is called to the results
of discussion on the zonal theory of solid bodies which took
place between the theorists of the Soviet Union.

AVAILABLE: Library of Congress
Card 2/2

1. Electrets—Properties—Theory

AUTHORS:

Gorkun, Yu. I., Tolpygo, K. B.

TITLE:

48-22-4-3/24

Polar Theory of the Breakdown of Ionic Dielectrics (Polyar-onnaya teoriya proboya ionnykh dielektrikov)

PERIODICAL:

Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, 1958, Vol. 22, Nr 4, pp. 377-382 (USSR)

ABSTRACT:

The theory of breakdown in ionic crystals must be based upon polaron conception of conductivity. All existing theor-ies of breakdown in ionic dielectrics are based upon zonal conceptions (references 1,2). The deficiency of such a con-ception in the theory of inert electrons was demonstrated in the papers by S. I. Pekar (Ref 3,4). As was shown by him, in ionic crystals the socalled polaron state is most advantageous. In this state the conduction electron with its field polarizes the surrounding dielectric and is located on a discreet level in the potential well, which is formed by the polarized di-electric. In alkali-halide crystals the respective level is by 0,15 - 0,2 eV lower than the conduction zone, no activation energy being necessary for a transition from the zonal into the polaron sate. Therefore the majority of the conduction electrons must be in polar state (in NaCl, for instance, at

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Polar Theory of the Breakdown of Ionic Dielectrics.   48-22-4-3/24

room temperature there is one zonal electron to 10^6 polarons.)
As can be seen from reference 3, such a self-coordinated state
of the electron and the dielectric is in a position to shift,
and by that to transport charge. The theory of an immovable
and inert polaron (reference 3) has been developed to the great-
est degree of perfection. The authors made it their aim to
find the breakdown field from the condition, that the energy
obtained by the conduction electron in the field evE (drift
speed) increases faster than the energy $\mathcal{E}(v)$ with an increase
of the field, E, the latter being lost by the electron per
unit time because of the interaction with the lattice. From
the energy balance at $E \leqslant E_{pr}$ it is found to be: $E = \dfrac{\mathcal{E}(v)}{ev}$

If E and v are small the function $\mathcal{E}(v)$ monotonuously increa-
ses. The unstable state is reached at the point v_{max}.

$$\frac{dE}{dv}\bigg|_{v=v_{max}} = 0, \qquad \frac{1}{v} \cdot \frac{d\mathcal{E}}{dv} - \frac{1}{v^2}\mathcal{E}(v) = 0 \qquad (2)$$

At $v \rangle v_{max}$ a further acceleration of the electron takes place
disregardin the reduction of the field. Apparently the break-
down occurs at $E = E(v_{max})$. According to reference 2 that point

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Polar Theory of the Breakdown of Ionic Dielectrics   48-22-4-3/24

corresponds to it, where the gradient in the diagram $\ln \mathcal{E}$ of $\ln v$ equals unity. From this it appears, that the determination of E_{pr} reduces to the problem of finding $\mathcal{E}(v)$ of the polaron. One of the authors in collaboration with Z. I. Uritskiy (reference 8) computed the fuhction $\mathcal{E}(v)$ for all 6 branches of the crystals NaC., KCl, KBr, when the polaron state is represented by the Gaussian function

$$\psi_0(r) = \left(\frac{2}{\pi}\right)^{3/4} \alpha^{3/2} e^{-\alpha^2 r^2}; \quad \alpha = \frac{m^* e^2}{3\sqrt{\pi} \hbar^2} c; \quad c = \frac{1}{n^2} - \frac{1}{\mathcal{E}}$$

$\mathcal{E}$ and n^2 denote the statistical and the dielectric high frequency constant m^* denotes the effective mass of zone electron. Analoguous computations were performed by the students of the State University Kiyev Yasinskiy and Nosar, Figure 1 (curve 5) shows the energy values, which the polaron looses in the function of the immeasurable velocity. Diagram 5 (table 1) shows corresponding values u_{max} and E_{pr}. For the latter (fig. 1) the following formula was set up.

$$E_{pr} = 1,26 \cdot 10^{-9} \frac{c}{r_0^2} V \, cm^{-1}; \quad r_0 = \frac{\hbar^2}{m^* e^2 c}$$

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Polar Theory of the Breakdown of Ionic Dielectrics   48-22-4-3/24

Table 2 (columns 3 and 4) contain measuring units of v_{max} and E_{pr} of the actual crystals. Due to the increase in size of the polaron radius with velocity (Figure 2) increases with $\mathcal{B}$ (u) more slowly in the case of a deformed polaron than is the case with a fixed polaron. The maximum of $\mathcal{B}$ (u) shifts toward smaller velocities, (figure 1, curve 5). This leads to a better agreement between theory and experiment. For the applicability of the microscopical theory (reference 3) the criterion 1o $r_0 \gg$ a is given. The better the microscopical method in the computation of the polaron can by applied, the greater is the agreement between theory and experiment. Still another cause for the higher values of E_{pr} exists. It is not inevitably necessary, that all current carriers possess a maximum velocity v_{max}. It is sufficient, if only a small proportion of the polarons, the random velocity of which coincides with the drift speed, satisfy this condition. More accurate results can be obtained for E_{pr} from a more rigorous computation with the help of kinetic equations. It is obvious, that this theory must be based upon a polaron conception, and that the deformation of the polaron with velocity must be taken into consideration. There are 2 figures, 2 tables, and 8 references, all of which are Soviet.

Card 4/5

Polar Theory of the Breakdown of Ionic Dielectrics   48-22-4-3/24

ASSOCIATION: Institut fiziki Akademii nauk USSR (Institute for Physics, AS Ukrainian BSR)

AVAILABLE: Library of Congress

1. Crystals--Dielectric properties   2. Electrons--Energy
3. Magnetic fields--Applications

Card 5/5

TOL-PY..., K.,

AUTHORS: Skanavi, G. I., Balygin, I. Ye., Tolpygo, K. B.   48-22-4-4/24

TITLE: Discussion on Lectures by V. A. Chuyenko, Yu. I. Gorkun, and K. B. Tolpygo (Preniya po dokladam: V. A. Chuyenkova; Yu. I. Gorkuna i K. B. Tolpygo)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Seriya Fizicheskaya, 1958 Vol. 22, Nr 4, pp. 383-385 (USSR)

ABSTRACT: The following scientists participated in this discussion: G. I. Skanavi, I. Ye. Balygin, K. B. Tolpygo and V. A. Chuyenkov. G. I. Skanavi made a few general remarks as to the role of impact ionization in the breakdown and in reference to the interrelation breakdown voltage with the lattice energy. Without doubt the breakdown of a solid dielectric shows two stages. Unfortunately, no experiment is known at present which permits to separate these two stages accurately. In the experimental investigation of the dielectric strength. No doubts exist at present as to the fact, that the initial stage of breakdown is conditioned by electron processes. The lecture on the polaron state of electrons (by Gorkun and Tolpygo) is interesting, because it represents the first attempt to compute the polaron states in the process of electric breakdown. The crit-

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Discussion on Lectures by V. A. Chuyenko, Yu. I. Gorkun, and   48-22-4-4/24
K. B. Tolpygo

erion by Khippel' applied in this paper, will at present be
hardly usable. It is not possible to investigate one single
electron, it is, on the contrary, necessary to investigate the
electron collective, and in consequence, the distribution
function. Skanavi with respect to the paper by Chuyenkov mak-
es the statement, that in spite of some difficulties it leav-
es satisfactory impression, showing less concessions than
other papers. I. Ye. Balygin criticises the paper by Tolpygo
and Gorkun. He states, that the neglections made by them are
so great, that the polaron theory has created even greater dis-
crepancies between theory and experiment than is the case with
other theories. Also the theory by Chuyenkov of the valence
crystals is calling for contradictions. The assertion, that
energetical losses of the electron in the scattering on latti-
ce vibrations is independent from its velocity is considered
to be impossible. The here given theories also do not show the
interrelation of the breakdown voltage with temperature. It
must be mentioned, that in taking into consideration stati-
stical fluctuations the criteria by Khippel' and Frelikh co-
incide. K. B. Tolpygo is of opinion, that the correspondence
of theory with experiment represents a convincing criterion,
if only the theory itself contains no contradictions. If this

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Discussion on Lectures by V. A. Chuyenko, Yu. I. Gorkun,   48-22-4-4/24
and K. B. Tolpygo

is not the case, an agreement with experiment is illusory, because essentially in the theory an error of unknown magnitude has occurred, which sometimes is able to basically change the result. It is obvious, that the zero-th approximation of the theory is absolutely inadequate. Therefore, the computations of the energy losses in this approximation cannot be correct. The zonal state of the electrons is not steady, and therefore every electron very quickly loses its initial velocity and transforms into a polaron, which penetrates into the crystal or which is formed because of impact ionization or because of photoeffect (within 10^{-12} sec. that is the vibration period of the lattice). It possesses a great effective mass and a considerable free length of path. Therefore the polaron theory is free of the contradictions of zonal theory. The polaron theory should only be applied in the description of the conditions previous to breakdown. Chuyenkov mentioned, that in the statistical treatment the low number of the zonal electrons plays a considerable part, the energy of which is by $0.15-1.2$ eV greater than that of the immovable polaron. The problem, however, proves to be much more complicated. A zonal electron

Card 3/4

Discussion on Lectures by V. A. Chuyenkov, Yu. I. Gorkun,   48-22-4-4/24
and K. B. Tolpygo

with low energy is not steady; in order to settle this dispute
it would be necessary to investigate the behaviour of even
faster polarons with energies of o,5 eV and to determine the
limit, at which the electrons can be regarded as zonal without
taking into consideration the polar effects. Up to this limit
the energy balance should be treated corresponding to polaron
theory. The great advantage of polaron theory consists in the
fact, that it not only operates with known parameters of the
crystals: ξ, n_0^2, ω_0 and m^*. In the here performed investigations
all quantities from previous papers on the theory of polarons
and F-centres were employed. From this it appears, that the
inconsistencies with the experiment are not very great.
There are no references.

AVAILABLE: Library of Congress

1. Dielectrics---Phase studies   2. Dielectrics--Theory   3. Elec-
trons---Applications

Card 4/4

TOLPYGO, K. B.

48-22-4-12/24

AUTHORS: Pisarenko, V. F.; Balygin, I. Ye., Fedoseyev, G. P.; Tonkonogov, M. P., Fridberg, I. D.; Tolpygo, K. B., Konorova, Ye. A., Skanavi, G. I.

TITLE: Discussions on Lectures by: S. M. Bragin, G. A. Vorob'yev and A. A. Vorob'yev; L. A. Sorokina and Ye. A. Konorova; V. D. Kuchin; Ye. A. Konorova, V. V. Krasnopevtsev and G. I. Skanavi (Preniya po dokladam: S. M. Bragina; G. A. Vorob'yeva i A. A. Vorob'yeva; L. A. Sorokinoy i Ye. A. Konorovoy; V. D. Kuchina; Ye. A. Konorovoy, V. V. Krasnopevtseva i G. I. Skanavi)

ABSTRACT: V. B. Pisarenko criticises the paper by G. A. Vorob'yev and A. A. Vorob'yev. He maintains, that in the investigation of the breakdown of colored rock salt the influence of space charge was not taken into consideration. I. Ye. Balygin maintains, that the experiments by Bragin are of great importance, as little research has hitherto been conducted in this field. In the lecture by Vorob'yev and Vorob'yev the divisionof breakdown into two stages was not sufficiently

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Discussions on Lectures by: S. M. Bragin, G. A. Vorob'yev   48-22-4-12/24
and A. A. Vorob'yev; L. A. Sorokina and Ye. A. Konorova; V. D. Kuchin;
Ye. A. Konorova, V. V. Krasnopevtsev and G. I. Skanavi

proved. He considers the method by Sorokina to be unreliable.
G. P. Fedoseyev states with respect to the lecture by Bragin:
The results are to be considered of great practical interest.
The investigation, however, is incomplete and therefore
cannot be recommended for practical technology. M. P.
Tonkonogov considers the lecture by Bragin as valuable for
the clarification of the interconnection between the
phenomena of dielectric losses and the phenomena of break-
down. I. D. Fridberg discusses the lecture by Bragin and
communicates his own experience in this field. K. B. Tolpygo
contests the results communicated in the lecture by
Krasnopevtsev, Konorova and Skanavi. Ye. A. Konorova answers
Balygin and states, that an overlapping of samples was
impossible. Methodical modification in comparison to the
thirties are represented by an employment of qualitatively
better samples, purer raw materials and of a previous
treatment as well as by the fact, that the measurements of
breakdown voltage are conducted more accurately. G. I. Skanavi
comments on the lecture by Vorob'yev and Vorob'yev and states
that the attempt to obtain data on the second stage of

Card 2/3

Discussions on Lectures by: S. M. Bragin, G. A. Vorob'yev   48-22-4-12/24
and A. A. Vorob'yev; L. A. Sorokina and Ye. A. Konorova; V. D. Kuchin;
Ye. A. Konorova, V. V. Krasnopevtsev and G. I. Skanavi

       breakdown proves to be of interest. The apprehensions of the
       authors regarding this problem are to be noticed. Subsequently
       he deals with some experiments of his own.
       There is 1 figure.

AVAILABLE: Library of Congress

       1. Scientific reports--Critic

Card 3/3

RASHBA, E.I.; SNITKO, O.V.; TOLPYGO, K.B.

First All-Union Conference on Photoelectric and Optical Phenomena in Semiconductors. Zhur.tekh.fiz. 28 no.12:2696-2706 D '58.

(MIRA 12:2)

1. Institut fiziki AN USSR, Kiyev.

(Semiconductors)

SOV/20-120-3-14/67

AUTHORS: Gorkun, Yu. I., Tolpygo, K. B.

TITLE: The Characteristic Features of the Motion of Rapid Current Carriers in Polar Crystals (Osobennosti dvizheniya bystrykh nositeley toka v polyarnykh kristallakh)

PERIODICAL: Doklady Akademii nauk SSSR, 1958, Vol. 120, Nr 3, pp. 491 - 494 (USSR)

ABSTRACT: When studying certain phenomena one is bound to direct one's attention also to the motion of fast electrons in solids. This is the case, above all, with electric breakdown, secondary electron emission, and with photoelectron- and autoelectron emission in semiconductors and in dielectrics. The present paper describes the results obtained by investigations of the behavior of polarons (the principal current carriers in ion crystals) in the case of an increase of energy. These investigations were carried out for the limiting case of a very strong bond, if the energy of the polaron is described with great accuracy by the semi-classical theory. The investigation was carried out for not very fast electrons the energy of which can, however, be much

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The Characteristic Features of the Motion of Rapid   SOV/2o-12o-3-14/67
Current Carriers in Polar Crystals

higher than that of thermal electrons. The characteristic
features of the methods employed by S.I.Pekar (Ref 1) and N.N.
Bogolyubov (Ref 3) are mentioned in short. First of all, an
equation is given for the fluctuating motion of a polaron the
center of mass of which shifts with a velocity of $\vec{v}$; this is
done for the case without exterior field. An expression for the
full energy of the system polaron-crystal is written down in
consideration of anharmonism. In view of the resonance between
the frequency of the enforcing force and the eigenfrequencies
during the motion of a fast electron, this motion is - strictly
speaking - not steady, but there is an uninterrupted transmission
of energy from the polaron to the crystal, i.e. the polaron is
slowed down. The here discussed properties of fast current
carriers may occur in connection with the emission of photo-
electrons and of secondary electrons during the motion of the
excited electron towards the surface. The authors investigated
only the "selfconsisting" quasi-steady motion of the polaron
along the field at a velocity that is constant with respect to
time. Several diagrams illustrate the radiation power of the

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The Characteristic Features of the Motion of Rapid   SOV/2o-12o-3-14/67
Current Carriers in Polar Crystals

oscillations, the dependence of the velocity of the polaron on
the field strength, and the mobility of the polaron. Finally,
the annihilation of the polaron by the field is discussed. The
approximation of strong coupling is, by the way, not applicable
in the case of most crystals. There are 4 figures, 2 tables, and
10 references, 9 of which are Soviet.

PRESENTED: December 25, 1957, by A.F.Ioffe, Member, Academy of Sciences,
               USSR

SUBMITTED: December 25, 1957

1. Electrons--Motion   2. Electorns--Energy   3. Crystals--Properties

Card 3/3

TOLPYGO, K.B.

SOV/4866

Soveshchaniye po poluprovodnikovym materialam. Moscow, 1957

Voprosy metallurgii i fiziki poluprovodnikov; trudy 3-go soveshchaniya. (Problems in the Metallurgy and Physics of Semiconductors; Transactions of the Third Conference) Moscow, Izd-vo AN SSSR, 1959. 129 p. Errata slip inserted. 3,200 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Institut metallurgii imeni A. A. Baykova. Resp. Ed.: N. Kh. Abrikosov, Doctor of Chemical Sciences; Ed. of Publishing House: P. Ya. Zolotov.

PURPOSE: This collection is intended for technical and scientific personnel concerned with the investigation and production of semiconductor materials. It may also be used by students in schools of metallurgy.

COVERAGE: The collection contains reports submitted at the Third Conference on Semiconductor Materials, held at the Institute of Metallurgy imeni A. A. Baykov, AS USSR, Moscow, in May 1957. The reports deal with problems of obtaining and investigating germanium, silicon, and semiconductor compounds. The collection was first edited by D. A. Petrov, Doctor of Technical Sciences. References accompany most of the reports.

Galperin, V. V. On the Problem of the Role of Some Factors in the Growth Process of Single Crystals From a Melt   23

Tolpygo, K. B. Investigation of Hole Zones of Diamond-Type Crystals on the Basis of the Multielectron Theory   29

Shlegel, Academician (Leader of Sciences, Hungarian People's Republic). Concerning the Problem of Semiconductor Point-Contacts   40

Majewski, Z. (Institute of Basic Technical Problems, Polish Academy of Sciences). Properties of P-N junctions in Germanium Single Crystals   43

Semenovich, L. (Institute of Physics, Polish Academy of Sciences); Effect of the Introduction of Minority Current Carriers on Light Reflection From Germanium   49

Buzy, A. A., V. Ya. Korenko, and Ye. G. Miselyuk. Diffusion and Solubility of Iron and Silver in Germanium   57

Prokhin, A. P., and V. A. Propov. Investigation of Moistening of Semiconductors with Salt   57

Vasilevskiy, V. M., and Ye. G. Miselyuk. Investigation of Segregation and Solubility of Some Impurities in Germanium During Crystallization   62

Trosil (Institute of Technical Physics, Czechoslovak Academy of Sciences). Problem of Obtaining Pure Silicon   68

Petrov, D. A., Yu. M. Shashkov, and V. D. Kvantishvili. Etching of Silicon Single Crystals   69

Abdullayev, G. B., M. I. Aliyev, A. A. Bashmakiyev, and G. M. Aliyev. Effect of Halide Impurities on the Physical Properties of Selenium   80

Abdullayev, G. B., G. A. Akhundov, A. A. Kuliyev, and Z. A. Aliyarov. On the Diffusion of Certain Metals in Polycrystalline Selenium   89

Dodik, L. D., and N. Kh. Abrikosov. Problem of Alloying Semiconductor Alloys   94

Baitang, Yao-ching (Institute of Applied Physics, Chinese People's Republic). Importance of Using Pure Water for Washing Materials Used in Semiconductor Engineering   107

Profasenko, A. P., and G. A. Fedorus. Effect of Tempering and Certain Impurities on the Dark Resistance and Photosensitivity of CdS Single Crystals   112

Babinov, I. (Institute of Technical Physics, Czechoslovak Academy of Sciences). Semiconductor Compounds With an Excess of One of the Components   117

Samoylov, V. F. Effect of Surface Condition on the Electrical Properties of Type A(III)B(V) Compounds   120

Presnov, V. A., N. A. Krivov, V. M. Vertoprakhov, A. G. Grigor'yeva, and Yu. V. Malinko. Production and Investigation of New Semiconductor Materials   127

AVAILABLE: Library of Congress

Card 5/5   JT/mv/cs

RASHBA, E.I.; SNITKO, O.V.; TOLPYGO, K.B.; LUBCHENKO, A.F.; SHEYNKMAN,
    M.K.; LASHKAREV, V.Ye., akademik, otv.red.; KISINA, I.V., red.
    izd-va; MATVEYCHUK, A.A., tekhn.red.

[Photoelectrical and optical phenomena in semiconductors. Works
of the First All-Union Conference on Photoelectrical and Optical
Phenomena in Semiconductors held at Kiev, November 20-26, 1957]
Fotoelektricheskie i opticheskie iavleniia v poluprovodnikakh.
Trudy Pervogo Vsesoiuznogo soveshchaniia po fotoelektricheskim
i opticheskim iavleniiam v poluprovodnikakh, Kiev, 20-26 noiabria
1957 g. Kiev, Izd-vo Akad.nauk USSR, 1959. 403 p. (MIRA 12:11)

1. Akademiya nauk SSSR. Komissiya po poluprovodnikam. 2. AN USSR
(for Lashkarev).
                        (Semiconductors)

30633

S/081/61/000/020/008/089
B145/B101

24, 7700 (1137, 1385, 1164)

AUTHOR: Tolpygo, K. B.

TITLE: Study of hole bands in diamond-type crystals on the basis of the many-electron theory

PERIODICAL: Referativnyy zhurnal. Khimiya, no. 20, 1961, 31, abstract 20B209 (Sb. "Vopr. metallurgii i fiz. poluprovodnikov". M., AN SSSR, 1959, 29 - 39)

TEXT: The hole states in diamond-type crystals are studied within the scope of the many-electron theory. The antisymmetrized product of the wave functions of σ-bonds representing linear combinations of the s and p states is assumed as wave function of the system. On removing an electron from the crystal, the two-electron function of σ-bonds is replaced by a single-electron function. Linear combinations of corresponding many-electron functions are found, which represent eigenfunctions of the translation operator and are characterized by the wave vector k of the hole. The author determined the dependence of energy E on k and found

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Study of valdley bands in diamond-type ...

that eight hole bands formed due to an overlapping of adjacent σ-bonds. The obtained two bands of heavy holes with different $E(k)$ functions touch the bands of light holes at $k = 0$, and join along the [111] direction. The interaction between holes and lattice vibrations is examined. Since removal of an electron disturbs the σ-bond, interaction forces occur between holes and phonons of mainly many-electron type. The principal result is that the probability of scattering of holes from optical phonons remains finite when the wave vector of the phonon tends toward zero. The author determined the temperature dependence of the hole mobility u, and found $u \sim T^{-3/2}$ for scattering on acoustic phonons, $u \sim \exp h\omega/kT - 1$ for scattering on optical phonons at low temperatures, and $u \sim T^{-5/2}$ at high temperatures. [Abstracter's note: Complete translation.]

Card 2/2

S/058/62/000/008/085/134
A062/A101

AUTHOR: Tolpygo, K. B.

TITLE: Kinetics of photoelectromotive forces in homogeneous semiconductors

PERIODICAL: Referativnyy zhurnal, Fizika, no. 8, 1962, 30, abstract 8E223
              (In collection: "Fotoelektr. i optich. yavleniya v poluprovodnikakh",
              Kiyev, AN USSR, 1959, 268 - 289)

TEXT: With sufficiently general assumptions on the passage of electrons
in the bulk and on the surface of a semiconductor, the time dependences of the
photo-emf and of the photoconductivity (P) were found in a linear approximation
on a homogeneous semiconductor (with no zone bends) at arbitrary frequencies of
light modulation. The formulae obtained are valid also when there is a zone bend
if the light absorption coefficient is much smaller than the inverse screening
radius. In that case the contact transparence coefficients have other values.
It has been shown that the pulse shape of the photo-emf permits a precise con-
clusion on the dominant character of photopassages in the semiconductor and
evaluate the effective contact transparence coefficients. It has been established

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S/058/62/000/008/085/134
A062/A101

that the absolute magnitude and the time dependence of P in the absence of surface recombinations do not depend on the light absorption coefficient. There are conditions at which the surface recombination can cause not only a decrease but also an increase of P. For that it is necessary that the surface play the part of adhesion levels for the holes and that the photogeneration process of the current carriers take place mainly along the screening length. In the general case the surface recombination reduces P, causes the decrease thereof with the increase of the light absorption coefficient and somewhat changes the time behaviour. A theoretical interpretation is given of the great inertness of P in comparison with the photo-emf in the case when the life time of the minority carriers on the adhesion levels is long. If these levels are centers of an intensive recombination, the theory predicts a negative P where the main role is played by the transitions between the electron levels and the hole zone.

O. Shustova

[Abstracter's note: Complete translation]

Card 2/2

TOLPYGO, K.B. [Tolpyho, K.B.]

Forces of ionic interactions and equations of ionic lattice
vibrations found by a many-electron consideration of ionic
states and an adiabatic approximation [with summary in English].
Ukr. fiz. zhur. 4 no.1:72-91 Ja-F '59.   (MIRA 12:6)

1. Institut fiziki AN USSR.
                            (Ionic crystals)

MOSKALENKO, S.A.; TOLPYGO, K.B.

Energy spectrum of Mott's exciton in ionic crystals [with summary
in English]. Zhur.eksp. i teor.fiz. 36 no.1:149-163 Ja '59.
                                                    (MIRA 12:2)

1. Institut fiziki AN Ukrainskoy SSR.
          (Excitons)   (Ionic crystals--spectra)

85155
S/181/60/002/009/046/047/XX
B004/B070

24.7700 (1043, 1143, 1144)

AUTHORS: Kucher, T. I. and Tolpygo, K. B.

TITLE: The Structure of Hole Bands of the Alkali-Chloride

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 9, pp. 2301-2309

TEXT: In a previous paper by the same authors (Ref. 1) on the many-electron theory of the local states of electrons and holes, there occurred an error in the sign of the matrix elements $H^{ll'}$. This has affected the results of the band states of holes in KCl (Ref. 2) and NaCl (Ref. 3). The present paper aims at correcting the error and summarizing the results obtained for KCl, NaCl, RbCl, and LiCl (for LiCl according to the data of L. I. Branda, Ref. 4). A formula for the dependence of the crystal energy $\overline{H}_k$ on the wave vector $\vec{k}$ is derived. The wave function $\overline{H}_k(\varkappa)$ for three directions of the wave vector is shown in Figs. 1-3. Fig. 4 shows the exchange integrals E and D and the width E of the hole band as functions of the lattice constant $a = d/2$. The principal values of the tensor $\mu(a)$ and the effective masses of the holes at the point $k(\varkappa, \varkappa, 0)$

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The Structure of Hole Bands of the
Alkali-Chloride

$S/181/60/002/009/046/047/XX$
$B004/B070$

are given as functions of the lattice constants and compared with the data of L. P. Howland (Ref. 5) in Fig. 5. Table 1 gives the properties of the hole bands in their dependence on the lattice constant; Table 2 gives the values of the constants $B = E_M + E_1 + E_2$ and $\overline{H}_{k\ min} = B + (\overline{H}_{\kappa} - B)$ for RbCl, KCl, NaCl, and LiCl. The experimental values of the width ΔE of the forbidden band are compared with the calculated values in Table 3. A comparison between the results of the present paper and those of Howland shows that it is not enough to regard the holes as being present only in the outer shell of the ions. The 3p states of Cl^- and K^+ must also be considered. If $\overline{H}_{k\ min}$ lies in the neighborhood of the origin of the coordinate system $\vec{k} = 0$, the spin-orbit interaction, which has not been taken into consideration for alkali-chloride so far, has a considerable effect. Professor S. I. Pekar is thanked for discussions. There are 5 figures, 3 tables, and 18 references: 8 Soviet, 6 US, 2 British, and 2 Dutch.

ASSOCIATION: Institut fiziki AN USSR, Kiyev (Institute of Physics of the AS UkrSSR, Kiyev)

Card 2/3

S/181/60/002/010/009/051
B019/B070

9,4300 (1643, 1137, 1143)

AUTHORS: Genkina, S. M., Tolpygo, K. B.

TITLE: Effect of Discrete Crystal Structure on the Amount of the Energy, the Effective Mass, and the Dispersion Law of the Polaron

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 10, pp. 2400-2410

TEXT: An attempt is made to obtain quantitative results about the energy and the effective mass of the polaron in a real discrete crystal. Only polarons of large radii are considered so that the wave function may be obtained by using the variational principle and the method of effective mass. Assuming that the quantum radius r_{qu} of the polaron is large in comparison to the lattice constant a, the eigenfrequency and the amplitude of vibration may be expanded in powers of $a\chi$ ending with $(a\chi)^2$. The energy and the radius of the polarons are obtained as functions of their velocities. It is found that the larger the effective mass of the band electron, the larger is the difference between the results obtained here and those

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Effect of Discrete Crystal Structure on the   S/181/60/002/010/009/051
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and the Dispersion Law of the Polaron

obtained in the continuous theory. This difference exists also in zero
approximation, and is due to the difference of the field of the true
density of the electron charge and that of a "smooth" charge. Numerical
calculations for an NaCl crystal show that differences from the results
obtained by an approximation with the "limiting wavelengths" are found
beginning with $r_{qu} \leqslant 3a$. The effect of the discrete structure of the
crystal is seen particularly in the energy as a function of velocity and
in the effective mass of the polaron. S. I. Pekar, N. N. Bogolyubov,
and M. Sh. Gitterman are mentioned among others. There are 2 figures and
18 references: 14 Soviet, 3 US, and 1 German.

ASSOCIATION: Kafedra teoreticheskoy fiziki kiyevskogo ordena Lenina
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SUBMITTED: March 25, 1960

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S/181/60/002/010/051/051
B019/B056

AUTHOR: Tolpygo, K. B.

TITLE: Optical, Elastic, and Piezoelectric Properties of Ion- and Valence Crystals With a ZnS-Type Lattice

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 10, pp. 2655 - 2665

TEXT: The general theory of crystals with deformed ions, which was extended to the diamond-type valence crystals by the author together with V. S. Mashkevich (Refs. 8, 9), is in the present article used for the purpose of investigating the physical properties of crystals of the ZnS-type. The limiting cases of pure ions and pure valence crystals are investigated, between which, as a result of the existence of volume dipole forces, great similarity was found to exist. In both cases the limiting frequencies of the transverse and longitudinal oscillations differed from one another. The same is the case with ε and n_o^2. Further, there exists a forbidden band between the transverse optical and acoustic branches. The acoustic vibrations have a dipole moment of the order a/λ in the absence of a symmetry center. The polar properties of

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the valence crystals vanish only, if the atoms are similar. A comparison
between the equations of the acoustic vibrations with those of the equa-
tions of the macroscopic elasticity theory and the piezoelectricity
makes it possible to calculate the elastic and piezoelectric constants.
At present the necessary experimental data are available only for six
crystals (CuCl, CuBr, GaSb, InSb, ZnS, SiC). For C, Si, and Ge, data
concerning the limiting frequencies are available, which were obtained
by means of neutron scattering experiments. The experimental data of
these nine crystals are given in Table 1. In Tables 2 and 3, calculated
physical parameters of ion- and valence crystals are given. In a detail-
ed discussion of this Table, the kinds of binding and the structure of
the crystals are dealt with. A. Demidenko is mentioned. There are
2 tables and 31 references: 9 Soviet, 15 US, 2 British, 2 German,
1 Swedish, and 1 Indian,

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Optical, Elastic, and Piezoelectric
Properties of Ion- and Valence Crystals
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SUBMITTED: April 4, 1960

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B006/B056

24.7700 (1043,1035,1143)

AUTHORS: Demidenko, Z. A. and Tolpygo, K. B.

TITLE: Injection Effects in the Passage of Current Through an
                Inhomogeneous Semiconductor

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 11, pp. 2753-2761

TEXT: When a current passes through an inhomogeneous semiconductor with
mixed conductivity, the concentration distribution of electrons and holes
is shifted by the field. The minority carriers (here it is assumed that
these are the holes) are injected from a high-impedance into a low-impe-
dance region of the semiconductor, if the direction of the current coincides
with the gradient of conductivity. Therefore, the carrier concentration
increases throughout the entire region of the semiconductor, and the field
becomes weaker. If current direction and gradient are antiparallel, car-
riers are extracted and the field grows. Thus, in the case of probe measure-
ments of resistivity of inhomogeneous semiconductors, the latter depends
on the magnitude and sign of the current. P. I. Baranskiy observed such
phenomena in Ge. The authors of the present paper developed a theory of

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Injection Effects in the Passage of Current   S/181/60/002/011/014/042
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these phenomena for the simplest cases of a semiconductor with a constant conductivity gradient. The concentration distribution of the holes and the distribution of the electric field as dependent on the current passing through, the conductivity gradient, and the carrier lifetime is investigated for the case of internal injection of holes. Furthermore, the algebraic sum of the potential differences between two adjacent bands is calculated for antiparallel current direction. This quantity is called the "volume-gradient emf, $\mathcal{E}^*$", following the example of Baranskiy who carried out similar calculations. In the case of weak currents, $\mathcal{E}^*$ is proportional to the square of the current, and in the case of strong currents, it is a linear function of the current; $\mathcal{E}^*$ is also a function of resistivity, carrier lifetime, and conductivity gradient. Furthermore, the part played by contacts during the measurement of $\mathcal{E}^*$ is discussed in connection with the electromotive forces appearing at these contacts. A comparison between theoretical results and the experimental results obtained by Baranskiy showed qualitative agreement. There are 4 Soviet references.

ASSOCIATION: Institut fiziki AN USSR, Kiyev (Institute of Physics of the AS UkrSSR, Kiyev)

SUBMITTED: June 7, 1960

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S/181/60/CO2/012/017/018
B006/B063

AUTHORS: Tolpygo, K. B. and Tomasevich, O. F.

TITLE: Wave Function and Energy of the Band Electron in NaCl. II

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 12, pp. 3110-3119

TEXT: In Part I of the present article, the authors calculated the energy
and wave function of the band electron in NaCl by a method described in
Ref. 2. The most significant results are discussed in the introduction.
Among other things, it was found that the energy minimum is in the middle
of the band and amounts to -1.58 ev compared to a vacuum. The energy as
a function of the wave vector, $E(\vec{k})$, near the middle of the band is
almost isotropic and parabolic in about one-eighth of the volume of the
cell of the reciprocal lattice. The effective mass was calculated to be
0.632. The probability ratio of finding the band electron near the cation
or anion was equal to 9.3 for k = 0 and approached infinity with growing
k in certain directions on the boundary of the cell. The authors now
discuss several inaccuracies of the method described in Part I, and
suggest a method making allowance for the correlation and motion of the

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Wave Function and Energy of the Band Electron   S/181/60/002/012/017/018
in NaCl. II   B006/B063

band electron and of the inner electrons of the cation. In analogy to
Part I, and using the symbols presented there, the authors define the
spherical harmonic χ_s which is used to represent the mean charge density
of the band electron in the s-th lattice site. This function is then used
to calculate the matrix elements of the Hamiltonian. Furthermore, the
energy, the effective mass, and the wave function of the band electron
are calculated. The energy values for various combinations of the com-
ponents of the wave vector are collected in a table. The diagonal matrix
elements are numerically calculated by using experimental values of the
ionization potential, and the exchange integrals are calculated directly.
In the last part, the obtained value $E(0) = +2.79$ ev is compared with
experimental results and is found to differ considerably from that obtained
by Mott and Gerni (-0.5 ev). The experimental values are widely spread, so
that the theoretical value of +2.7ev is still within the spread limits.
There are 1 figure, 1 table, and 10 references: 5 Soviet, 2 US, and 3
British.

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