

SOV/108-13-2-8/15-15/5

AUTHOR: Grinberg, A. A.

TITLE: On the Theory of the **Transfer** Characteristic of a **Triode Transistor** (K teorii perekhodnoy kharakteristiki poluprovodnikovogo trioda)

PERIODICAL: Radiotekhnika, 1958, Vol. 13, Nr 2, pp. 51 - 53 (USSR)  
Received: April 25, 1958

ABSTRACT: Here the **transfer** characteristics of a **triode transistor** under current control and with different wiring schemes are obtained. The analytical form of the **transfer** characteristic gives the possibility to consider the collector capacity and the load resistance of the triode. At first the transition characteristic of a triode in a scheme with a grounded and current-controlled basis is investigated. Laplace's representation of the current **transfer** characteristic  $g(t)$  ... equation (1) obtained in Reference 1 is put down, which corresponds to the deltaform  $[\delta(t)]$  emitter current. The consideration of the collector capacity  $C_c$  and the finite load resistance  $R_{load}$  with the help of the equivalent scheme with small signals for

Card 1/2

SOV/108-13-2-8/15-15/5

On the Theory of the ~~Transfer~~. Characteristics of a Triode Transistor

the collector circuit leads to equation (7). By application of the multiplication theorem of operation calculus the ~~trans-~~ ~~fer~~ characteristic  $G(t)$  of the triode ... equation (8), which takes the influence of the collector capacity and of the load resistance into consideration, is obtained.  $G(t)$  is the exact solution of the problem investigated by A. V. Ayrapsyanets and S. M. Ryvkin (Reference 5). There are 5 references, 5 of which are Soviet.

SUBMITTED: March 25, 1957

Card 2/2

GRINBERG, A.A.

Calculation of transients in semiconductor triodes. *Viz.tver.tela*  
1 no.1:31-43 Ja '59. (MIRA 12:4)  
(Transistors) (Transients (Electricity))

67390

SOV/181-1-9-8/31

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

Ryvkin, S. M., Ivanov, Yu. L., Grinberg, A. A., Novikov, S.R.,  
Potekhina, N. D.

TITLE:

A New Longitudinal Magnetostriction Effect and Its Application to the Determination of the Ratio Between the Concentrations of Heavy and Light Holes

PERIODICAL:

Fizika tverdogo tela, 1959, Vol 1, Nr 9, PP 1572 - 1575 (USSR)

ABSTRACT:

When investigating the diffusion of the nonequilibrium carrier in the magnetic field, the appearance of electrical fields is usually studied (e.g. the photomagnetic Kikoin-Noskov effect). The present paper offers the results obtained from an investigation of the concentration distribution of the minority carrier in the magnetic field, and in particular, the results of an investigation of the longitudinal magnetostriction effect in the longitudinal magnetic field. A plane-parallel semiconductor plate was arranged perpendicularly to a homogenous magnetic field. On the plate, a point light probe exactly faced a point collector. The injected nonequilibrium carriers diffused through the plate and the collector determined the concentration of the minority carrier. The concentration

Card 1/3

67390

A New Longitudinal Magnetostriction Effect and Its Application to the Determination of the Ratio Between the Concentrations of Heavy and Light Holes SOV/181-1-9-8/31

recorded thereby increased with H. Figure 1 shows a schematic representation of the measuring arrangement, a description of which is given. Theoretically, one obtains for the concentration of the injected carrier on the z-axis

(H || z): Δn\_H = (i\_0 β e^{-z/l\_D}) / (2κ D\_n z I(γ\_v)), where i\_0 β is the electron-hole pair production rate, l\_D the diffusion length, D\_n the electron diffusion coefficient.

Figure 2 shows the result obtained by an attempt of experimentally verifying this formula for electron injection into hole-type germanium. The best agreement is obtained with a microscopic drift mobility of the electrons μ\_n^0 = 3650 cm^2/v.sec. When investigating the hole diffusion in n-type germanium a considerable divergence between theory and experiment is observed, which, however, can be explained when taking into account the existence of

Card 2/3

67390

A New Longitudinal Magnetostriction Effect and Its Application to the Determination of the Ratio Between the Concentrations of Heavy and Light Holes SOV/181-1-9-8/31

heavy and light holes. The theoretical curve drawn for this case nicely describes the experimental results. The concentration ratio between heavy and light holes is deduced from measuring results as being 57; this value approaches the result (50.0) obtained by an other way (Ref 1). There are 2 figures and 2 references.

SUBMITTED: March 7, 1959

4

Card 3/3

Franklin, A. L., Canal Progr-Health Sci -- (1950) "Investigation of the process of  
nitro reduction in the sulfonamide pathway in Canal Progr-Health Sci -- (1950)",  
Science, 1950, 111 (1950) Institute of Health Sci. Boston, MA. (See also Canal Progr-Health Sci -- (1950))  
(SI, 11-50, 105)

S/181/60/002/01/29/035  
B008/B014

24.7900

AUTHOR:

Grinberg, A. A.

TITLE:

Theory of the Anisotropic Photomagnetic Effect in Germanium

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 1, pp. 153-156

TEXT: The article under review deals with the photomagnetic effect discovered and studied by I. K. Kikoin and Yu. A. Bykovskiy (Refs. 1-3). In contrast to the ordinary photomagnetic effect, the sign of this effect does not change with changing direction of the magnetic field. It is described as follows: An electric field is generated in an illuminated sample located in a magnetic field that forms a certain angle  $\alpha$  with the illuminated surface. This field is generated not only in the direction corresponding to the ordinary photomagnetic effect (according to Kikoin - Noskov) but also in a direction perpendicular to the former. Studies of the even (quadratic) effect on germanium have shown (Ref. 3) that the formula holding for the ordinary photomagnetic effect is not applicable to anisotropic samples. Here, the effect is non-zero even at  $\alpha = 0$ .

Card 1/3



Theory of the Anisotropic Photomagnetic  
Effect in Germanium

S/181/60/002/01/29/035  
B008/B014

The author suggests another mechanism for the development of this effect. It is related to the anisotropic nature of the conductivity of the sample, which arises in consequence of the magnetic field. When the sample is illuminated in the presence of a magnetic field, the direction of the ambipolar current flux of the p-n pairs deviates from the direction of the arising concentration gradient. This is ascribed to the anisotropic nature of conductivity. For this reason, there is a non-zero component of the ambipolar flux in the direction of the magnetic field, though the magnetic field lies in a plane with the illuminated surface of the sample. This component is not caused by the "repeated" deviation but by the effect of the change in resistivity within the magnetic field. The authors believe that this mechanism offers an explanation of the even anisotropic photomagnetic effect observed by Kikoin and Bykovskiy in n-type germanium. The illuminated surface of the latter coincides with the (111) plane. The calculation of this effect is given. The author thanks S. M. Ryvkin and S. R. Novikov for their discussion of the article under review. There are 1 figure and 7 references, 5 of which are Soviet.

✓

Card 2/3

1  
Theory of the Anisotropic Photomagnetic Effect  
in Germanium

S/181/60/002/01/29/035  
B008/B014

ASSOCIATION: Leningradskiy fiziko-tekhnicheskiy institut AN SSSR  
(Leningrad Institute of Physics and Technology of the  
AS USSR)

SUBMITTED: May 26, 1959

4

Card 3/3

*Grinberg, A. A.*

S/181/60/002/05/09/041  
B008/B058

AUTHOR: Grinberg, A. A. *γ*

TITLE: Photomagnetic Effect in Isotropic Semiconductors and Its  
Application for the Measurement of the Lifetime of Minority  
Carriers *γ*

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 5, pp. 836-847

TEXT: An equation for the current, with regard to two types of carrier with equal signs (holes), is derived from the kinetic equation with arbitrary dependence of the relaxation time on the energy. The photocurrent and the photomagnetic emf are determined for arbitrary magnetic fields by means of this equation within the range of the application of the solution of the classical equation of motion. The photomagnetic method of measuring the lifetime is investigated next, and equations for the determination of the lifetime on transitions to strong fields are derived. Moreover, a survey on studies carried out in this field is given in the paper, and the following persons are mentioned: B. Ya. Moyzhes, Yu. N. Obraztsov, I. K. Kikoin, Yu. A. Bykovskiy, A. G. Mironov, K. B. Tolpygo, G. Ye. Pikus, and A. I. Ansel'm. Fig. 1 shows the experimental setup for the measuring of

Card 1/2

*✓c*

Photomagnetic Effect in Isotropic Semiconductors S/181/60/002/05/09/041  
and Its Application for the Measurement of the B008/B058  
Lifetime of Minority Carriers

the photomagnetolectric effect<sup>2</sup> (Kikoin-Noskov effect). Fig. 2 shows the difference between the regular actual lifetime and that computed from formula (31) for various magnetic field strengths. The magnetic field extends along the Z-axis, and the exposed surface coincides with the area (XZ). The exposure is accomplished with light with a depth of penetration much smaller than the diffusion length of the disequibrated carrier. Presuming that the sample be long as compared to its thickness, and that  $E_y$  does therefore not depend on x, it is found, according to the potential of the electric field, that  $E_x$  does not depend on y. The author finally expresses his gratitude to S. M. Ryvkin, Doctor of Physical and Mathematical Sciences. There are 2 figures and 35 references: 16 Soviet and 19 English.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN SSSR, Leningrad  
(Institute of Physics and Technology AS USSR Leningrad)

SUBMITTED: August 5, 1959

Card 2/2

✓c

GRINBERG, A. A.

S/181/60/002/007/001/042  
B006/B070

AUTHOR: Grinberg, A. A.

TITLE: A Theory of the Photomagnetic Effect<sup>21</sup> in Anisotropic Cubic Crystals

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 7, pp. 1361-1367

TEXT: The purpose of this work was to develop a theory of the photomagnetic effect of anisotropic cubic crystals in weak magnetic fields for an arbitrary orientation of the crystal. The first theory of this effect, a macroscopic theory, is by Yu. M. Kagan and Ya. A. Smorodinskiy (Ref. 14). It obtains the angular dependence of the anisotropic photomagnetic effect (the so-called Kikoin-Bykovskiy effect) in an approximately correct form. For the determination of the magnitude of the effect, it uses a phenomenological coefficient, which, however, can be calculated on the basis of the microscopic theory developed in the present work. First of all, equations are set up which determine the electric fields that appear on irradiating a plane-parallel plate of a semi-

Card 1/3

A Theory of the Photomagnetic Effect in  
Anisotropic Cubic Crystals

S/181/60/002/007/001/042  
B006/B070

conductor placed in a magnetic field. The geometric relations of the experiments are shown in Fig. 1. These equations are then solved on the supposition that the dimensions of the sample are large compared to the diffusion length of the minority carriers (holes). Explicit expressions are given for the components of the electric field and the concentration of the minority carriers. These are valid for an arbitrary orientation of the crystal to the magnetic field. These results are then applied to some special cases. One application is made to the irradiation of the (111) plane; Fig. 2 shows the dependence of the field component  $E_2$  on the angle  $\alpha^0$  obtained from formula (23), and the experimental angular dependence according to Ref. 3, the angle  $\alpha^0$  giving the direction of the magnetic field relative to the sample. Fig. 3 shows  $E_2$  as function of  $\varphi$  for  $\alpha^0 = 45^\circ$  and  $H = 24,000$  oersteds,  $\varphi$  characterizing the directions of the coordinate axes with respect to the [111] direction. The experimental angular dependence (Fig. 3a) is again compared with the theoretical value (Fig. 3b). The other application of the theory is made to the case of the irradiation of the (110) plane, that is,  $Ox_3$  lies in the [110] direction. Fig. 4 shows  $E_2(\varphi)$  at  $\alpha^0 = 45^\circ$ . The theory of

✓

Card 2/3

A Theory of the Photomagnetic Effect in  
Anisotropic Cubic Crystals

S/181/60/002/007/001/042  
B006/B070

anisotropy of the photomagnetic effect developed here is in good agreement with the experimental results. There are 4 figures and 14 references: 11 Soviet and 3 US.

ASSOCIATION: Fiziko-tekhnicheskiy institut AN SSSR Leningrad  
(Institute of Physics and Technology of the AS USSR,  
Leningrad)

SUBMITTED: December 21, 1959

✓C

Card 3/3

*GRINBERG, A. A.*

82544

S/181/60/002/007/024/042  
B006/B060

24.7700

AUTHORS: Grinberg, A. A., Strokan, N. B.

TITLE: Influence of the Rate of Surface<sup>1</sup> Recombination and of the Absorption Coefficient on the Transient Responses of Photodiodes

PERIODICAL: Pizika tverdogo tela, 1960, Vol. 2, No. 7, pp. 1536-1541

TEXT: Photodiodes<sup>25</sup> are to this day known as the converters<sup>6</sup> of light signals or radiation pulses to electric pulses with the least inertia; the study of the influence of various parameters on their inertia has a great practical importance. The present paper is a contribution to this problem. The authors obtained, theoretically, an expression for the transient response of a photodiode for arbitrary values of the surface recombination rate  $S$  and of the absorption coefficient  $k$ ; the importance of considering finite  $S$ - and  $k$  values is discussed in the introduction. As the initial step for the formulation of the problem (which is treated as a one-dimensional one), the authors used a schematic representation of a photodiode as is shown by Fig. 1. With large  $k$  values, e.g., in the conversion of a step pulse

Card 1/3



82544

Influence of the Rate of Surface Recombination and of the Absorption Coefficient on the Transient Responses of Photodiodes S/181/60/002/007/024/042 B006/B060

( $\square$  pulse) by a photodiode, distortions of two types occur: the pulse experiences a shift with time and a modification of the form.  $\theta_1$  (delay time) denotes the time from the beginning of excitation to the moment at which the current has attained 0.1 of its stationary value  $I_{st}$ ;  $\theta_2$  denotes the duration of the current growth in the interval  $I_{st}[0.1; 0.7]$ . The authors wanted to determine  $\theta_1(k, S)$  and  $\theta_2(k, S)$ , and to find  $I_{\square}(t)$  for a  $\square$ -excitation pulse. First, the transient response is found for a  $\delta$  pulse, by which it is possible to determine  $I(t)$  by means of Duhamel's formula for various exciting pulse shapes. Formulas (5) and (9) are obtained for  $I_{\delta}(t)$  and by means of them for some special cases the transient responses are calculated for  $S=0$  and shown in Fig. 2.  $I_{\square}(t)$  is given by formula (10). By means of these formulas,  $\theta_1$  and  $\theta_2$  can be determined as functions of  $k$ ; Figs. 3 and 4 show these for various  $S$  values. ( $w$  characterizes the distance between the irradiated diode surface and p-n junction, cf. Fig.1).  $\theta_1$  shows the largest change in the transition range of uniform generation

Card 2/3

82544

Influence of the Rate of Surface Recombination  
and of the Absorption Coefficient on the  
Transient Responses of Photodiodes

S/181/60/002/007/024/042  
B006/B060

( $kw \ll 1$ ) to a strong absorption ( $kw \gg 1$ ). In the range of  $kw \ll 1$ ,  $Q_1$  practically does not depend on  $S$ .  $Q_2$  is less dependent on  $kw$  than  $Q_1$ .

$Q = Q_1 + Q_2$ , is basically determined by  $Q_1$ ;  $Q$  drops with rising  $S$  and scarcely varies with  $kw$ . It is stated in conclusion that the transient responses of photodiodes are only slightly influenced by  $S$ . Consequently, the formulas which are given for  $S = 0$  can be used in practice, namely (11) for  $I_0(t)$  and (12) for  $T_{\text{r}}(t)$ . The authors finally thank D. V. Tarkhin for his aid in the numerical calculations. There are 4 figures and 5 references: 4 Soviet.

ASSOCIATION: Fiziko-tehnicheskiy institut AN SSSR Leningrad  
(Institute of Physics and Technology of the AS USSR,  
Leningrad)

SUBMITTED: December 21, 1959

Card 3/3

GRINBERG, A. A.

82546

S/181/60/002/007/026/042  
B006/060

24.7700

AUTHORS: Grinberg, A. A., Paritskiy, L. G., Ryvkin, S. M.

TITLE: The Influence of Adhesion Levels in Semiconductors on the Steady Photoconductivity and the Lifetime of the Minority Carriers 71

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 7, pp. 1545-1561

TEXT: The present bulky article deals with a comprehensive study of the influence exerted by adhesion levels introduced into a crystal upon the carrier recombination in the steady state (thus, upon  $\tau_p$ ,  $\tau_n$ , and  $\Delta\sigma$ ) taking place above other traps located in the forbidden band. The study is extended to cover the influence of filling of adhesion levels on the dependence of  $\tau_n$  and  $\tau_p$  on temperature and light intensity. In the introduction, the authors discuss a number of relevant publications. In the first section of the paper, the influence of adhesion levels on  $\tau_n$  and  $\tau_p$  in the steady state is qualitatively examined by means of an example

Card 1/4

The Influence of Adhesion Levels in Semi-  
conductors on the Steady Photoconductivity and  
the Lifetime of the Minority Carriers

82546

S/181/60/002/007/026/042  
B006/B060

of a high injection level. This is done on the model of a semiconductor in whose forbidden band there exist two types of local levels with sharply differing properties (Fig. 1): the S levels are assumed to be traps for the minority electrons from the conduction band and the holes from the valency band, i.e., they are recombination centers for the light-produced minority charges. The M levels are, due to electron exchange, connected with the conduction band (the electron exchange with the valency band is forbidden), and therefore they are adhesion levels for the electrons. It is shown that the electron and hole concentrations in the S centers are closely related to the electron and hole concentrations in the bands. E. g., if the electron concentration in the conduction band is changed anyhow, the electron lifetime  $\tau_n = 1/\gamma_n p_s$  in this band is decreased, and the hole lifetime  $\tau_p = 1/\gamma_p n_s$  in the valency band grows. This is the sense in which the introduction of adhesion levels acts. ( $\gamma_n$  and  $\gamma_p$  are the trapping factors,  $n_s$  and  $p_s$  the electron and hole concentrations in the S centers;  $n_s + p_s = S$ , the concentration of the recombination centers). In the following

Card 2/4

82546

The Influence of Adhesion Levels in  
Semiconductors on the Steady Photoconductivity  
and the Lifetime of the Minority Carriers

S/181/60/002/007/026/042  
B006/B060

sections of the paper the authors first examine in a general way the influence exerted by adhesion levels in the case of a high injection level at a low concentration of the recombination centers, and then the same is done for a semiconductor with two types of injection levels. In this semiconductor the forbidden band contains, besides the recombination centers S and the adhesion levels M for the electrons, adhesion levels L for the holes from the valency band (Fig. 7). Section 4 again treats, for a semiconductor with one adhesion level in the forbidden band, the case of a high injection level, but at a high concentration of the recombination centers S. Finally, section 5 deals with the case of a low injection level at an arbitrary concentration of the recombination centers. Here, the Fermi quasi-levels of electrons and holes practically coincide, and the traps may be classified into adhesion levels and recombination centers only on the basis of the various trapping cross sections. (5.9) and (5.10) are first generally derived for  $\tau_n$  and  $\tau_p$ ; for  $M = 0$  they go over to (5.11). The latter formulas are then further treated for the special cases of an n-type and a p-type semiconductor.

Card 3/4

8251.6

The Influence of Adhesion Levels in  
Semiconductors on the Steady Photoconductivity  
and the Lifetime of the Minority Carriers

S/181/60/002/007/026/042  
B006/B060

S. G. Kalashnikov is mentioned. There are 10 figures and 19 references:  
5 Soviet, 9 US, and 3 German.

ASSOCIATION: Fiziko-tehnicheskiy institut AN SSSR Leningrad  
(Institute of Physics and Technology of the AS USSR,  
Leningrad)

SUBMITTED: November 27, 1959

Card 4/4

86425

S/181/60/002/011/009/042  
B006/B056

24.2200 (1138, 1160, 1162)

AUTHORS: Grinberg, A. A. and Novikov, S. R.

TITLE: Investigation of the Longitudinal and Transverse Magnetic Concentration Effects for the Purpose of Determining the Coefficients of Magnetic Conductivity in Anisotropic Crystals of Cubic Symmetry

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 11, pp. 2713 - 2717

TEXT: This paper is a continuation of two earlier ones, in which the authors investigated these problems for isotropic crystals and showed that the minority-carrier mobility may be determined also from the relations between the concentrations of heavy and light holes. As, however, directional dependence of the concentration effects in Ge was experimentally found, these effects are now investigated in anisotropic cubic crystals, proceeding from the phenomenological equation of Seitz 
$$\vec{J} = \sigma \vec{E} + \alpha [\vec{E}\vec{H}] + \beta \vec{E}\vec{H}^2 + \gamma \vec{H}(\vec{E}\vec{H}) + \delta T\vec{E}$$
 for the charge current. T is a matrix with the elements  $T_{ik} = H_i^2 \delta_{ik}$ ;  $\sigma_0$  is the electrical conductivity at H=0;

f

Card 1/3

86425

Investigation of the Longitudinal and Trans- S/181/60/002/011/009/042  
verse Magnetic Concentration Effects for the B006/B056  
Purpose of Determining the Coefficients of Magnetic Conductivity in  
Anisotropic Crystals of Cubic Symmetry

$\alpha/\sigma_0$  is the approximate Hall mobility;  $\beta/\sigma_0$ ,  $\gamma/\sigma_0$ , and  $\delta/\sigma_0$  are material constants (in the case of isotropy,  $\delta=0$  and  $\beta+\gamma=0$ ). The coefficients may be experimentally determined by two methods mentioned in publications. The Seitz equation, however, holds only for weak fields up to about

$1.5 \cdot 10^3$  oersteds. As, however, no other equation taking the anisotropy of holes in Ge into account, and which is also valid for strong magnetic fields, the authors endeavor to obtain a solution by way of a compromise, which may be looked upon as a useful approximation also in the case of strong fields. This is possible for the cases in which  $\vec{H} \parallel [111]$  and  $\vec{H} \parallel [110]$ . The coefficients  $\beta/\sigma$ ,  $\gamma/\sigma$ , and  $\delta/\sigma$  were determined on n-type Ge specimens with a resistivity of 2.3 and 10 ohm.cm by measurement of the longitudinal and transverse magnetic concentration effects

(at  $H=1.1 \cdot 10^4$  oe). The results are given in a table and compared with the values obtained in Refs. 4 and 5. The following experimental values were obtained for the three parameters:  $-1.4 \cdot 10^{-9}$ ,  $0.6 \cdot 10^{-9}$ , and  $0.55 \cdot 10^{-9}$ .

Card 2/3



86425

Investigation of the Longitudinal and Transverse Magnetic Concentration Effects for the Purpose of Determining the Coefficients of Magnetic Conductivity in Anisotropic Crystals of Cubic Symmetry S/181/60/002/011/009/042 B006/B056

The corresponding values for heavy holes were found to be  $-0.75 \cdot 10^{-9}$ , 0, and  $0.64 \cdot 10^{-9}$ . S. M. Ryvkin, Doctor of Physical and Mathematical Sciences, is thanked for advice and interest. There are 1 figure, 1 table, and 6 references: 2 Soviet and 4 US.

ASSOCIATION: Fiziko-tehnicheskii institut AN SSSR Leningrad (Institute of Physics and Technology of the AS USSR, Leningrad)

SUBMITTED: May 27, 1960

Card 3/3

*Cambridge, R.A.*

81947  
S/181/60/002/04/05/034  
B002/B063

24.7700

AUTHORS: Rykin, S. M., Grinberg, A. A., Ivanov, Yu. L.,  
Novikov, S. R., Potekhina, N. D.

TITLE: Investigation of the Diffusion of Minority Carriers in a  
Magnetic Field <sup>21</sup>

PERIODICAL: Fizika tverdogo tela, 1960, Vol. 2, No. 4, pp. 575-590

TEXT: The distribution of the concentration of minority carriers introduced into a magnetic field by "point" injection was theoretically and experimentally studied. A light spot was focused onto a germanium sheet cut out of a single crystal. The occurring emf was measured by means of an JB-9 (LV-9) tube voltmeter. The setup is schematically represented in Fig. 1. Thus, the longitudinal magnetostriction effect (Fig. 5) was measured on p-type and n-type germanium. Such measurements may be used to determine such semiconductor parameters as the microscopic drift mobility of carriers and the concentration ratio between carriers of equal sign but different effective mass. The concentration ratio between light and heavy holes in germanium was about 2 per cent. Mention is made of

X

Card 1/2

Investigation of the Diffusion of Minority  
Carriers in a Magnetic Field

81947  
S/181/60/002/04/05/034  
B002/B063

I. K. Kikoin, Noskov, and Pikus. There are 7 figures and 18 references:  
7 Soviet, 1 American, 9 British, and 1 French.

ASSOCIATION: Leningradskiy fiziko-tehnicheskiy institut AN SSSR  
(Leningrad Physicotechnical Institute of the AS USSR)

SUBMITTED: July 24, 1959

Card 2/2

TO :

Director, CIA  
Washington, D.C.

ATTN :

Mr. [Name]

FROM :

Mr. [Name], [Organization]

RE :

[Subject]

INFO :

[Additional information]

[Signature]

[Main body of the document containing detailed text]

[Faint, mostly illegible typed text, possibly a memorandum or report, with some words like "subject" and "information" visible.]

...  
...  
... collector

100-10-1-9/17

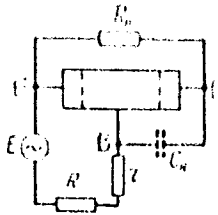


FIG. 1

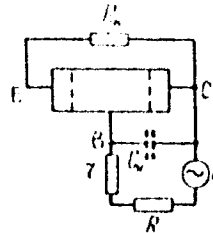


FIG. 2

Card 3/3

010/042

S/181/61/003/001/010/042  
B102/B212

9.4178 (also 1137)

AUTHOR: Grinberg, A. A.

TITLE: Theory of the transverse photomagnetic effect

PERIODICAL: Fizika tverdogo tela, v. 3, no. 1, 1961, 94-96

TEXT: In 1956 I. K. Kikoin and Yu. A. Bykovskiy have investigated the transverse photomagnetic effect (ph.m.e.) on germanium very closely; up to that time the anisotropic ph.m.e. on Ge had not been known. The theory of the transverse ph.m.e. has been developed by B. Ya. Moyzhes and Yu. N. Obraztsov (1957); they assumed a relaxation time independent of energy, and showed that, if only one type of electrons and holes is present, the transverse ph.m.e. cannot change its sign with increasing H; but this had been proved experimentally for p-type Ge specimens. When considering the existence of heavy and light holes, it is possible to explain the change of sign with p-type Ge theoretically, however, only for such concentration and mobility ratios of heavy and light holes, which are incompatible with data on the Hall constant and others. The only possible experimental explanation is that the change of sign is caused mainly by an anisotropic ph.m.e.; the

Card 1/5

89277

S/181/61/003/001/010/042  
B102/B212

Theory of the transverse...

present paper tries to verify this theoretically. The transverse ph.m.e. is calculated with an exact consideration of the carrier scattering mechanism. Using the equations and notations from a previous work (Ref. 8) and taking into account the energy dependence of the relaxation time and the existence of light and heavy holes, one obtains the following expressions for the transverse ph.m.e. of an anisotropic semiconductor:

a) for p-type material ( $p_0 \gg n_0$ ):

$$E^s = \frac{kT}{q} \frac{\Delta n(0) - \Delta n(d)}{d} \frac{\mu_n}{\mu_p p_0} \left\{ 1 - \frac{\mu_p^{**} (1 + \operatorname{tg}^2 \theta_p^{**} \operatorname{tg} \theta_n)}{\mu_p^{**} (1 + \operatorname{tg}^2 \theta_p^{**})} \right\} \frac{\sin 2\alpha}{2}; \quad (1)$$

b) for n-type material ( $n_0 \gg p_0$ ):

$$E^s = -\frac{kT}{q} \frac{\Delta p(0) - \Delta p(d)}{d} \frac{\mu_p}{\mu_n n_0} \left\{ 1 - \frac{\mu_p^{**} (1 + \operatorname{tg}^2 \theta_p^{**} \operatorname{tg} \theta_n)}{\mu_p^{**} (1 + \operatorname{tg}^2 \theta_p^{**})} \right\} \frac{\sin 2\alpha}{2}, \quad (2)$$

$\alpha$  denotes the angle which  $\vec{H}$  forms with the exposed semiconductor surface. For weak magnetic fields with scattering of carriers by acoustic vibrations of the lattice, these formulas read as follows:

Card 2/5



by 117

S/181/61/003/001/010/042  
B102/B212

Theory of the transverse...

a) for p-type material:

$$E_z = \frac{I_0 \beta}{\left(\frac{D_n}{D_p} + S\right)} \frac{kT}{q d \rho_0} \frac{\mu_n}{\mu_p} \frac{9\pi}{16} \left(\frac{\mu_n H}{c}\right)^2 \left[ 1 - \left(\frac{\mu_p}{\mu_n}\right)^2 \frac{(\lambda+1)^2}{(\lambda+\lambda)^2} \right] \times$$

$$\times \left[ (\lambda + \lambda^3) - \frac{\pi}{4} \frac{(\lambda + \lambda^3)^2}{\lambda + \lambda} \right] + \frac{\pi \mu_p}{4 \mu_n} \frac{(\lambda + \lambda^3)(\lambda + 1)}{(\lambda + \lambda)^2} \left. \frac{\sin 2a}{2} \right]; \quad (3)$$

b) for n-type material:

$$E_z = \frac{I_0 \beta}{\left(\frac{D_p}{D_n} + S\right)} \frac{kT}{q d \rho_0} \frac{\mu_p}{\mu_n} \frac{9\pi}{16} \left(\frac{\mu_p H}{c}\right)^2 \left[ \left(\frac{\mu_n}{\mu_p}\right)^2 \left(1 - \frac{\pi}{4}\right) - \frac{(\lambda + \lambda^3)(\lambda + 1)^2}{(\lambda + \lambda)^2} \right] -$$

$$- \frac{\pi \mu_n}{4 \mu_p} \frac{(\lambda + \lambda^3)(\lambda + 1)}{(\lambda + \lambda)^2} \left. \frac{\sin 2a}{2} \right]; \quad (4)$$

and for strong magnetic fields:

a) 
$$E_z = \frac{kT}{q} \frac{\Delta n(0) - \Delta n(d)}{d} \frac{\mu_n}{\mu_p \rho_0} \left(1 + \frac{\mu_p}{\mu_n}\right) \frac{\sin 2a}{2}; \quad (5)$$

b) 
$$E_z = -\frac{kT}{q} \frac{\Delta p(0) - \Delta p(d)}{d} \frac{\mu_p}{\mu_n \rho_0} \left(1 + \frac{\mu_n}{\mu_p}\right) \frac{\sin 2a}{2}; \quad (6)$$

Card 3/5

09277

Theory of the transverse...

S/181/61/003/001/010,042  
B102/B212

$I_0$  denotes the illumination intensity,  $\beta$  the quantum yield,  $\lambda$  the concentration ratio of heavy holes to light holes, and  $\kappa$  the mobility ratio. From these formulas it is evident that, even if there are not two types of holes ( $\lambda \rightarrow \infty$ ), the sign of the effect changes in p-type and n-type material alike; the change of sign will take place if the mobility of the majority carriers exceeds the mobility of the minority carriers by several times. For  $\lambda \rightarrow \infty$ , the condition for the change in sign of the quadratic effect in isotropic semiconductors is: a) for p-type material:  $\mu_p > 4\mu_n/(4-\pi)$ ; b) for n-type material:  $\mu_n > 4\mu_p/(4-\pi)$ . An investigation of the physical nature of the change in sign of the transverse p.m.e. in an isotropic semiconductor (which has been carried out for a p-type material) shows that this change in sign is related to the focusing effect of the magnetic field upon the ambipolar diffusion current of electron-hole pairs; this effect manifests itself in an additional motion of electrons and holes in the direction of the magnetic field. The sign of the resulting electric field is not only a function of the mobility difference but also caused by the difference of the focusing factors. A change in sign of the transverse p.m.e. is expected for a material like n-type InSb ( $\mu_n \gg \mu_p$ ), which is

Card 4/5

89277

Theory of the transverse...

S/181/61/003/001/010/042  
B102/B212

only a function of the focusing effect of the magnetic field. The author thanks S. M. Ryvkin, Doctor of Physical and Mathematical Sciences, for discussions. There are 8 references: 7 Soviet-bloc and 1 non-Soviet-bloc.

ASSOCIATION: Fiziko-tehnicheskiy institut AN SSSR imeni akad. A. F. Ioffe Leningrad (Institute of Physics and Technology AS USSR imeni Academician A. F. Ioffe, Leningrad)

SUBMITTED: May 16, 1960

X

Card 5/5

27298

S/181/61/003/008/028/034  
B109/B202

9.4178

AUTHORS: Grinberg, A. A., Ryvkin, S. M.

TITLE: Unipolar nonsteady photomagnetic effect

PERIODICAL: Fizika tverdogo tela, v. 3, no. 8, 1961, 2470-2474

TEXT: While under steady conditions the ordinary photomagnetic effect (Kikoin-Noskov) occurs only in the case of bipolar photoconductivity of a semiconductor, a photomagnetic effect (PME) may occur also in a unipolar semiconductor under nonsteady conditions. At the moment of illumination a diffusion current of unbalanced charge carriers is formed because the charges do not have sufficient time to form a counterfield. The noncompensated diffusion current of the unbalanced charge carriers is deflected in the magnetic field thus causing the PME voltage. After the illumination is switched off a voltage of reverse polarity occurs (Fig. 1) due to "suction" of the volume charges. Quantitative estimation: The authors proceed from the formula

Card 1/5

27298

Unipolar nonsteady photomagnetic effect

S/181/61/003/008/028/034  
B109/B202

$$\mathbf{j} = \varphi \left\{ \mathbf{j}^* - \frac{\beta H}{\sigma} (\mathbf{j}^* \mathbf{k}) \right\} + (1 - \varphi) (\mathbf{j}^* \mathbf{k}) \mathbf{k},$$

$$\text{где } \mathbf{j}^* = e\mu n_0 \mathbf{E} + eD \text{grad} \Delta n; \quad \varphi = \frac{e}{m^* \mu} \left( \frac{\tau_p}{1 + \left( \frac{e\tau_p}{m^* \sigma} H \right)^2} \right); \quad \tau_p - \text{время релакса-} \quad (1)$$

given by A. A. Grinberg (Ref. 1: FTT, II, 836, 1960) ( $\tau_p$  relaxation time,  $\mu$  electron mobility,  $\tilde{\mu}$  Hall mobility of the electrons, the other denotations are the same as in Ref. 1). Under ordinary conditions, this formula is sufficiently accurate. The following relation is obtained for the electric field

$$E_x = \frac{\beta H}{\sigma} \frac{4\pi e D}{sL} \Delta n_{st} \tau \frac{\left\{ \left[ \left( \frac{1}{\tau} - \frac{1}{\tau_p} \right) t - 1 \right] e^{-\frac{t}{\tau}} + e^{-\frac{t}{\tau_p}} \right\}}{\left( 1 - \frac{\tau}{\tau_p} \right)^2} \quad (6)$$

where  $\Delta n_{cT}$  is the concentration of the unbalanced carriers in the neutral part of the illumination range of the specimen with  $t \rightarrow \infty$ ,  $N_{cM} = N_c \exp(-\Delta E_M/kT)$ , where  $N_c$  is the effective density of the states of

Card 2/5

27298

S/181/61/003/008/028/034  
B107/B202

Unipolar nonsteady photomagnetic effect

the conduction band,  $M$  the total concentration of the defects, and  $m_0$  the concentration of the defects which, in the case of thermal equilibrium, is occupied by electrons,  $q$  photon capture cross section in a defect. Fig. 3 shows the relaxation effect of  $E_x$  for two ratios  $\tau/\tau_0$ .

$$E_s^{(max)} \approx \frac{\beta H}{\sigma} \frac{4\pi e D}{4L_p} \Delta n_{st} \frac{\tau_0^2}{\tau} \quad (9)$$

holds for the maximum value. The short-circuit current is

$$I_{s.c.} = -\frac{\beta H}{\sigma} e D L_p \frac{e^{-\frac{t}{\tau_0}} - e^{-\frac{t}{\tau}}}{(1 - \frac{\tau}{\tau_0})} \Delta n_{st} \quad (10),$$

the maximum short-circuit current amounts to

$$I_{s.c.}^{(max)} = e D \frac{\beta H}{\sigma} L_p \Delta n_{st} \left[ \frac{\tau}{\tau_0} \right] \left( \frac{\tau}{\tau_0 - \tau} \right) \quad (11).$$

The ratio (10) : (11) indicates that the nonsteady unipolar PME is strongly

Card 3/5

27298

Unipolar nonsteady photomagnetic effect

S/181/61/003/008/028/034  
B109/B202

marked in poorly conductive materials. Thus, with the following values  $L_z = 1\text{cm}$ ,  $L_x = L_y = 0.1\text{ cm}$ ,  $\epsilon = 16$ ,  $\mu H/c \approx 1$ ,  $\Delta n \approx n_0$ ,  $I_{0m0q} \approx 10^{15}\text{ 1/sec}\cdot\text{cm}^3$ ,  $4 \cdot 10^{-10}\text{ a}$  is obtained for the maximum short-circuit current. With a mobility of  $\mu \approx 10^3\text{ cm}^2/\text{v sec}$  the interval resistance  $R_1 = 10^7\text{ ohm}$ . Thus voltage of  $10^{-3}\text{ v}$  is formed at a load resistance  $R \approx 0.3 R_1$ . The authors thank L. E. Gurevich for valuable help. There are 3 figures and 1 Soviet reference.

ASSOCIATION: Fiziko-tehnicheskiy institut im. A. F. Ioffe AN CCCP, Leningrad (Institute of Physics and Technology imeni A. F. Ioffe AS USSR, Leningrad) X

SUBMITTED: March 18, 1961 (initially), April 5, 1961 (after revision)

Card 4/5

9,4160 (also 1137,1043,1143)  
26.2421  
26.1360

89611

S/020/61/136/002/015/034  
B019/B056

AUTHORS: Grinberg, A. A., Novikov, S. R., and Ryvkin, S. M.

TITLE: The New Effect of Negative Photoconductivity in a Magnetic Field

PERIODICAL: Doklady Akademii nauk SSSR, 1961, Vol. 136, No. 2, pp. 329-331

TEXT: Fig. 1 shows a scheme of the experimental order, by means of which the authors carried out their experiments. By means of this device they were able to transmit light pulses to the semiconductor in the case of the existence or non-existence of a magnetic field. The photoconductivity without a magnetic field corresponded to the "positive" conductivity, that with magnetic field corresponding to the "negative" conductivity. The effect produced by the photo-emf of the specimen could be inhibited. The explanation of this effect proceeds from the fact that in the motion of the carriers in a magnetic transversal field their trajectory is curved, whereby the resistance is increased. The Hall field formed in this connection partly aligns the trajectories again, and thus decreases the

Card 1/4



89611

The New Effect of Negative Photoconductivity      S/020/61/136/002/015/034  
in a Magnetic Field      B019/B056

growth of the resistance in a magnetic field. Thus, by some decrease of the Hall field, the resistance of the semiconductor is increased. By irradiation with light from the absorption band, electron-hole pairs are produced, and the increase of the electron concentration leads to a decrease of the Hall field. A formula is derived for calculating the negative change in the photoconductivity in n-type germanium, and further, two inequalities are given, by means of which it is possible to determine when no negative photoeffect may be observed in n-type or p-type material. There are 3 figures. ✓

ASSOCIATION:      Fiziko-tekhnicheskii institut Akademii nauk SSSR (Institute of Physics and Technology of the Academy of Sciences USSR)

PRESENTED:      August 1, 1960, by A. F. Ioffe, Academician

SUBMITTED:      July 28, 1960

Card 2/4

07011

The New Effect of Negative Photoconductivity  
in a Magnetic Field

S/020/61/136/002/015/034  
B019/B056

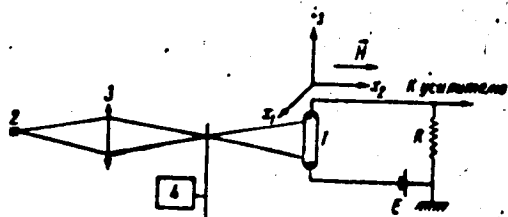


Рис. 1. Схема для наблюдения отрицательной фотопроводимости в магнитном поле. 1 — образец, 2 — источник света, 3 — объектив, 4 — модулятор света.

Card 3/4

89611

**The New Effect of Negative Photoconductivity  
in a Magnetic Field**

S/020/61/136/002/015/034  
E019/B056

Legend to Fig. 1: 1) Specimen. 2) Source. 3) Objective. 4) Light  
modulator.

Card 4/4

33348

S/181/62/004/00/017/052

B108/B104

24.7700 (1043, 1143, 1482)

AUTHOR: Grinberg, A. A.

TITLE: Volt-ampere characteristic of a p-n junction in forward direction

PERIODICAL: Fizika tverdogo tela, v. 4, no. 1, 1962, 99 - 103

TEXT: At present, two principal difficulties spoil the theory of the volt-ampere characteristics of p-n junctions. The first is the infinite increase in carrier concentration, the second is the departure of the experimental voltampere characteristic from the "root-I" law. These difficulties are explained by a space charge in the p-n junction. In the calculations it is assumed that the p- and n-domains are perfectly symmetric in geometry as well as in their properties. Recombination in the junction is neglected. The strong currents in the forward direction only are considered so that the voltage drop across the narrow band of space charge can be neglected. The volt-ampere characteristic in this case is calculated as

$$V = - \frac{kT}{e} (2I - L)L, \text{ where } L = l\kappa, \kappa = \sqrt{4Te^2 N_d / \epsilon kT}, I = J/J_0, J_0 = eDN_1 \kappa,$$

Card 1/2

X

33348

S/181/62/004/001/017/052  
B108/B104

Volt-ampere characteristic of ...

$N_d$  = concentration of donor impurities. It is shown that with rising current, carrier concentration increases up to a maximum and then decreases again. This behavior is due to the increasing effect of the electric field with increasing current so that carrier diffusion is gradually reduced and a space charge occurs. If the electric field strength increases more rapidly than current, the injected carrier concentration will decrease. The author thanks S. M. Ryvkin, Doctor of Physics and Mathematics, and A. A. Rogachev for discussions. There are 2 figures and 5 references: 3 Soviet and 2 non-Soviet. The 2 references to the English-language publications read as follows: N. H. Fletcher. Proc. IRE, 45, 862, 1957; A. K. Jonscher. J. Electr. and Control., 5, 1, 1958.

4

ASSOCIATION: Fiziko-tehnicheskii institut im. A. F. Ioffe AN SSSR  
Leningrad (Physicotechnical Institute imeni A. F. Ioffe AS  
USSR, Leningrad)

SUBMITTED: July 12, 1961

Card 2/2

GRINEBERG, A.A.; NIKOLAYEV, I.N.

On the photomagnetic effect on a p-n junction. Dokl. AN SSSR  
147 no.5:1057-1060 D '62. (MIRA 16:2)

1. Moskovskiy gosudarstvennyy universitet im. M.V. Lomonosova i  
Fiziko-tekhnicheskoy institut im. A.F. Ioffe AN SSSR. Predstavleno  
akademikom I.K. Kikoinym.  
(Photomagnetic effect) (Junction transistors)

GRINEERG, A.A.

Coherent emission of long-wave phonons by nonequilibrium current  
carriers in semiconductors. *Fiz. tver. tela* 6 no.2:590-592 F '64.  
(MIRA 17:2)

1. Fiziko-tekhnicheskii institut imeni A.F.Ioffe AN SSSR, Leningrad.

ACCESSION NR: AP4019859

S/0181/64/006/003/0911/0911

AUTHOR: Grinberg, A. A.

TITLE: Amplification of ultrasound in semimetals and semiconductors with internal conductance

SOURCE: Fizika tverdogo tela, v. 6, no. 3, 1964, 911-914

TOPIC TAGS: ultrasonic absorption, semimetal, charge carrier, ponderomotive force, acoustic wave propagation, hole drift

ABSTRACT: The coefficient of ultrasonic absorption  $\alpha$  (amplification) has been calculated in semimetals under strong transverse electric and magnetic fields. The calculation includes recombination of nonequilibrium charge carriers, the deformation potential of ponderomotive (Lorentz) force, and increase in lattice charges. These are included in the equation for acoustic wave propagation along the axis  $Oy$ , axis of electron and hole drift for  $\lambda_{ph} \ll \lambda_{ac}$  ( $\lambda_{ph}$  - mean free path of thermal phonons,  $\lambda_{ac}$  - wave length of acoustic wave), and an expression for  $\alpha$  is derived from the resulting dispersion equation. Under the conditions

Card 1/2



ACCESSION NR: AP4019859

of coefficient amplification  $E_c/H_0 < -1$ , the "viscous" action effect of electron-hole gas is shown to lead to the inequality

$$\beta < \frac{E_c}{H_0} \frac{v^2}{v_{th}^2 (E_n - E_p)}$$

For InSb at 77K,  $H \sim 3 \times 10^4$  oersted,  $|E_n - E_p| \sim 15$ , and  $|E_c/H_0| = 2$  this inequality yields  $\omega < 10^7 \text{ sec}^{-1}$ . The author is grateful to L. E. Gurevich, V. L. Gurevich and V. G. Skobov for their help and advice. Orig. art. has: 12 formulas.

ASSOCIATION: Fiziko-tehnicheskii institut im. A. F. Ioffe AN SSSR Leningrad (Physicotechnical Institute AN SSSR)

SUBMITTED: 17Jun63

DATE ACQ: 31Mar64

ENCL: 00

SUB CODE: PH

NO REF SOV: 005

OTHER: 002

Card 2/2

ACCESSION NR: AP4028457

S/0181/64/006/004/1228/1229

AUTHOR: Grinberg, A. A.

TITLE: A possible experimental verification of the relation between the absorption coefficient of ultrasonic energy and the acoustical-electron current in solids

SOURCE: Fizika tverdogo tela, v. 6, no. 4, 1964, 1228-1229

TOPIC TAGS: ultrasonics, acoustical electron current, absorption coefficient

ABSTRACT: When sound is completely absorbed in a sample, the acoustical-electron emf should not depend on the absorption coefficient but should be determined entirely by the absorption of sound energy falling on unit area of a sample per unit time. The author used the relations derived by G. Weinreich (Phys. Rev., 107, 317, 1957) to find the desired relations, and he obtained the following expression: 
$$j = -\frac{\mu_n W_0}{2ds} (1 - e^{-2sd}) f(\omega)$$
 , where  $j$  is the current density,  $\mu_n$  the electron mobility,  $W_0$  the sound energy absorbed by unit area per unit time,  $f(\omega)$  a correction factor that is equal to unity when Weinreich's relations are satisfied,  $\alpha$  the absorption coefficient of ultrasonic energy,  $d$  the length of the sample, and  $s$  the velocity of sound. This equation may be used to determine Weinreich's

Card 1/2

ACCESSION NR: AP4028457

relations when  $2\alpha d \gg 1$ . Its advantage over measurement of the acoustical-electron emf lies in the fact that a larger absorption coefficient is achieved with larger concentrations of current carriers, which leads to a small acoustical-electron emf. At the same time, the acousto-electrical current does not depend on carrier concentrations at  $2\alpha d \gg 1$ . This may appear paradoxical, but it must be borne in mind that the condition  $2\alpha d \gg 1$  cannot be obtained in the absence of free current carriers. Orig. art. has: 5 formulas.

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR, Leningrad  
(Physicotechnical Institute AN SSSR)

SUBMITTED: 22Oct63

DATE ACQ: 27Apr64

ENCL: 00

SUB CODE: SS, GP

NO REF SOV: 000

OTHER: 007

Card 2/2

L 7042-65 EWT(l)/EWG(k)/EWP(a)/T/EWP(q)/EWP(b) Ez-6 IJP(c)/AFWI/ASD(a)  
SSD/RAEH(a)/ESD(g)/ESD(t)/REAH(t) JD/AT

ACCESSION NR: AP4041700

8/0181/64/006/007/2010/2013

AUTHOR: Grinberg, A. A.

TITLE: Acoustic magnetoelectric effect in semiconductors B

SOURCE: Fizika tverdogo tela, v. 6, no. 7, 1964, 2010-2013

TOPIC TAGS: acoustic magnetoelectric effect, ultrasonics, semi-conductor, semiconductor ultrasound absorption, indium antimonide

ABSTRACT: A new effect in intrinsic semiconductors has been described, involving the interaction of acoustic, magnetic, and electric fields. Longitudinal ultrasonic oscillations directed at right angles to a magnetic field will generate a potential difference along the third orthogonal axis. The effect is explained by the generation of equal flows of electrons and holes excited by the absorption of sound and deflected in opposite directions by the magnetic field. The intensity of the effect, which is related to the degree of absorption of ultrasound, can also be amplified to a considerable degree by illuminating the specimen with light. For an indium antimonide specimen 1 cm long, the resulting potential difference will be  $10^{-4}$  v, given

Card 1/2

L 7042-65  
ACCESSION NR: AP4041700

2

the ultrasonic field parameters of 1 watt and  $\omega = 10^9 \text{ sec}^{-1}$ , and a temperature of 300 K. "The author thanks S. M. Ryvkin for discussing the results of this work." Orig. art. has: 17 formulas and 1 figure.

ASSOCIATION: Fiziko-tekhnicheskiy institut im. A. F. Ioffe AN SSSR  
Leningrad (Physicotechnical Institute, AN SSSR)

SUBMITTED: 03Dec63

ATD PRESS: 3104

ENCL: 00

SUB CODE: SS, GP

NO REF SOV: 004

OTHER: 001

Card

2/2

ACCESSION NR: AP4034031

S/0020/64/155/006/1293/1293

AUTHOR: Grinberg, A. A.

TITLE: Elucidation of Saturation of the drift velocity of current carriers in piezoelectric semiconductors

SOURCE: AN SSSR. Doklady\*, v. 155, no. 6, 1964, 1293

TOPIC TAGS: semiconductor drift velocity, piezoelectric semiconductor, volt ampere characteristic, acoustical electric current, semiconductor sound velocity, CdS, CdSe, GaAs, semiconductor, solid state circuitry

ABSTRACT: It has been found by R. W. Smith (Phys. Rev. Letters 9, 87, 1962) that the drift velocity  $v$  of the charge carriers (and therefore the current density) levels off with an increase of voltage in piezoelectric semiconductors (CdS, CdSe, GaAs) when it becomes equal to, or greater than, the sound velocity  $S$ . Furthermore, this deviation from Ohm's law is accompanied by a large flux of ultrasonic energy. This phenomenon is interpreted by using the concept of acoustico-electric current which is a part of the total current. If  $v > S$ , the

Card 1/2

ASSOCIATION REF: A24034031

former is opposite to the latter. The present author expresses this idea quantitatively. The excess of power is spent in that case not on generation of ultrasonic oscillations, but on heat evolution. The quantitative consideration of the increase of the heat noises and of the fact that the potential difference at the specimen is given not only by the Ohmic part of the electric field, but also by the acoustico-electric emf, leads to a volt-ampere characteristics which agrees with the experimental findings. Orig. art. has: no figures, 1 eq.

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

SUBMITTED: 18Nov63

DATE ACQ: 20May64

ENCL: 00

SUB CODE: GP

NO REF SOV: 000

OTHER: 002

Card 2/2

ACCESSION NR: AP4042018

S/0020/64/157/001/0079/0082

AUTHORS: Grinberg, A. A.; Kramer, N. I.

TITLE: Acousto-magnetic effect in piezoelectric semiconductors

SOURCE: AN SSSR. Doklady\*, v. 157, no. 1, 1964, 79-82

TOPIC TAGS: piezoelectric effect, semiconductor, indium antimonide, semiconductor conductivity, carrier density, ultrasonic wave propagation

ABSTRACT: The effect described is present only in piezoelectric semiconductors with bipolar conductivity, the properties of which have not yet been treated in the literature. It consists in the fact that if ultrasound is transmitted through a piezoelectric placed in a magnetic field in a direction perpendicular to the magnetic field, then an electric field is produced in the third direction. The reason for the current is the deflection of the electrons and

Card 1/4



ACCESSION NR: AP4042018

holes which are dragged by the ultrasonic waves in opposite directions, which produces a potential difference. The electromagnetic equations are solved in the case of a one-dimensional model of a piezoelectric with equal electron and hole densities. Formulas are derived for the coefficient of absorption (amplification) of the ultrasound, for the current density, and for the acousto-magnetic field. The results show that in case of piezoelectric interaction the absorption coefficient at fixed frequency decreases with the increasing carrier density, whereas the absorption coefficient due to the deformation potential (which is present in all semiconductors) increases. In InSb, the acousto-magnetic effect in the region of presently available ultrasound frequencies is determined completely by the deformation potential, and not by the piezomechanical property. Orig. art. has: 3 figures and 11 formulas.

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

Cord 2/4

ACCESSION NR: AP4042018

SUBMITTED: 31Jan64

ENCL: 01

SUB CODE: SS

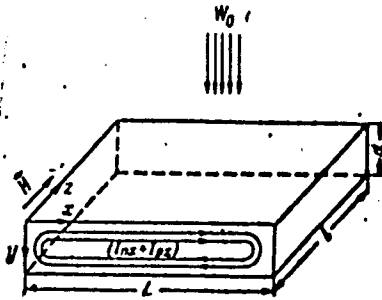
NR REF SOV: 007

OTHER: 006

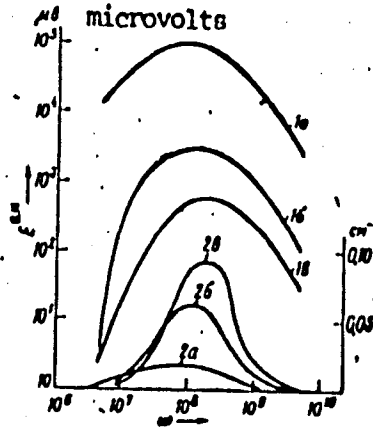
Card 3/4

ACCESSION NR: AP4042018

ENCLOSURE: 01



Relative directions of fields and current



Dependence of acousto-magnetic voltage (curves 1) and of coefficient of ultrasound absorption (curves 2) on the frequency for three values of the concentration.

Card 4/4

L 14292-65 EWA(h)/EWG(k)/EWP(k)/EWT(1)/T Pf-4/P1-4/Pz-6/Peb IJP(c) AT  
ACCESSION NR: AP4049127 S/0020/64/159/001/0049/0052

AUTHOR: Konstantinov, B. P.; Grinberg, A. A.; Kastal'skiy, A. A.;  
Ry\*vkin, S. M.

TITLE: Generation of ultrasound<sup>21</sup> in the p-n junction<sup>21</sup> of a nonpiezo-  
electric material

SOURCE: AN SSSR. Doklady\*, v. 159, no. 1, 1964, 49-52, and bottom  
half of insert facing p.44

TOPIC TAGS: ultrasound, ultrasound generation, semiconductor  
ultrasonics, p-n junction ultrasonics

ABSTRACT: Proceeding from the work of D. L. White (IRE, TVE-9, 1962)  
on the generation of ultrasound in a GaAs-to-metal transition layer,  
the authors investigated analytically and experimentally the possibil-  
ities of ultrasound generation in a usual p-n junction or in any  
barrier layer of nonpiezoelectric materials. The generating mechanism  
in this case is the attraction between the donors and the acceptors  
of the space charge zone. An outside potential applied to the junction

Card 1/4

L 14292-65

ACCESSION NR: AP4049127

will effect a change in the thickness of the space charge and thus change the force of attraction, which in turn determines the stress within the crystal. Resonance conditions are investigated in the case of a high bias potential applied in the barrier direction and a low sinusoidal exciting voltage, the diode being acoustically loaded from the side of the n-region by a continuous medium of the same material as the junction, while its p-region is bounded by vacuum. Expressions for the amplitude and the acoustical energy at resonance are derived and applied to real conditions where the regions of a p-n junction adjacent to the space charge are finite and the energy is radiated into a medium with an acoustic resistance differing from that of the junction material. Three limiting cases are then considered: the case of a symmetric system with equal p and n regions, equal acceptor and donor concentrations, and the thickness of the p and n regions larger than the thickness of the acceptor space charge; the case of the acceptor space charge being much thinner than that of the donors and both being much thinner than the p and n regions; and a similar case modified by the p region being much thinner than the n region of the junction. The second is considered

Card 2/4

L 14292-65

ACCESSION NR: AP4049127

to be the most favorable theoretically as well as experimentally. Calculations show that in a Ge junction in air, with the donor concentration of  $10^{17}$  per  $\text{cm}^3$  being much lower than that of the acceptors, at a sinusoidal voltage of 3 v, a bias of 30 v, the p and n regions having a total thickness of 0.5 cm, the pressures developing in the specimen reach the order of  $3 \text{ kg/cm}^2$ , and the radiated power is about  $0.4 \times 10^{-5} (2n + 1)^2 \text{ W/cm}^2$  ( $n = 1, 2, \dots$ ). In an experimental test, the amplitude of the oscillations proved to be proportional to the sinusoidal voltage, and the relative lattice displacement in the direction perpendicular to the p and n contact plane reached a value of the order of  $10^{-3}$  at a sinusoidal voltage of 3 v and a bias of 15 v. Due to internal losses, however, the experimental width of the resonance region greatly exceeded the theoretical value, which caused the amplitude to drop by about 3 orders of magnitude below the theoretical. Orig. art. has: 1 figure.

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

Card 3/4

L 14292-65

ACCESSION NR: AP4049127

SUBMITTED: 03Aug64

NO REF SOV: 000

ENCL: 00

OTHER: 001

SUB CODE: SS

ATD PRESS: 3136

0

*copy  
4/2*

L 63512-65 EWT(1)/T/EWA(h) Pz-6/Peb IJP(c) AT

ACCESSION NR: AP5017319

UR/0181/65/007/007/2195/2205

AUTHOR: Ryvkin, S. M.; Grinberg, A. A.; Kramer, N. I.

TITLE: Indirect optical transitions in semiconductors accompanied by interaction with charge carriers

SOURCE: Fizika tverdogo tela, v. 7, no. 7, 1965, 2195-2205

TOPIC TAGS: semiconductor, indirect transition, free carrier, optical transition, semiconductor laser.

ABSTRACT: A new indirect transition mechanism in semiconductors involving free carriers rather than phonons is analyzed. It is shown that absorption and emission of photons with energies less than the width of the forbidden gap accompanied by transfer of energy and momentum between electrons (holes) and free carriers is possible. A cross section is calculated for capture of photons as a result of such transitions averaged over the energies of electrons (holes). It is pointed out that absorption of photons by means of such a process can be achieved by applying an electric field to a sample which has been cooled to a low temperature in order to generate the hot electrons required for such a transition. The possibility of an

Card 1/2



L 63512-65

ACCESSION NR: AP5017319

indirect free-carrier-assisted transition laser is discussed in another paper (A.A. Grinberg, et al. PTT, v. 7, no. 7, 1965, 2206). Orig. art. has: 20 formulas, 5 figures, and 1 table. [CS]

ASSOCIATION: Fiziko-tehnicheskij institut im. A. F. Ioffe AN SSSR, Leningrad (Physicotechnical Institute, AN SSSR)

SUBMITTED: 23Feb65

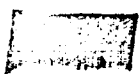
ENCL: 00

SUB CODE: SS, EC

NO REF SOV: 002

OTHER: 007

ATD PRESS: 4049



Card 2/2

L 63511-65 EWA(k)/FBD/EWG(r)/EWT(1)/EEC(k)-2/T/EEC(b)-2/EWP(k)/EWA(h)/  
EWA(m)-2 Pm-4/Pn-4/Po-4/Pf-4/Pi-4/Pl-4/PeB SCTB/IJP(c) WG

ACCESSION NR: AP5017320

UR/0181/65/007/007/2206/2208

AUTHOR: Grinberg, A. A.; Rogachev, A. A.; Ryvkin, S. M.

TITLE: Possibility of negative absorption at free-carrier-assisted indirect transitions

SOURCE: Fizika tverdogo tela, v. 7, no. 7, 1965, 2206-2208

TOPIC TAGS: <sup>25</sup> laser; semiconductor laser, indirect transition, indirect transition laser, stimulated emission, negative absorption

ABSTRACT: An analysis is conducted of criteria required to attain negative absorption due to indirect transitions involving transfer of energy and momentum between electrons (holes) and free carriers. Such a mechanism, first discussed by S. M. Ryvkin in FTT, v. 7, no. 4, 1965, p. 1278, and later analyzed by Ryvkin et al. in FTT, v. 7, no. 7, 1965, p. 2195, requires the presence of an applied electric field to generate hot carriers. Since the main advantage of any indirect transition laser is that only a small concentration of charge carriers is required, the authors consider only the nondegenerate case (absence of carrier degeneracy). It is shown that the criteria for attaining negative absorption by means of indirect free-carrier-assisted transitions is identical to those for phonon-assisted transitions, derived by N. G. Basov et al. in 1960. It is shown that amplification can be achieved at a  
Card 1/2

L 63511-65

ACCESSION NR: AP5017320

moderate concentration of excess carriers in semiconductors with the valence and the conduction band minima not displaced relative to one another in the energy momentum space and for photons with energies several hundreds of ev smaller than the width of the forbidden gap. In the calculations the free carrier absorption, believed to be mainly responsible for failure to achieve laser action by means of indirect phonon assisted transitions (W. Dumke, Physical Review, v. 127, 1962, p. 1559), was taken into account. Orig. art. has: 4 formulas and 1 figure. [CS]

ASSOCIATION: Fiziko-tehnicheskii institut im. A. F. Ioffe AN SSSR, Leningrad  
(Physicotechnical Institute, AN SSSR)

SUBMITTED: 23Feb65

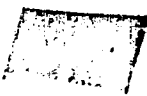
ENCL: 00

SUB CODE: SS, *sc*

NO REF SOV: 003

OTHER: 002

ATD PRESS: 4049



*bat*  
Card 2/2

L 30049-65 ENT(1)/ENT(m)/T/ENT(t)/ENT(k)/ENT(b) PI-4/P1-4 IJP(c) JD

ACCESSION NR: AF5005245

S/0057/65/035/002/0376/0380

AUTHOR: Grinberg, A.A.; Kastal'skiy, A.A.; Ryvkin, S.M.

TITLE: Excitation of ultrasonic vibrations in germanium by current pulses

SOURCE: Zhurnal tekhnicheskoy fiziki, v.35, no.2, 1965, 376-380

TOPIC TAGS: germanium, ultrasonic vibration, thermal shock, current pulse

27  
B

ABSTRACT: Rectangular parallelepipeds of n-type germanium were excited by short current pulses and their subsequent mechanical vibration was observed with a piezo-electric transducer fixed to one end. The samples were  $4 \times 4 \times h$  mm<sup>3</sup> in size, where h varied from 6 to 20, and the resistivity of the material was 0.3 ohm cm. Square current pulses with a 0.5 microsec rise time, various durations of the order of 10 microsec, and intensities up to 1000 A/cm<sup>2</sup> were introduced at the square faces. Mechanical vibrations with an amplitude proportional to the square of the current density and a frequency equal to the mechanical resonant frequency of the specimen (approximately 125 Kc/sec for the 20 mm long specimen) were thereby excited. The excitation of the vibrations is ascribed to thermal shock due to the Joule heat evolved. Two independent trains of vibrations were excited by each pulse: one by

1/2

L 30049-65  
ACCESSION NR: AP5005245

the current rise at the beginning of the pulse, and another, with opposite phase, by the current drop at the end. This is evinced by the fact that the vibrations were particularly strong when the pulse duration was equal to a half-period of the mechanical vibration and were nearly absent when the pulse duration was a full period. A theory of the thermal excitation of mechanical vibrations is developed, and the predictions of the theory are shown to be in reasonable agreement with the experimental data. Orig.art.has: 16 formulas and 3 figures. [02]

ASSOCIATION: none

SUBMITTED: 18May64

ENCL: 00

SUB CODE: SS,GP

NR REF SOV: 002

OTHER: 000

ATD PRESS: 3194

L 27730-66 EWT(1)/T IJP(c)

ACC NR: AP6015480

SOURCE CODE: UR/0181/66/008/005/1555/1561

AUTHOR: Grinberg, A. A.; Kramer, N. I.

41  
B

ORG: Physicotechnical Institute im. A. F. Ioffe AN SSSR, Leningrad (Fiziko-tekhni-cheskiy institut AN SSSR)

TITLE: Light-light scattering in semiconductors and insulators

SOURCE: Fizika tverdogo tela, v. 8, no. 5, 1966, 1555-1561

TOPIC TAGS: neodymium, light scattering, laser optics, phonon scattering, semiconductor laser

ABSTRACT: The authors consider <sup>21</sup> photon-photon scattering <sup>2/</sup> in insulating crystals. The process is caused by the polarizability of the crystal due to virtual transitions of electrons from the valence band to the conduction band. The dipole approximation is used for calculating the scattering cross section. It is shown that the scattering of phonons with energy  $h\omega$  much less than the width of the forbidden band is proportional to  $\omega^6$ . When  $h\omega_1 + h\omega_2 \approx E_g$ , the cross section is of the order of  $10^{-28}$  cm<sup>2</sup>.

The practical feasibility of using a neodymium laser for observing photon-photon scattering is evaluated. The number of quanta scattered at the interaction of two light beams with volume  $V$  in a time  $t$  where the intensities of the beams (in kw/cm<sup>2</sup>·sec)

2

Card 1/2

L 27730-66

ACC NR: AP6015480

are  $I_1$  and  $I_2$  is equal to

$$\Delta N = \frac{I_1 I_2 n}{c_0} \sigma V t$$

where  $n$  is the refractive index. A neodymium laser with a power of  $10^6$  w gives  $I_1 = I_2 = 10^{24}$  kw/cm<sup>2</sup> sec for a time  $t \sim 10^{-3}$  sec for a focusing area of 10 cm<sup>2</sup>. For the given scattering cross section,  $n=3$ ,  $V=30$  cm<sup>3</sup> and  $\Delta N=3 \cdot 10^9$ . Orig. art. has: 2 figures, 11 formulas. [14]

SUB CODE: 20/

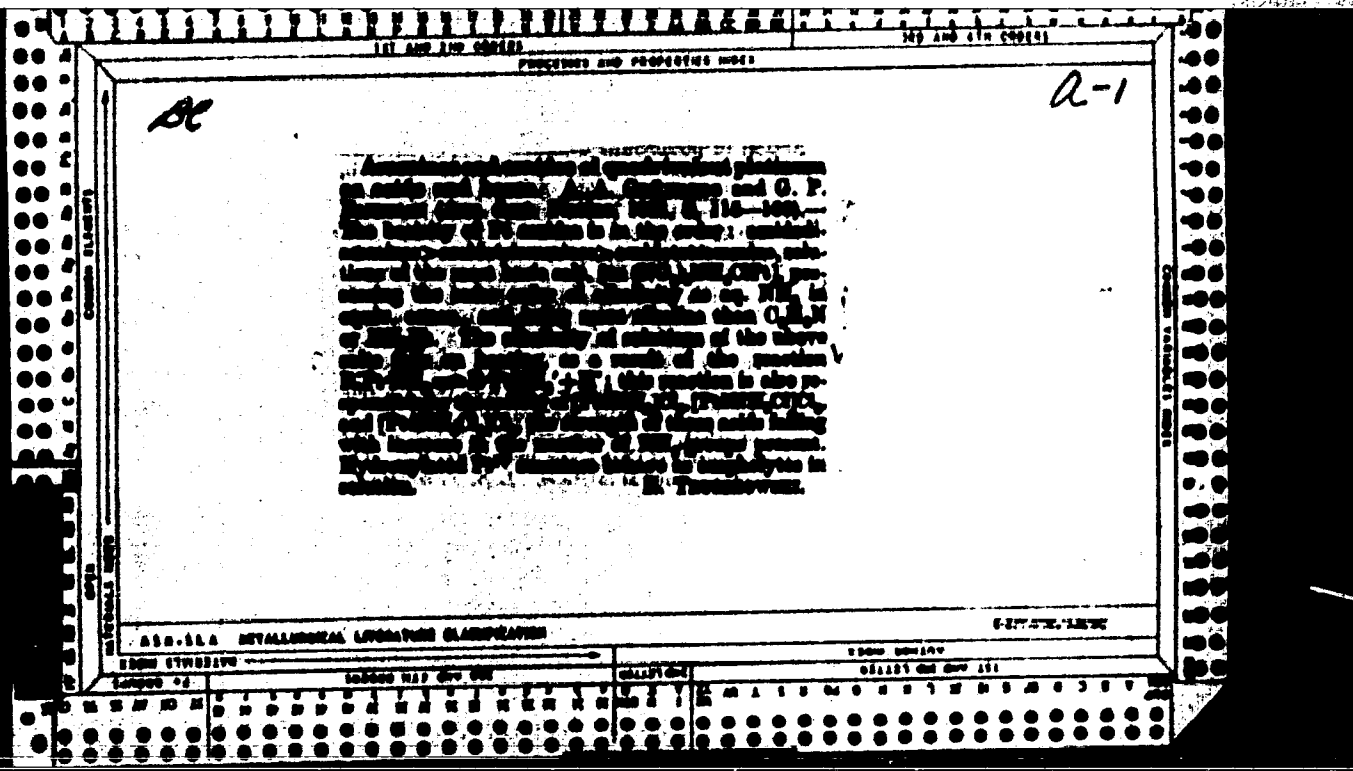
SUBM DATE: 01Jul65/

ORIG REF: 002/

OTH REF: 013/

ATD PRESS: 5002

Card 2/2 · BLG





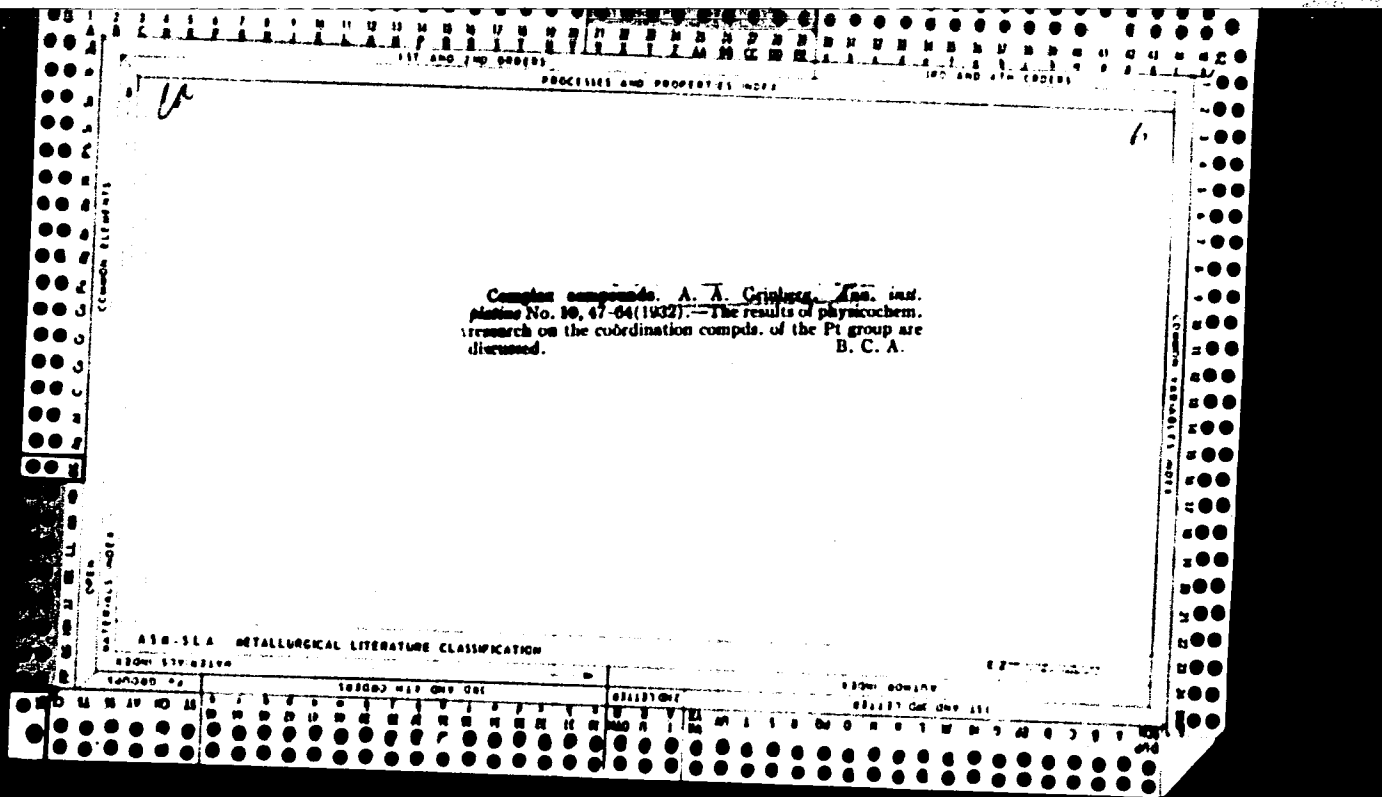
GRINBERG, A.A.

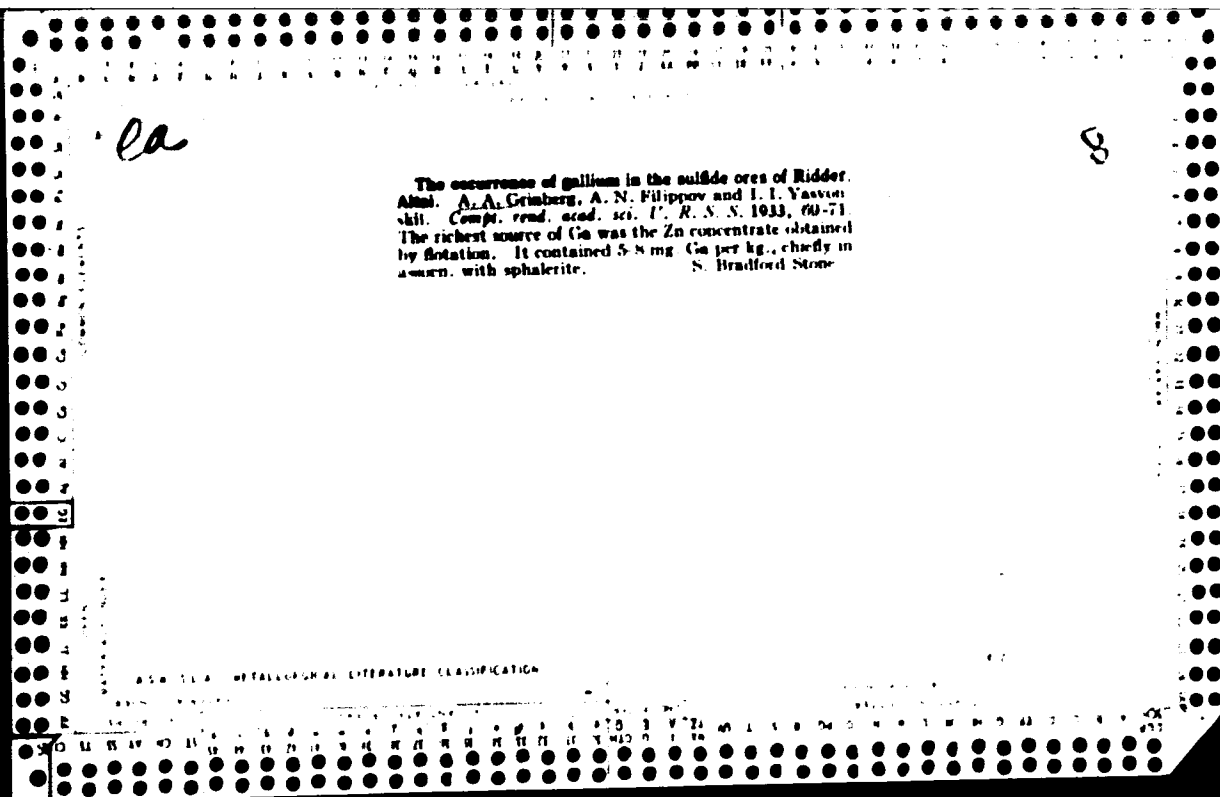
Thermal decomposition of bisulfate platinum amines. A.A. GRINBERG AND H.V. PIRSOV. *Ann. Inst. Chim. No. 9, 73-80(1937)* - The thermal stability of compds.

having the general formula  $[Pt(NH_3)_2X_2]$  decreases in the following order:  $SO_4 > CrO_4 > Cl_2 > Br_2 > (NO_2)_2 > I_2 > (SCN)_2$ . The transition temps are 225°, 218°, 178°, 166°, 145°, 139° and 117° resp. In the thermal decomps. of  $[Pt(NH_3)_2Cl_2]$ ,  $[Pt(NH_3)_2Br_2]$ ,  $[Pt(NH_3)_2I_2]$  and  $[Pt(NH_3)_2(NO_2)_2]$  in eq. cond. there are formed intermediate products with evolution of  $NH_3$  according to  $[Pt(NH_3)_2]X_2 \rightarrow [Pt(NH_3)_2X_2] + 2NH_3$ . The thermal decomps. of thiocyanate under similar conditions takes place in part in like manner and in part according to  $2[Pt(NH_3)_2(SCN)_2] \rightarrow [Pt(NH_3)_2][Pt(SCN)_2] + 4NH_3$ . In the thermal decomps. of dry tetrammine thiocyanate  $[Pt(NH_3)_4][Pt(SCN)_2]$  is formed exclusively. The vapor pressures detd. are for  $[Pt(NH_3)_2]Cl_2$  53 mm. at 180°, and 110 mm. at 207°;  $[Pt(NH_3)_2]Br_2$  64 mm at 170°, and 115 mm. at 190°;  $[Pt(NH_3)_2]I_2$  89 mm. at 160°, and 204 mm. at 178°. The transition temp. for dry  $[Pt(NH_3)_2Cl]Cl$  is 170-2°. The stabilities of various compds. of the type  $[Pt(NH_3)_2X_2]$  are of approx. the same order as those of the tetrammines.

W. P. BAICKS

ASB 318 METALLURGICAL LITERATURE CLASSIFICATION





ca

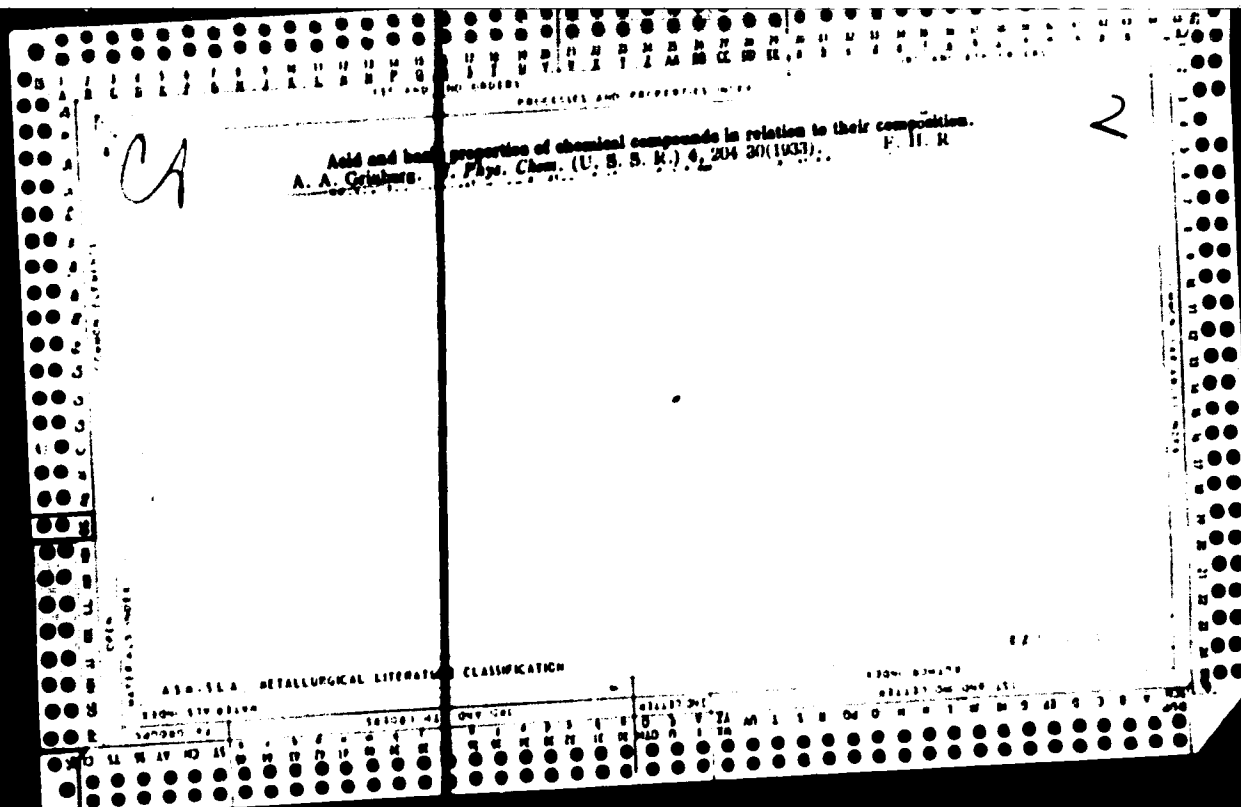
6

**Isomeric palladium diammines.** A. A. Grinberg and V. M. Shulman. *Compt. rend. acad. sci. U. R. S. S. [N. S.]*, 1963, 215-20.---The following isomers of Pd diammines were prepd. by the action of  $NH_3$  or pyridinium acetate on aq. solns. of  $K_2PdCl_4$  or  $K_2PdBr_4$ :  $Pd(NH_3)_2Cl_2$ ,  $Pd(NH_3)_2Br_2$ ,  $PdPy_2Cl_2$  and  $PdPy_2Br_2$ . These isomers differ from the ones obtained previously in color, crystal structure, soly. and elec. cond., as well as in their behavior with KI and HCl. Their color has a more brownish shade, and their solns. gradually ppt.  $AgCl(AgBr)$  when treated with  $AgNO_3$ . Their behavior is quite similar to that of the corresponding Pt compds., and hence they should be considered *cis* forms. They have the structure I as compared with the known compds. of the structure II.



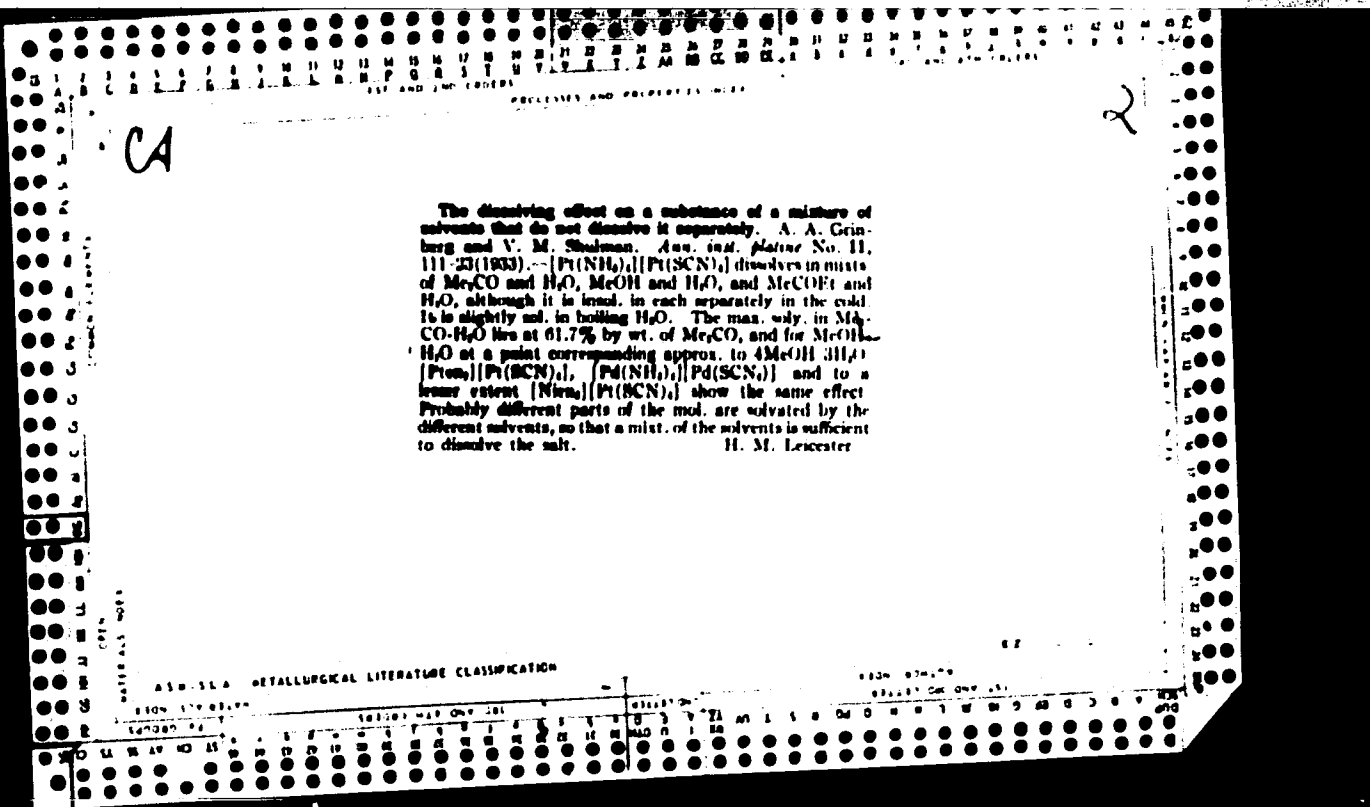
The *trans* isomer is more sol. in  $CHCl_3$  than the *cis* isomer. The new isomers are more active with HCl than the old ones, and they acquire a red coloring upon the addn. of a few drops of KI to their soln. in acetone. *cis*- $Pd(NH_3)_2Cl_2$ , like the bromide, reacts with KI but to a smaller extent. The same reaction is characteristic for *cis*- $PdPy_2Cl_2$  and *cis*- $PdPy_2Br_2$  in  $CHCl_3$ , in which case the upper (aq. layer) acquires a red color. The numerical data for the soly. and elec. cond. of various *cis* and *trans* isomers are tabulated. A. A. Buchting

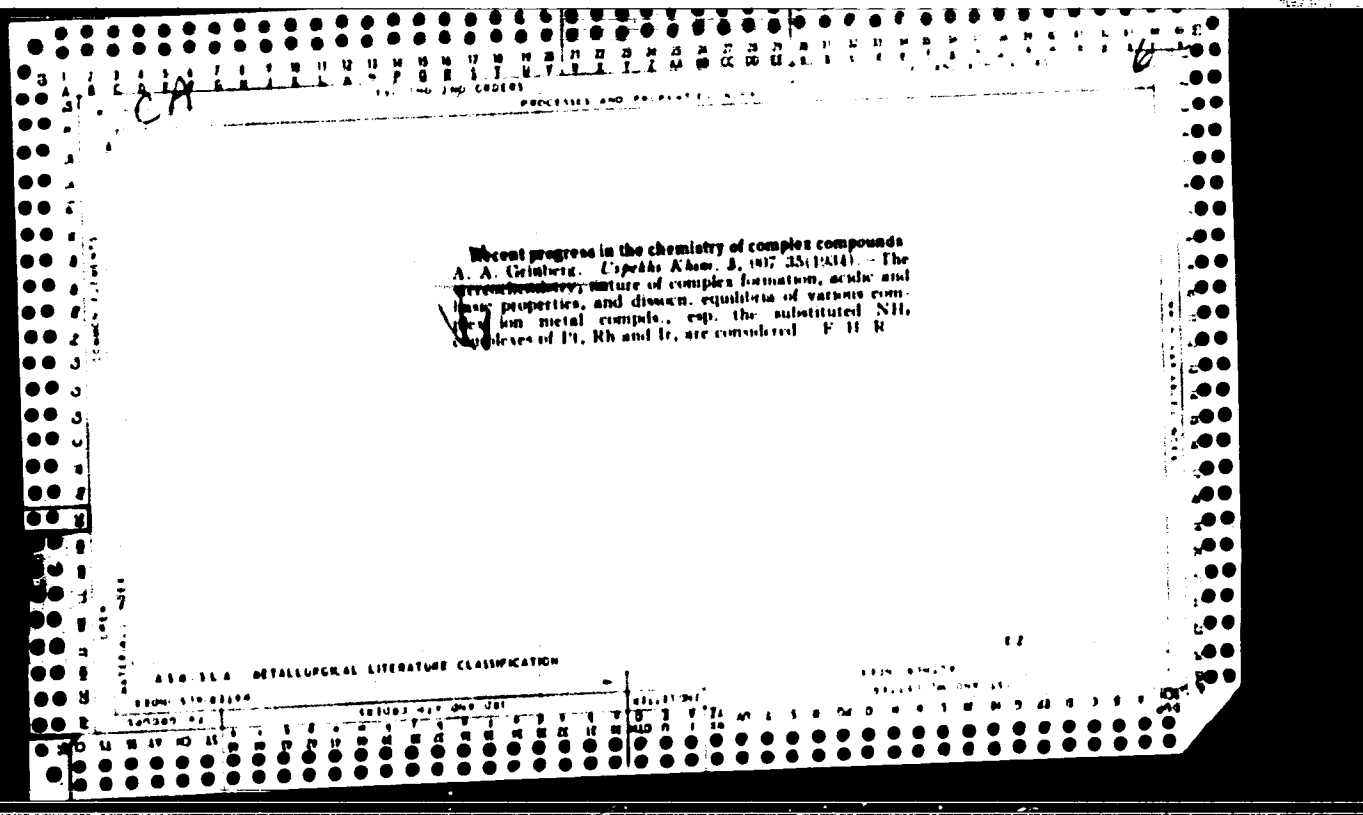
A 50-51.4 METALLURGICAL LITERATURE CLASSIFICATION



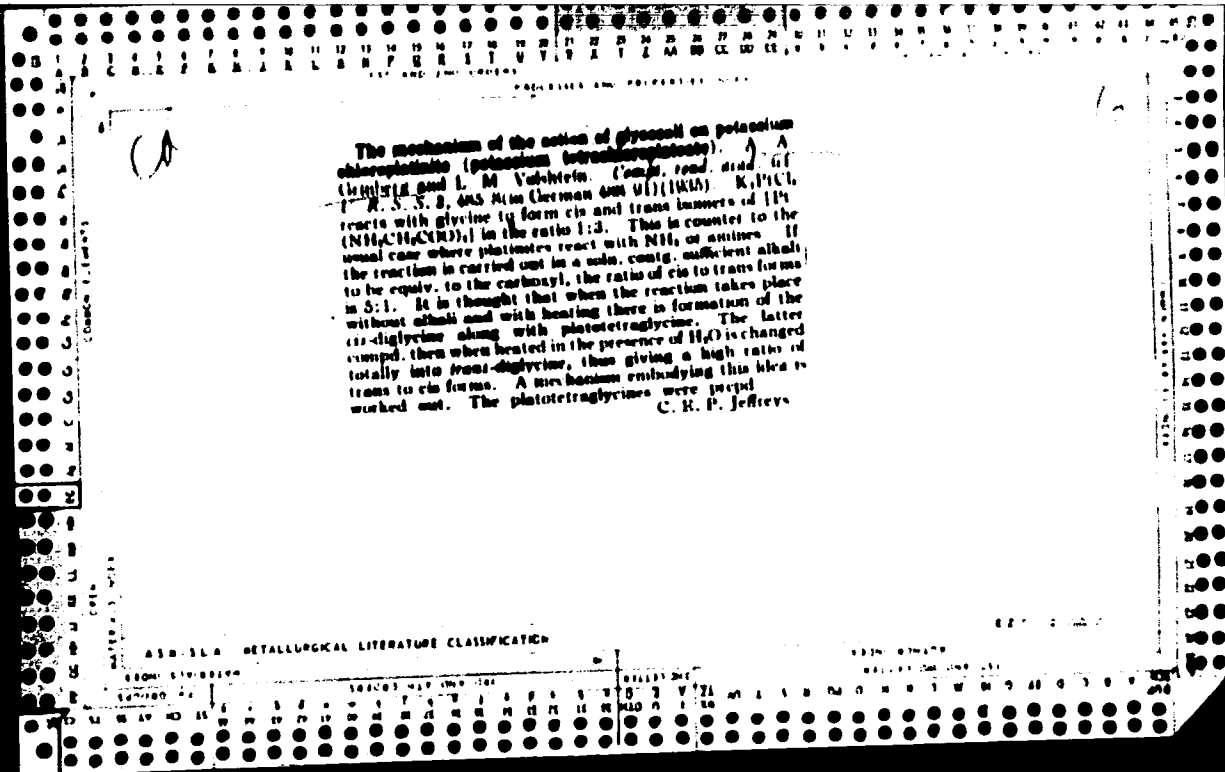
**\*Volumetric Methods of Determining Metals of the Platinum Group.** A. A. Grinberg and B. V. Pizrin (*Doklady Akademii Nauk S.S.S.R. (Compt. rend. Acad. Sci. U.R.S.S., 1968, (N.S.), (6), 284-290).*—[In Russian and French.] Potentiometric titration of Ir<sup>III</sup> salts with KMnO<sub>4</sub> can be applied not only in pure Ir<sup>III</sup> solutions, but also in the presence of Rh<sup>III</sup>, Ir<sup>IV</sup>, Pt<sup>IV</sup>, Fe<sup>III</sup>, and Fe<sup>II</sup> salts. Potentiometric titration of Ir<sup>IV</sup> salts with (NH<sub>4</sub>)<sub>2</sub>FeSO<sub>4</sub> is useful in the presence of Ir<sup>III</sup>, Pt<sup>IV</sup>, Rh<sup>III</sup>, and Fe<sup>III</sup>. Pt<sup>IV</sup> may be determined by reduction to Pt<sup>II</sup> with a solution of Cu<sub>2</sub>Cl<sub>2</sub> in HCl, followed by differential potentiometric titration with KMnO<sub>4</sub> in a current of O<sub>2</sub> in the presence of excess of MnSO<sub>4</sub>. Pt<sup>IV</sup> and Ir<sup>III</sup> may be determined simultaneously by potentiometric titration with KMnO<sub>4</sub>; the presence of Ir<sup>IV</sup> in the solution has no influence on the result.—N. A.

ADP 112 METALLURGICAL LITERATURE CLASSIFICATION










PROCESSES AND PROPERTIES INDEX

2

The strength of geometrical isomeric bases. A. A. Golubov and D. I. Myshchikov. *Acta Physicochim. U. S. S. R.*, 155-72(1954) (in German); cf. *C. A.* 20, 3701<sup>o</sup>.—Colorimetric detn. of *pn* showed that the *trans*-NH<sub>2</sub> OH

base  is more strongly alk. than the *cis*-base, es-

pecially at the higher concns. The alkln. of salts contg. anions capable of forming complexes to solns. of the *trans*-base caused a decided increase in the alk., which decreases in the order I<sup>-</sup>, CNS<sup>-</sup>, Br<sup>-</sup>, Cl<sup>-</sup>, SO<sub>4</sub><sup>2-</sup> and NO<sub>3</sub><sup>-</sup>. The NO<sub>3</sub> ion cannot displace the OH ions, but the reverse reaction [Pt(NH<sub>2</sub>)(NO<sub>3</sub>)<sub>2</sub>] + 2NaOH = [Pt(NH<sub>2</sub>)(OH)<sub>2</sub>] + 2NaNO<sub>3</sub> goes to completion, and the Pt content, detd. by titration with NaOH, checked with the detn. with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> by the method of Grinberg and Pritsyn (*C. A.* 20, 3332<sup>o</sup>). Titration with the glass electrode showed that the first and second hydrolysis of the *trans*-base are very different, with the consts.  $K_1 = 0.53 \times 10^{-7}$  and  $K_2 = 1 \times 10^{-7}$ , resp. The *cis*-base has an av. value of  $0.16 \times 10^{-7}$  for  $K_1$ , but the sep. consts. could not be calcd. The effect of the positions of the OH groups on the properties of these bases is compared to the effect of geometrical isomerism on the acidities of fumaric and maleic acids, resp.

H. R. Rushton

METALLURGICAL LITERATURE CLASSIFICATION

PROCESSING AND PROPERTIES INDEX

(1) APR 1964 (2) 100 AND 1000000

BC

U-1

Nature of the trans-effect. A. GONCHARENKO (Acta Physicochim. U.R.S.S., 1965, 3, 573-582).— Theoretical. In symmetrical complex ions of the type  $MX_6$ , the anions are placed symmetrically around the cation, so that the effect of dipoles induced by reciprocal polarization is neutralized. Substitution of a new anion disturbs the reciprocal polarization, resulting in a dipole in the cation. Trans-effect appears when the central ion has strong polarization properties, and is further influenced by all properties related to polarization. C. R. H.

A 30-31A METALLURGICAL LITERATURE CLASSIFICATION

FROM SOURCE

RECORD STRUCTURE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

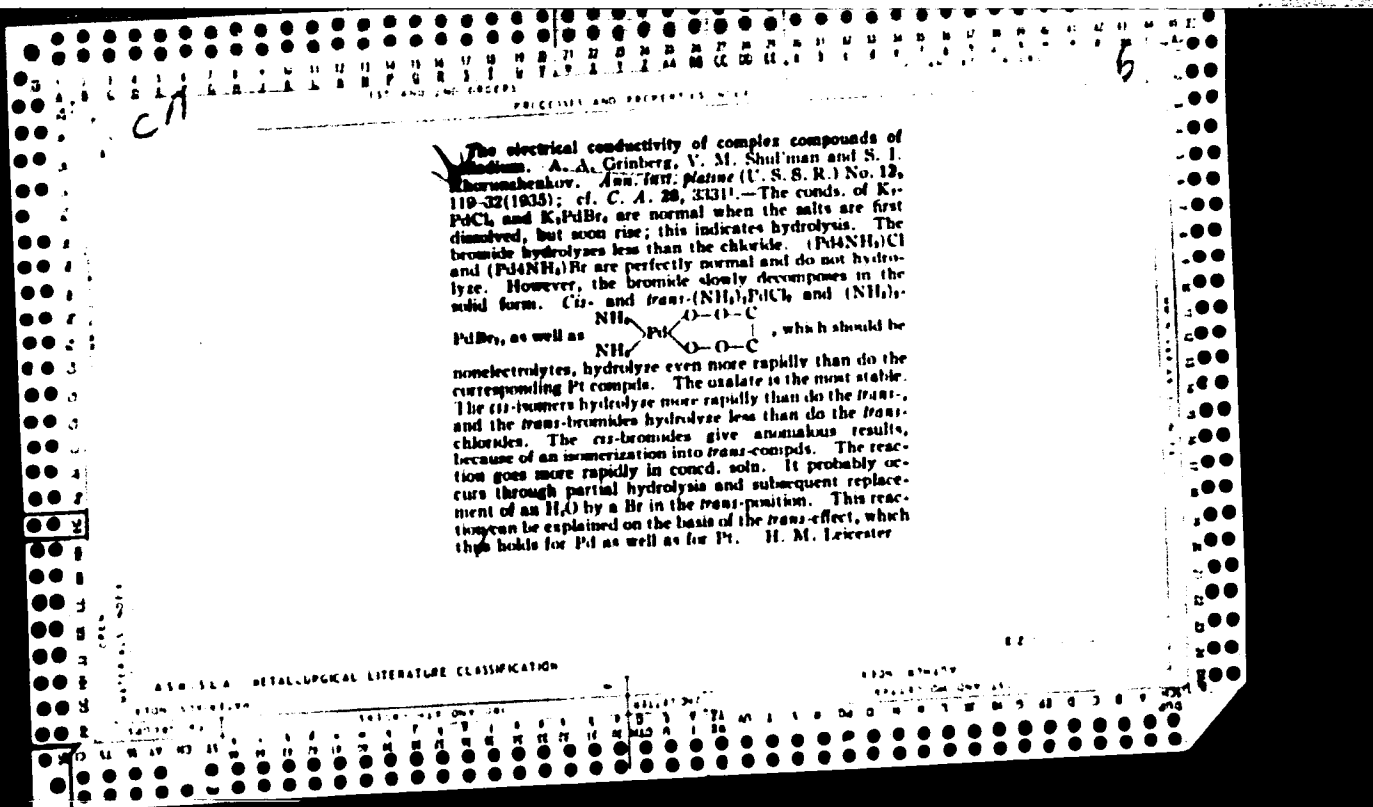
PROCESSED AND PROPERTIES INDEX

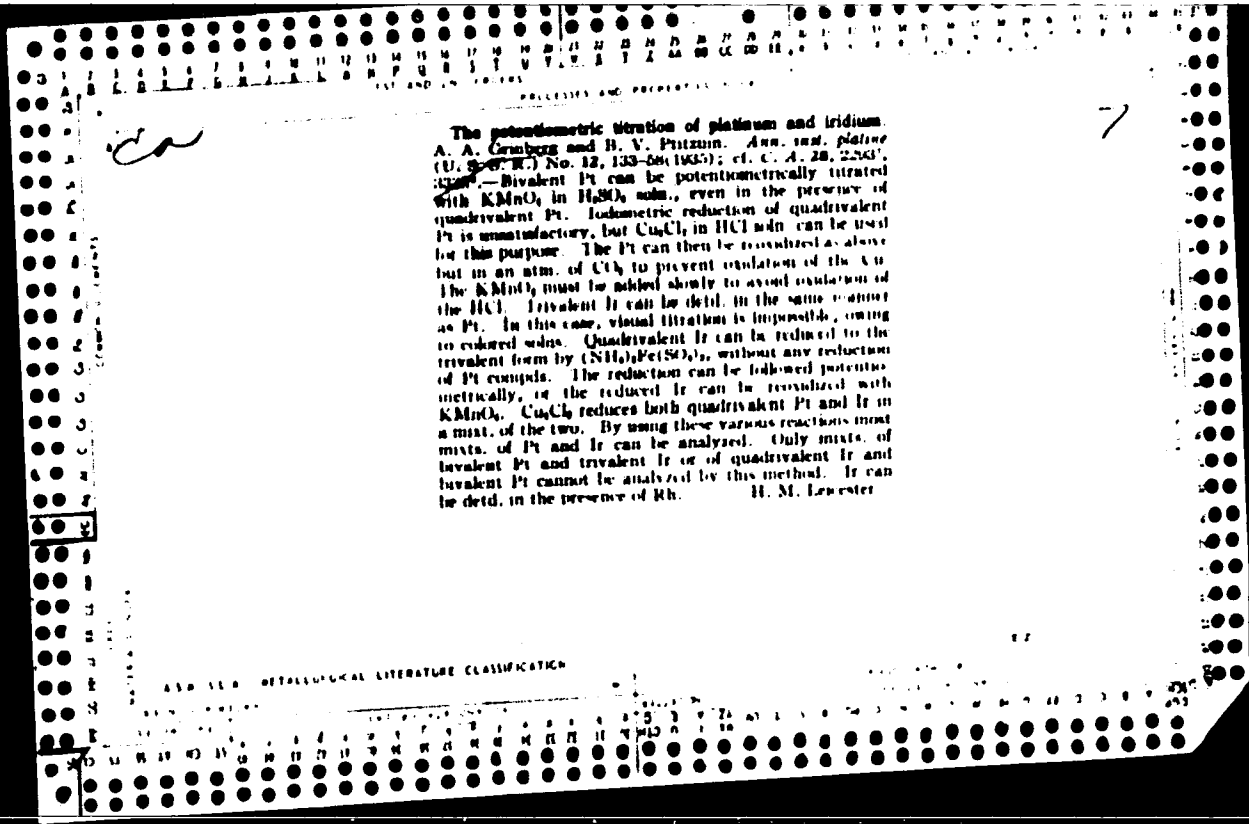
A-1

BC

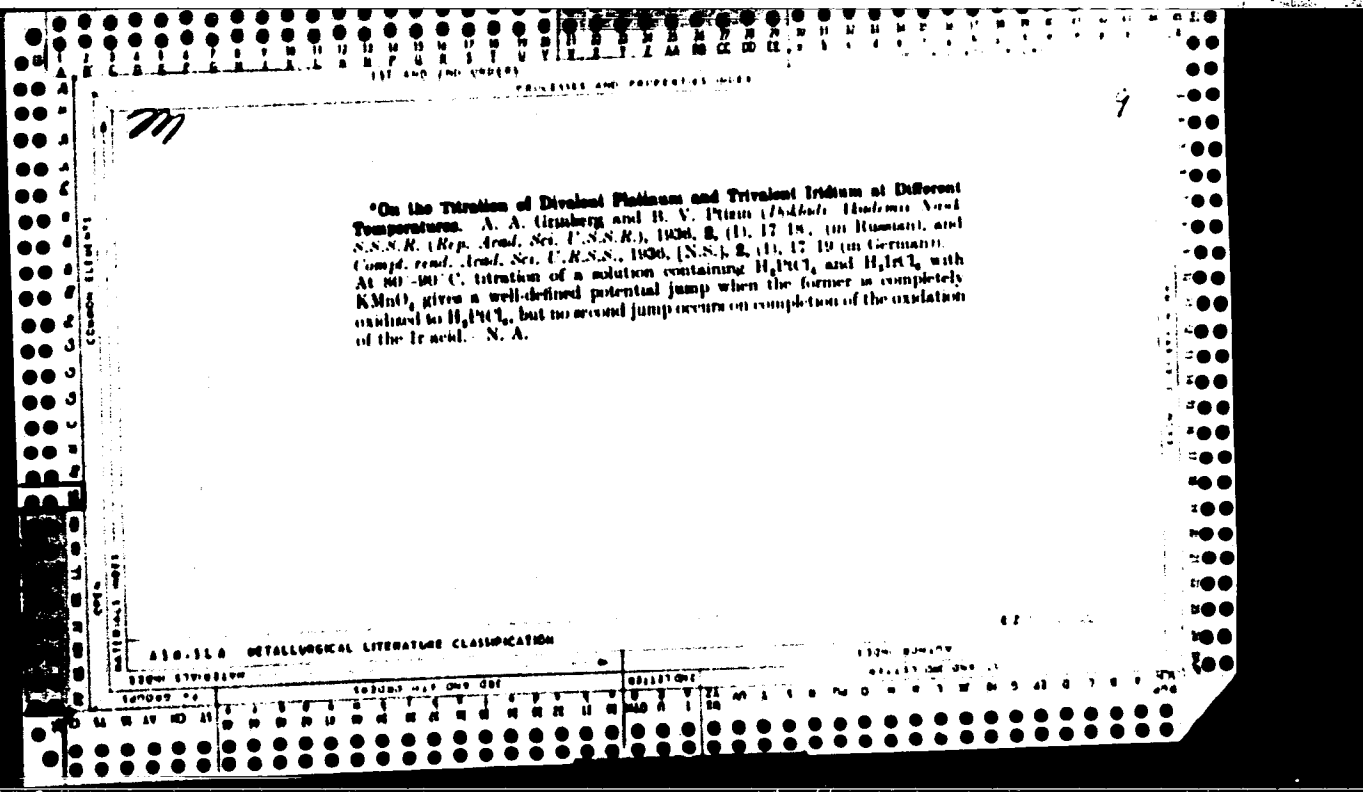
Strength of isomeric bases of the type  $[Pt(NH_3)_4(OH)_2]Cl$ . A. A. GORREDO and D. I. RYABOV (Comp. rend. Acad. Sci. U.R.S.S. 1958, 4, 309-310). Titration of the cis-compound with 0.1N HCl at room temp. gives a colour change with Mo-red when 80% of the theoretical amount of acid has been added owing to the formation of the weak acid  $[Pt(NH_3)_4(H_2O)_2]^{2+}$ . The change  $[Pt(NH_3)_4(H_2O)_2]^{2+} \rightarrow [Pt(NH_3)_4Cl] + 2H_2O$  occurs on warming and the theoretical end-point may be obtained. The trans-compound gives an end-point at room temp. corresponding with 80% of the theoretical amount of acid and this is attributed to the formation of  $[Pt(NH_3)_4(H_2O)(OH)]Cl$ . The final titration val. is obtained on warming. R. S.

ASB-31.4 METALLURGICAL LITERATURE CLASSIFICATION





The potentiometric titration of platinum and iridium.  
A. A. Granberg and B. V. Pritzun. *Ann. inst. platin*  
(U. S. G. P. No. 12, 133-56(1935); cf. C. A. 20, 2563,  
3327. — Divalent Pt can be potentiometrically titrated  
with  $KMnO_4$  in  $H_2SO_4$  soln., even in the presence of  
quadrivalent Pt. Iodometric reduction of quadrivalent  
Pt is unsatisfactory, but  $Cu_2Cl_2$  in HCl soln. can be used  
for this purpose. The Pt can then be reoxidized as above  
but in an atm. of  $Cl_2$  to prevent oxidation of the Au.  
The  $KMnO_4$  must be added slowly to avoid oxidation of  
the HCl. Trivalent Ir can be detd. in the same manner  
as Pt. In this case, visual titration is impossible, owing  
to colored solns. Quadrivalent Ir can be reduced to the  
trivalent form by  $(NH_4)_2Fe(SO_4)_2$ , without any reduction  
of Pt compounds. The reduction can be followed potensio-  
metrically, or the reduced Ir can be reoxidized with  
 $KMnO_4$ .  $Cu_2Cl_2$  reduces both quadrivalent Pt and Ir in  
a mixt. of the two. By using these various reactions most  
mixts. of Pt and Ir can be analyzed. Only mixts. of  
divalent Pt and trivalent Ir or of quadrivalent Ir and  
divalent Pt cannot be analyzed by this method. It can  
be detd. in the presence of Rh. H. M. Leicester



157 AND THE SOURCE PROCESSES AND PROPERTIES METS

9

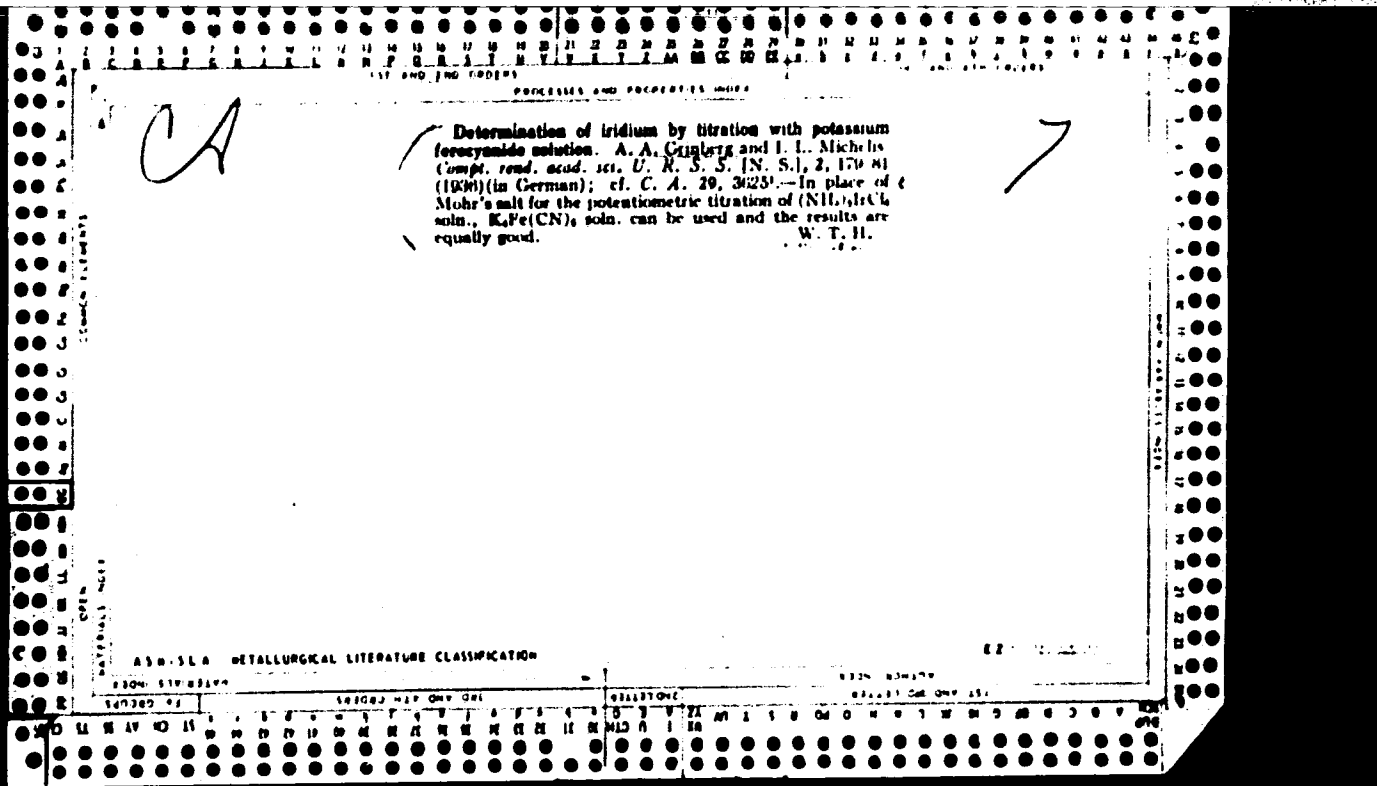
301

Quantitative Determination of Iridium by Titration with Potassium Ferricyanide A. A. Ginzburg and U. I. Mikhlin (*Izvestiya Akademii Nauk S.S.S.R. Ser. Khim. Nauk*, 1939, B, (5), 177-178 (in Russian); and *Compt. Rend. Acad. Sci. U.R.S.S.*, 1939, [N.M.], B, (5), 179-181 (in German)). Ir can be determined potentiometrically by titration of  $H_2IrCl_6$  with  $K_3Fe(CN)_6$  in dilute  $H_2SO_4$  solution. N. A.

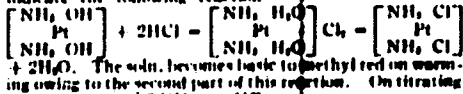
METALLURGICAL LITERATURE CLASSIFICATION

CLASSIFICATION	COLLECTIONS





The strength of the isomeric bases of the type  $[Pt(NH_2)_2(OH)_2]$ . A. A. Grinberg and D. I. Ryabchikov. *Compt rend acad sci U. R. S. S. (N. S.)*, 6, 259 (1966) (in German).—Titration of  $[Pt(NH_2)_2Cl_2]$  with 0.1 N NaOH, with phenolphthalein gave approx. theoretical results from the amt. of Pt. This is attributed to hydrolysis according to the equation  $[Pt(NH_2)_2Cl_2] + 2H_2O = [Pt(NH_2)(OH)_2]Cl + [Pt(NH_2)_2(OH)_2] + 2HCl$ . When a soln. of  $[Pt(NH_2)_2(OH)_2]Cl$  is titrated with 0.1 N HCl in the cold, with methyl red as indicator, the rose color appears after the addn. of 95% of the acid theoretically required. When the soln. is heated, it turns yellow again and can be titrated to 100%. With thymol blue, the soln. can be titrated completely. These results indicate the following reaction



the isomeric base  $\begin{bmatrix} NH_2 & OH \\ | & | \\ Pt \\ | & | \\ OH & NH_2 \end{bmatrix}$  with acid, the rose color appears much earlier than with the *cis*-isomer, and on heating, the yellow color returns and the base can be titrated to completion. This shows that the *trans*-isomer represents a much stronger base and the difference between the first and second hydroxyl is much sharper than in the *cis*-base. This was confirmed by potentiometric titration with a glass electrode. When the *trans*-base is half-titrated in the cold with phenolphthalein or thymol

blue, the complex  $\begin{bmatrix} OH & NH_2 \\ | & | \\ Pt \\ | & | \\ NH_2 & H_2O \end{bmatrix} Cl$  is obtained. This hydrolytic titration can be applied to  $K_2PtCl_6$  in dil. soln. and at the h. p.; otherwise  $Pt(OH)_2$  seps. The color change of the indicator is less pronounced because of the color of the salt.  
R. R. Rushton

AD-554 DETAILORICAL LITERATURE CLASSIFICATION

117 042 120 992811

BC

a 3

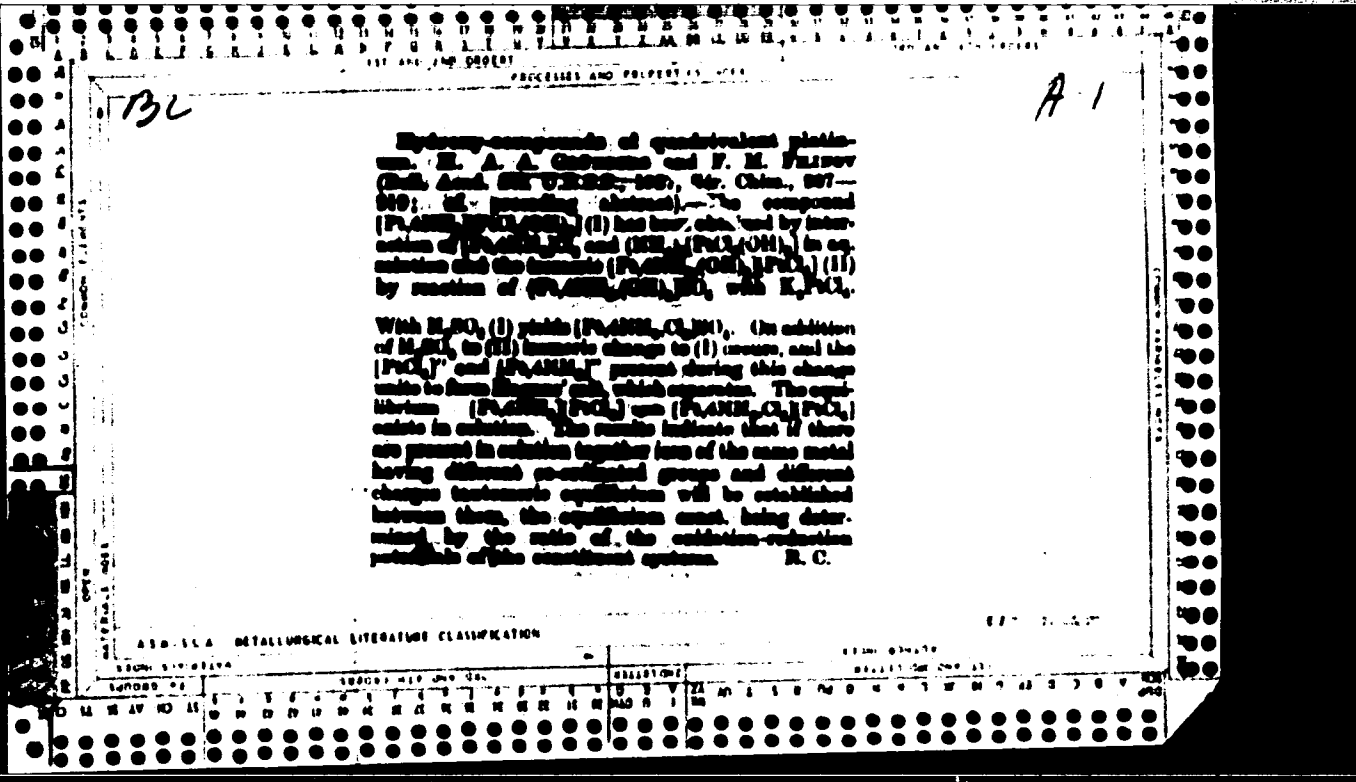
Complex compounds of divalent platinum with glycine. A. A. GORUNOV and I. M. VIKHOREVA. (Dokl. Akad. Nauk S.S.S.R., 1969, 2-84). -K<sub>2</sub>PtCl<sub>4</sub> and glycine (HG) yield K<sub>2</sub>PtCl<sub>4</sub>. From which K<sub>2</sub>PtCl<sub>4</sub>, (HG)<sub>2</sub>PtCl<sub>4</sub>, and Ag<sub>2</sub> with is obtained with HCl or HNO<sub>3</sub>. (I) has mainly octahedral geometry, the anion (I) → [PtCl<sub>2</sub>(HG)]<sup>2-</sup> → [PtCl<sub>2</sub>(HG)]<sup>2-</sup> → [PtCl<sub>2</sub>(HG)]<sup>2-</sup> being obtained by varying the pH of the solution. The salts [Pt(HG)<sub>2</sub>Cl<sub>2</sub>], (HG)<sub>2</sub>PtCl<sub>4</sub>, [PtCl<sub>2</sub>Cl<sub>2</sub>], and [PtCl<sub>2</sub>Cl<sub>2</sub>] are prepared from (I) and the appropriate acids. (I) yields chiefly K<sub>2</sub>PtCl<sub>4</sub> with heating H<sub>2</sub>O, and chiefly from PtCl<sub>2</sub> with (II) HCl. The mechanism of the reaction is discussed. R. T.

ASB-31A METALLURGICAL LITERATURE CLASSIFICATION

CLASSIFICATION	CLASSIFICATION	CLASSIFICATION	CLASSIFICATION

ca  
 6  
**Compounds of bivalent platinum with  $\alpha$ -alanine.**  
 A. A. Grinberg and L. M. Volshtein. *Dokl. Akad. Nauk SSSR*, 1937, 805-808 (in German 903-6); cf. *C. A.* 25, 3563; 27, 1290; 29, 6600; 31, 7361. — Compd. first studied by Ley and Fickon (*C. A.* 9, 207) included those of  $\alpha$ -alanine and glycine. The Pt salt of alanine,  $PtAn_2$ , is obtained in 50% theoretical yield by the reaction:  $K_2PtCl_6 + 2AnH = PtAn_2 + 2KCl + 2HCl$ . The yield could be raised by concn. of filtrate but at the expense of purity. The trans isomer is formed; the cis isomer could not be obtained.  $PtAn_2$  is obtained by adding  $K_2PtCl_6$  to  $AnH$  soln. in  $NaOH$ , heating the mixt. and adding  $H_2SO_4$  and  $KMnO_4$  to the  $(Pt(AnH)_2Cl)_2$  formed.  $PtAn_2$  is very hygroscopic and could not be obtained as a solid. The mixed salt of alanine and glycine,  $PtAnGl$ , is prepd. as follows:  $K_2PtCl_6 + GHI = PtAnGl + KCl + HCl$ .  $GHI$  should be 4 times the theoretical quantity. Yield 75-80% theoretical.  $PtCl_2(AnH)_2$  and  $PtCl_2(AnH)(GHI)$  are obtained at 90% theoretical yield by adding concd.  $HCl$  to  $PtAn_2$  or  $PtAnGl$ .  $(Pt(S-C(NH_2)_2)(AnH)(GHI))Cl_2$  and  $(Pt(S-C(NH_2)_2)(AnH)_2)Cl_2$  are obtained at 65-70% theoretical yield by adding  $S-C(NH_2)_2$  to  $PtCl_2(AnH)(GHI)$  or  $PtCl_2(AnH)_2$ . They are very hygroscopic but after prolonged drying over  $P_2O_5$  are found to contain  $2H_2O$  of crystn.  $PtAn_2(NH_3)_2$  and  $PtAnGl(NH_3)_2$  are obtained by adding  $NH_3$  to  $PtAn_2$  or  $PtAnGl$  at 70-80% theoretical yield. Both are highly sol. in water. V. A. Kainchevsk

ASD 51.6 METALLURGICAL LITERATURE CLASSIFICATION



Reactions between complex compounds of one and the same metal at different valency levels.  
 A. A. Ginzburg and P. M. Puzosov (Dokl. Akad. Nauk SSSR, Div. Chem., 1957, 1243-1244).  
 The equilibrium  $cis- or trans-[Pt(NH_3)_2X_2] + K_2[PtX_4] \rightleftharpoons cis- or trans-[Pt(NH_3)_2X_2] + K_2[PtX_4]$  established in the case X = Cl, Br, CNS, or I; the velocity of the reaction rises in the order given.  
 Compounds of the type  $cis- or trans-[Pt(NH_3)_2X_2][Pt(NH_3)_2X_2]$  (X = Br, I) are also formed in the above reaction.  
 R. T.

450 51A METALLURGICAL LITERATURE CLASSIFICATION

Complex compounds of bivalent platinum with glycine.

A. A. Ginzberg and L. M. Vidalshtein. *Russ. Acad. Sci. Div. Chem. Sci. Div. Math. Nat. Sci. Div. Ser. Chem.* 1959, No. 1, 3-23 (in German 23-41); cf. *C. A. B.* 50, 2049; 51, 2049.

Salts of the type  $M_2Pt(NH_2CH_2COO)_4$  were prepd. by addn. of a excess of a neutral glycine soln. to  $K_2PtCl_4$ . In this manner  $BaPt(NH_2CH_2COO)_4$ ,  $Ag_2Pt(NH_2CH_2COO)_4$ , and the corresponding NH<sub>4</sub> salts were obtained. Theoretical quantities of inorg. acids added to the above salts yield the complex acid  $H_2Pt(NH_2CH_2COO)_4$  in the cryst. state. The latter acid exhibits marked ampholytic properties unlike those of amino acids. A series of salts containing the cation  $[Pt(NH_2CH_2COOH)_4]^{2+}$  is described, among which are  $[Pt(NH_2CH_2COOH)_4](NO_3)_2$ ,  $[Pt(NH_2CH_2COOH)_4]Cl_2$ , and  $[Pt(NH_2CH_2COOH)_4](PtNH_2CH_2COO)_2$ . These salts when treated with HCl undergo a peculiar change in accord with the equation  $[Pt(NH_2CH_2COOH)_4]X_2 \rightarrow 2HX + H_2Pt(NH_2CH_2COO)_4$ . The previously cited bivalent cation behaves as a tetrahedral acid. The values of its acidic dissociation constants are approx. as follows:  $K_1 = 4.08 \cdot 10^{-3}$ ,  $K_2$  between  $4.8 \cdot 10^{-4}$  and  $4.7 \cdot 10^{-4}$ ,  $K_3 = 4.0 \cdot 10^{-8}$  and the lower limit of  $K_4$  is  $10^{-8}$ . Aq. solns. of  $H_2Pt(NH_2CH_2COO)_4$  on warming decomp. quantitatively into *cis*-diglycine (yield, *cis* form 95.0%, and *trans* form 4.5%). On warming with KCl aq. solns. of increasing KCl content the acid undergoes pro-

gressive change with an increasing yield of *trans*-diglycine and a decreasing yield of the *cis* form. The latter change is even more marked when HCl solns. are substituted for KCl. Thus in 6 N HCl, the yield of *trans*-diglycine is quant. With low HCl concns. the action of the latter is entirely catalytic; however, at higher acid concns. its catalytic effect ceases and the Cl<sup>-</sup> detrs. the course of the reaction product. A theoretical interpretation of the transformation of tetraglycine into diglycine derives is also included. W. A. Cook

AS 6 314 DETAIL SUPPLEMENTAL LITERATURE CLASSIFICATION

Ca

7

Interaction of complex compounds of like metals with different degrees of valency. A. A. Gribberg and P. M. Filinov. *Bull. acad. sci. U. R. S. S. Class. sci. math.*, *Ser. Chem.* 1937, No. 5, 1245-52 (in German 1250-4); cf. C. A. 32, 2045. In a pair of ions of a like metal with unlike valencies and coordination groups there are always formed automerous complexes, whose constants are detd. by the correlation of the oxidation-reduction potentials of the corresponding systems (cf. C. A. 31, 3806). A shift of the equilibrium in corresponding direction can take place in a system forming poorly sol. products. On the basis of this theory, the migration processes are considered in the system:  $[Pt(NH_3)_6]^{2+} + [PtCl_4]^{2-} \rightleftharpoons [Pt(NH_3)_5Cl]^{2+} + [PtCl_3]^{-}$ . Proceeding from the known oxidation-reduction potentials of the systems  $[PtCl_4]^{2-} + 2Cl^- \rightleftharpoons [PtCl_6]^{2-} + 2e^-$  and  $[Pt(NH_3)_6]^{2+} + 2e^- \rightleftharpoons [Pt(NH_3)_5Cl]^{2+} + Cl^-$ , the equl. const. is calcd.:  $K = \frac{[Pt(NH_3)_5Cl]^{2+} \cdot [PtCl_3]^{-}}{[Pt(NH_3)_6]^{2+} \cdot [PtCl_4]^{2-}} = 10^{10.2}$  (in 0.1 N HCl at 25°). The migration processes were studied in the systems of the *cis*- and *trans*- $[Pt(NH_3)_2X_4]$  +  $K_2[PtX_6]$  (X = Cl, Br, I and SCN). In all these systems the transposition proceeds by the

formula:  $[Pt(NH_3)_2X_4] + K_2[PtX_6] = [Pt(NH_3)_2X_5] + K_2[PtX_5]$ . Though the oxidation potentials of the haloplatmates decrease in the direction from Cl to I, the conversion velocity of the migration processes of solid systems is greater than that of the chloride systems with the bromides occupying the intermediate position. This is explained by the greater rate of secondary dissociation in the direction Cl-I, according to the formula:  $K_2[PtX_6] + K_2[PtX_4] + X_2 \rightleftharpoons [Pt(NH_3)_2X_5] + K_2[PtX_5]$ . In the systems *trans*- $[Pt(NH_3)_2Br_4] + K_2[PtBr_6]$  and *cis*- $[Pt(NH_3)_2I_4] + K_2[PtI_6]$ , in addition to the normal oxidation products, quimhydrone-like mol. complexes of the compd.  $[Pt(NH_3)_2X_5] \cdot [Pt(NH_3)_2X_6]$  were isolated. The structure of the compds. of this type is being studied. No solid products of the interaction of *cis*- $[Pt(NH_3)_2SCN_4]$  with  $K_2[Pt(SCN)_6]$  could be obtained, though the corresponding *trans* compd. gives the normal oxidation product. Chav. Blanc

ADDITIONAL METALLURGICAL LITERATURE CLASSIFICATION



GRINBERG, H. A.

6

The oxidation-reduction potentials of the compounds of the platinum metals. 1. Oxidation-reduction potentials of the system  $[PtX_2] + 2X + [PtX_4] + 2e$ . A. A. Gombal, J. V. Pilsyn and V. N. Lavrent'ev. *Zh. Fiz. Khim.* 31, 8, 10, 1017 (1957). The oxidation-reduction potential of this system varies very strongly with the nature of the coordinating X ion. With respect to the H<sub>2</sub>/Pt electrode, in 0.01 N solns. of the two Pt salt, and 1 N NaX, the  $E_0$  values at 25° and the heat effects (from temp. coeff.) for various X<sup>-</sup> ions are: Cl<sup>-</sup>, 0.758 v.; Br<sup>-</sup>, 0.681 v.; I<sup>-</sup>, 0.323 v.; SCN<sup>-</sup>. These different values are attributed to the different stabilities of the complex ions.  $K_2PtBr_6$  was prepd. by the action of an excess of hot KBr soln. on  $K_2PtCl_6$  in presence of H<sub>2</sub>O, and then cooling.  $K_2PtBr_6$  was obtained by reduction of  $K_2PtCl_6$  with the calcd. amt. of K<sub>2</sub>C<sub>2</sub>O<sub>4</sub> in presence of Pt black and final recrystn. from EtOH.  $K_2PtI_6$  was prepd. by boiling  $K_2PtCl_6$  with excess KI.  $K_2PtI_6$  was obtained by slightly warming  $K_2PtCl_6$  in an excess of 1 N KI.  $K_2Pt(SCN)_6$  and  $K_2Pt(SCN)_4$  were both prepd. by the action of warm 1 N KSCN on  $K_2PtCl_6$  and  $K_2PtCl_4$ , resp. P. H. Rathmann.

The system CaO-Al<sub>2</sub>O<sub>3</sub>-Fe<sub>2</sub>O<sub>3</sub>. Bonaventura Tavaresi. *Ann. chim. applicata* 27, 245-18 (1937). The system CaO-Al<sub>2</sub>O<sub>3</sub>-Fe<sub>2</sub>O<sub>3</sub> was studied by Hansen, Brownmiller and Bogue (C. A. 22, 1523) who limited themselves to the zone high in CaO. In extending the study T. restudied the binary systems involved (C. A. 30, 845-9; 31, 8147). The presence of a ternary compl. 4CaO·Al<sub>2</sub>O<sub>3</sub>·Fe<sub>2</sub>O<sub>3</sub> confirmed. It is completely miscible with 2CaO·Fe<sub>2</sub>O<sub>3</sub>.

A constituent which was thought to be 4CaO·2Fe<sub>2</sub>O<sub>3</sub> was found to be a mixt. of 2CaO·Fe<sub>2</sub>O<sub>3</sub> and CaO·Fe<sub>2</sub>O<sub>3</sub> conforming Sussman and Merwin (C. A. 10, 2670). A compound 4CaO·2Fe<sub>2</sub>O<sub>3</sub> was identified, whose characteristic property is its complete miscibility with CaO·2Fe<sub>2</sub>O<sub>3</sub>. When heated above 1400°, it decomps. ternary complex being among the products formed. A. W. Cottrell.

Bc

Application of oxidation-reduction potentiometric titration to the determination of the constitution of complex compounds. A. A. (in Russian) and D. I. MAZUREKOV (Ukrainian transl. Acad. Sci. U.S.S.R., 1937, 10, 119-122; cf. A., 1938, 123).--The titration curves for Magnus' green salt in conc.  $H_2SO_4$  and for  $Pt(NH_3)_2Br_2$  with  $KMnO_4$  and  $KBrO_3$  at room temp. and  $80^\circ$  show one break corresponding with the total Pt. The curve for  $[Pt(NH_3)_2][PtBr_4]$  in HCl with  $KBrO_3$  shows one break in the cold, but two at  $80^\circ$  corresponding with the end-points of  $[Pt(NH_3)_2]^{2+}$  and  $[PtBr_4]^{2-}$ . The curve for  $[Pt(NH_3)_2][Pt(CN)_4]$  with  $KMnO_4$  shows breaks at the end-points of  $[Pt(NH_3)_2]^{2+}$  and  $[Pt(CN)_4]^{2-}$ . The curve for the monomeric form  $Pt(NH_3)_2(CN)_2$  shows one break corresponding with the total Pt.

O. D. S.

ASAC 55A METALLURGICAL LITERATURE CLASSIFICATION

