Electronics Research Laboratory
University of California
Berkeley, California
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REPORT OF A VISIT TO EUROPEAN RESEARCH LABORATORIES ACTIVE IN SOLID STATE DEVICE RESEARCH AND OF THE 1964 INTERNATIONAL CONFERENCE ON THE PHYSICS OF SEMICONDUCTORS IN PARIS, FRANCE

by

R. S. Muller

July 29, 1964

ABSTRACT

A survey of the solid-state electronics research presently underway in six European laboratoies is presented, together with a review of the 1964 Conference on the Physics of Semiconductors. Of the laboratories visited, two were government-owned, three were industrial and one was in an institution of higher learning.

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Telefunken A. G.
Fachunterbereich Halbleiter
Heilbronn/Neckar
Germany

At Telefunken, Heilbronn is the advanced development, development and fabrication of solid-state devices.* The most fundamental work at this laboratory is on surface and surface-oxide interface states in Si and Ge and on devices for integrated circuits. Projects in these areas will be described more fully when specific personnel are discussed.

A few words on the production work—the layout and equipment approximate their American counterparts, and one is surprised only because all the girls in the line are speaking German. The highest frequency units made at Heilbronn are Si 50 Mc planar, diffused units. A substantial portion of their work is on Ge units.

The people visited were as follows: Dr. Epple, leader of the Technological Laboratories; Dr. Fritzsche, head of the Research Laboratories; Research Engineers - Dr. Ehlbeck, Dr. Goldbach and Mr. Seiter. The over-all director of the semiconductor department is Dr. Hűhn.

Dr. Ehlbeck is circuits oriented, and is working on MOS structures. The general feeling in Europe seems to be that, although research is still needed on the MOS structure to eliminate long term drift effects, the MOS devices have sufficient circuit applications to warrant this effort.

Dr. Goldbach is the most fundamentally oriented, (except for his boss, Dr. Fritsche) and is engaged in an interesting project aimed at increasing free carrier lifetime near Ge and Si surfaces by monitoring the surface photovoltage in the following manner—A field plate is held

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* Heilbronn is best reached from Stuttgart(about one hour by train).

near the material, and monochromatic light, having energies exceeding the gap energy, is shined through a mechanical chopper onto the surface. (The mechanical chopper is used only to provide an easily detectable ac signal.) The absorption length for the light into the material is a function of wavelength through differing electron transition cross-sections. For the same total quantum flux, one expects the same net carrier concentration to be generated, although the spatial dependence of the generated carriers will be a function of frequency. Thus, any variation in surface photovoltage output is thought to stem from recombination variations owing to the length of the diffusion path between the variable generation point and the space-charge zone. Thus, using published curves of absorption lengths coupled with surface photovoltage measurements, one can calculate recombination times near the surface. This work will soon be published (in Germany) in the Telefunken research journal. Dr. Goldbach heads an optics group with much fine equipment, and also supports other laboratory projects.

Mr. Seiter is new to the laboratory, having come from the Ulm Division (to be described). He was a student of Professor Stőckmann at Karlsruhe and worked with him on Hall effect in thin films. Seiter has made some TFT's in CdS, but his material is not of as high a quality as obtained in our effort at the University of California [$\mu_H \simeq 1$ to 10 cm^2/v sec, μ as obtained from g_m measurements $\simeq 40$ cm^2/v sec]. The output resistance of his TFT's is about 10 KΩ - channel width about 10μ. He achieves the channel width by mask indexing which must be done after the sample is removed from the bell jar. Thus, he has a slow process, and one that allow surface contamination. Telefunken has good mask-making techniques, and has achieved very good-looking definition in their depositions. They use KPR and electrochemical etching of Ni to make these masks. Seiter has noted the drifts in TFT characteristics, and attributes them to surface states, although little work has been done. He has achieved very good oxides by evaporating very slowly through a

Knudsen cell source in an over-pressure of O_2. His final oxides (measured on an ellipsometer) are about 500 Å thick and sustain about 3V. The input resistance at the gate is about 10 MΩ for this thickness of oxide. Seiter has started an effort to make metal base transistors, by all-deposited techniques, but has not made any yet. He also is looking at Schottkey diodes.

Dr. Fritzsche oversees all the research, but has a special interest in materials studies. He has directed work at Heilbronn on GaAs luminescent-source diodes, and Telefunken is marketing these now. Before Telefunken, he was at Leipzig in the East Zone of Germany and published work on CuO rectifiers and ZnS phosphors.

Dr. Epple was at Hoffman semiconductors, El Monte, California, for a year and is farily up-to-date on American technological developments. He acts as support to the other groups on technology.

To sum up, Telefunken receives only company support at Heilbronn, and the work must stay fairly close to development. They keep up with external research, rather than stay ahead.

Telefunken Research Laboratory
Ulm (Donau)
Germany

In Ulm, Telefunken has its major research facility. It is quite a small effort, and includes only about 70 professionals. The work done is still mainly research on vacuum tubes and electron-stream properties. The solid-state work is done by about nine to ten professional people, divided roughly in half between those studying the electronic properties of solids, and those looking at magnetic materials. The head of the electronic properties studies is Dr. H. V. Schuetze and my discussions were with him and with Dr. Hennings.

Schuetze's chief material's research effort has been on sputtered Ta films, and the major result of his efforts has been the achievement of Ta films 1000 to 5000 Å thick which show reproducible resistivity values as high as 0.1Ω cm. This resistivity is achieved by using low sputtering voltages (1000 V), instead of the 4 or 5 KV usually employed. Schuetze's work indicates that the high ρ of the Ta films is a consequence of Ar inclusion in the films. The Ar inclusion can be regulated both by changing the gas pressure, and by monitoring the electrode voltages. More complete details will soon be published in the Proc. IEEE. The method of Ar inclusion permits building resistors having extremely low temperature coefficients of resistance.

The bulk of the other work at Ulm has gone into processing techniques for integrated circuits. In order to produce all Si circuits, Schuetze has an effort which consists of obtaining maximal flatness on wafers. He has found an optimum degree of agitation of the acid bath does exist which will produce pits smaller than 0.1 μ across, and roughly 0.1 μ deep. Standard HF-HNO_3 etchant has been used. Another effort, underway jointly with C. Zeiss (also at Ulm) is aimed at obtaining KPR masks with 1 μ resolution. Schuetze feels that these dimensions are

needed for really high-frequency performance in microcircuits. I was shown pictures with sharp definition in this range. The possible chemical undercutting problems have not yet been studied.

In the area of vacuum, Telefunken has developed a double-chambered system in which all vapor sources are isolated from the main chamber. Evaporation is done through 5mm holes from the source chamber to the substrate chamber. With proper cooling of the chamber walls, Schuetze claims 10^{-9} Torr pressures are obtained in the inner chamber in an all oil, liquid-nitrogen trapped system.

To sum up, Telefunken Ulm has its major effort confined to process studies in support of all Si integrated circuits. The manpower is too small for any large-scale attack on solid state devices, but several practical solutions to important microcircuit problems have been found.

Institute fur Technische Elektronik
Technische Hochschule
Arcisstrasse
Munich, Germany

The Technische Hochschule in Munich is one of the foremost in Germany. It has a total of roughly 8000 students, a large number of them graduates. In the European tradition, it is divided into institutes, each headed by a very influential professor. The Solid State work in Electrical Engineering is done in the Electrotechnical Institute, headed by Dr. M. Knoll. Professor Knoll is well known in the USA for his research on electron optics. He spent ten years (1946-1956) at Princeton University, where he consulted at RCA Laboratories. His personal interest at present is in medial electronics and especially in the induction of brain sensations by electrical stimulation.

Dr. Knoll introduced me to Mr. I. Ruge, who is the individual most concerned with solid-state device research. Mr. Ruge is a doctoral candidate, and a Research Assistant. This designation should not be confused with its usage at UC; Mr. Ruge has all the duties of an Assistant Professor in the United States. Once one has achieved the Diploma, he may become an RA, and take up teaching courses and advising students. His thesis work may take a number of years, during which he and his fellows carry most of the traditional load of the Institute. The very few professors act purely as overseers, and have little contact with any students but the Research Assistants. The assistants also give most of the lectures in the lower division; although only professors are specified as teaching the courses.

The two doctoral candidates working on devices are Mr. Ruge and Mr. Hartl. They have together 15 diploma candidates doing research in the field. The external support comes from the government in Bonn. The current unifying theme to the work is the development of radiation detectors. (At the suggestion of the federal government.)

Mr. Ruge showed me the apparatus (diffusion and alloying furnaces, etc.) which are used to make Li-drifted p.i.n. γ ray detectors. The group has produced 5mm wide intrinisic zones in Si. The new idea which has been developed at Munich is the use of back-biased conventional pn Si junctions in the pre-breakdown region where micro-plasmas are occuring. Research showed that the rate of micro-plasma production will be a linear function of incident γ ray radiation. Thus, the device is a solid-state analogue of a Geiger-Muller tube. The devices built at Munich were sensitive to from 10 to 10^4 R/h radiation. In connection with this device study, research has been extensive into the properties of microplasmas in Si junctions near breakdown.

Mr. Hartl is exploring an interesting α particle detector. It consists of a monitor for the current between a low-level electron beam (lower level than the energy of the electron beam to be detected) striking the outer surface of an anodized Ta film and the Ta sheet, itself. The use of Ta_2O_5 films followed research on deposited oxide film properties. Hartl's results were much poorer with deposited oxides owing to pinholes, etc. In conversation, however, I gained the feeling that the oxide deposition procedures were too primitive for good results. Thus, the superiority of anodized films in his case is not surprising.

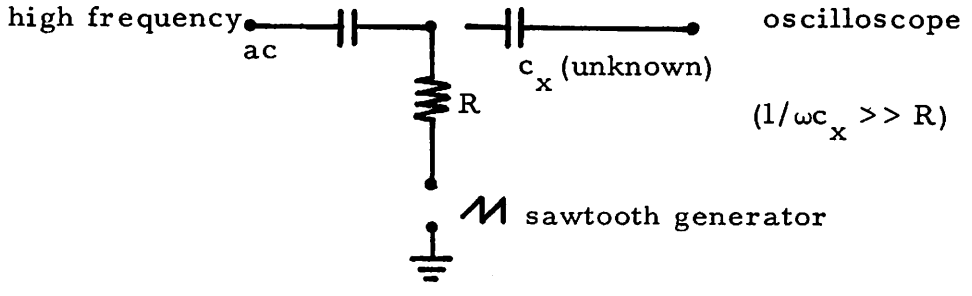
The following are short impressions obtained from my visit. Over-all, the Institute is well equipped; for example a complex electron-spin resonance measuring system from Varian has been purchased for studies of organics subjected to high-energy radiation.....The system of the all-powerful Institute Professor has more drawbacks than virtues (at first glance), and is currently being subjected to a frontal attack by a new organization in the physics area at Munich. A new institute is being formed in experimental solid-state physics, which will have roughly the number of professors that would exist in the US counterpart for an equal number of students. Agreement to this radical scheme was obtained at the insistence of R. Mossbauer when he decided to move from Cal Tech back to Munich. Mossbauer will have no fewer than 16 professors in his institute.

Siemens-Halske
Balanstrasse 73
Munich, Germany

Siemens A. G. is roughly divided into two divisions—one for machinery and high current applications, and the other for communications equipment. The former has its research arm in Erlangen at Siemens Schukertwerke, and the latter's research is concentrated in Munich at Siemens-Halske. This was the division which was visited. The chief of the division concerned with device electronicsis Dr. W. Heywang. The major research in thin-film electronics is done under the direction of Dr. M. Zerbst. Zerbst has been concentrating almost all his efforts on understanding the characteristics of MOS triodes.

Zerbst has been conducting an intensive research program aimed at determining the properties of the oxide - Si surface. Over the past year, he has made a series of experiments with metal-oxide Si capacitors to uncover the significant facts about surface states. These experiments consisted mainly of capacitance and resistance measurements as a function of frequency and dc bias in the manner described by Lehovic (Solid State Elect. 6, p. 536 and in Phys. Status Solidi 3, p. 47).

A simple, but effective circuit used at Siemens to obtain displays of capacitance as a function of dc bias is shown in the accompanying figure.

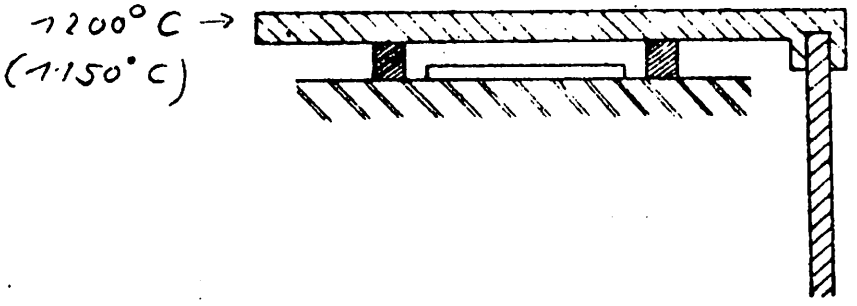


SIEMENS

Epitaxie mit vorhergenender Gasatzung

(S-P-Epitaxie)

Bild a



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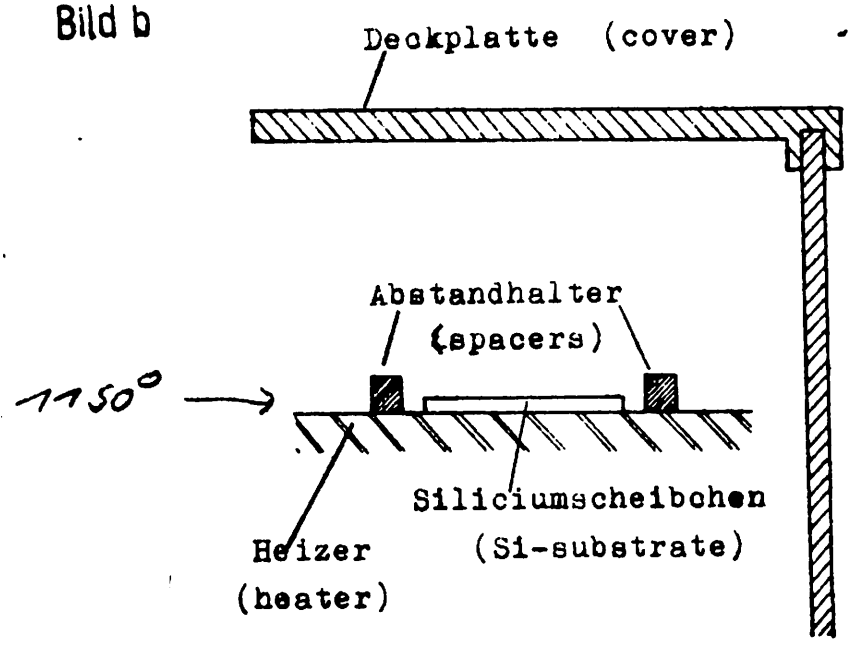

a) Gasätzung (vapor phase etching)

b) Siliciumabscheidung (deposition)

An Hcl vapor-etch technique has been found by Zerbst to produce a clean Si surface, and a minimum number of labile surface states. Superior results are obtained with the vapor-etch technique if a SiC cover plate is brought near to the Si wafer which is to be cleaned. When the cover is heated to a temperature of about 1200°C and the Si is heated to 1150°C and the two pieces in close proximity (as shown in Fig. a), etching of the Si wafer takes place provided $SiCl_4$ and HCl vapors are passed through the chamber. The cover plate becomes coated with Si in this process. If the cover plate is moved (as in Fig. b), Si will grow epitaxially on the wafer. If an oxide is to be grown on the surface, then best results (in terms of low surface-state density) are obtained if the growth proceeds very slowly in a dry ambient.

Laser studies at Siemens are under the direction of Dr. R. Muller, who is active in research on laser modulation techniques. He has shown that broadband modulation (in the GC range) is possible using the effects field-dependent permittivity in substances such as $NH_4H_2PO_4$ (ADP) and KH_2PO_4 (KDP). Other laser work on solid state and gas sources are underway at Siemens-Halske, including GaAs injection-laser mode studies. A good resume of the work of this group has been published in a series of five articles published in the Zeit. Angewandte Physik 17, Band I, p. 1 to 30 (1964).

Physikalisch Technische Institute
Deutsche Akadamie der Wissenschaften zu Berlin
Bereich Elektronische Halbleitern
40/41 Mohrenstrasse
Berlin W8, Germany

(Technical Institute of the German Academy of Science at Berlin, Electronic Semiconductor Division)

The German Adademy of Science is a purely research-oriented arm of the German Federal Republic (eastern puppet regime). Its physical location is in the middle of what in pre-war was downtown Berlin, just three blocks from thehideous wall in the gutted wasteland of East Berlin. It occupies buildings put up in 1951 at the edge of the Hamboldt University medical school. The German Academy of Science is charged with roughly the equivalent work of its free-German counterpart, the Max Planck Institutes. That is, it is not a teaching organization, but rather a government supported research laboratory. Some doctoral candidates do work at the laboratory at a fixed salary, but the research they do will be submitted to a University for the degree. This procedure is general European practice for doctoral study. The Academy is divided into various sections which are dispersed in location. The two sections which do solid-state work in the general area applicable to electronic devices are the Electronic Semiconductors Section and the Electronic Breakdown Section. The East German Government wants to make absolutely certain that no two laboratories are doing the same type of work, as they think that this would be wasteful. As an example of the organizational breakdown, other sections of the Academy, each a separate entity, deal with Electron Microscopy and Lasers. Despite their pure research charter, some sections of the Adademy of Science have, of late, had to do development work for various East German industrial concerns. These concerns have very little research capability, and are so strictly regulated in their use of funds that they may not begin to build one.

Technical discussions were mainly with Dr. G. O. Müller (no relation to the author) and with Drs. C. Vogel, A. Schnürer and F. Eckart. All of these people appeared to very capable technically.

Dr. Müller told me that CdS, Se, Si, InSb GaAs and SiC were the only materials studied in detail at present. The group has had much experience with CdS in single crystal form and is lately at work on CdS films. Dr. Müller was certain that two-carrier space-charge-limited currents have been observed at his laboratory in thin CdS crystals with Al and Au contacts. He says that Diemer at Phillips has done theoretical work that makes such a Schottky barrier device a distinct possibility for a new type of laser. To support this view, Müller showed me data which indicated that green emission of high intensity has occured in 5μ thick CdS diodes at only 1.4 V forward bias. Emission at such a low bias is impossible to explain by other mechanisms than direct bimolecular recombination; hence, two-carrier-space-charge-limited currents must be present.

Müller has also done experiments which have indicated that hole lifetimes in CdS in the μ sec range are possible. Lifetimes in this very long range were obtained in materials subjected to very heavy illumination with optical photons. These are certainly the longest hole lifetimes reported by anyone for CdS.

One problem which Dr. Müller pointed out to be in need of solution about SCLC in solids is the influence of band-bending at a blocking contact on the Rose theory of volume-distributed trap influence on SCLC. This problem is difficult mathematically, but should be amenable to computer solution. A solution would have important practical application.

Other work going on is the evolution of a crystal growth theory for II-VI compounds. The original idea to explain the presence of platelets in II-VI's grown from the vapor was to postulate screw dislocations as being growth sites according to the theory of Slater.

However, an etch technique evolved at Berlin to exhibit screw dislocations has failed to show any appreciable screw dislocation density.* Hence, some new growth theory must be found.

Dr. Schnurer has done some fine work using x ray studies to determine the term density in the conduction band of CdS. He has also looked at surface photovoltage in CdS. Other work going on includes observations on SiC light emission. This, however, has only begun.

At the Electrical Breakdown Section, Dr. H. Berger has worked for sometime on deposited CdS films, and now uses a system of evaporation very similar to the one used here at UC. Berger has seen similar Hall mobility behavior to that observed here, and has a model for it similar in mathematics to Petritz's, but it is not completely formulated and fails to match all the data we have taken in our own laboratories.

Short Notes: The laboratory has many difficulties not faced by us in America. As an example, no instrument equivalent to the Hewlett Packard 425 A exists there, so an electrometer had to be built by the personnel themselves...The East Germans appear to have copied Tektronix scopes almost exactly and get roughly the same performance from them... The only semiconductor factory in East Germany appears to be one located in Frankfurt/Oder.

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* The etchant is a solution of $CdCl_2$ in HCl.

General Post Office Research Laboratories
Brook Road
Dollis Hill
London NW2, England

Since England's post office is responsible for all communication systems in the country, the Post Office Research Laboratory (GPO) is in some ways the equivalent of Bell Laboratories in the USA. It is, of course, smaller than BTL (1500 on the staff), and has very little connection with the military. Work for the military in England is done rather at establishments such as Royal Radar at Malvern which works only on defense projects. There is an appreciable capability in physical chemistry at GPO, and a small staff at work on over-all device electronics. The people contacted were the following: Drs. M. F. Holmes, J. I. Carasso, M. M. Faktor, G. R. Newns, D. C. Shotter, I. W. Stanley and F. H. Reynolds. Most of these people work under the direction of Dr. Tillman, whose current research is chiefly on II-VI compound preparations, especially CdS.

In the device area, a very capable group under the direction of M. Holmes has begun looking at thin film electronics. This is the same group which has worked for years on electronic elements for submarine cables. They developed long life vacuum-tube units for many of the cables now in operation. In tubes for submerged repeaters, these people think that present achievements of gain and useful lifetime are about as good as can be expected, and that further progress is most likely in solid state devices. Even greater reliability will be needed for solid-state amplifiers than for vacuum tubes, however, if one must accept the inherently low input impedance obtainable with bipolar transistor amplifiers. This is a fact because redundancy in function by virtue of paralleling has been practiced in submarine amplifiers, thus reducing unit reliability demands. Nonetheless, the group thinks that even bipolar transistors are on the verge of being acceptable.

Surprising to the author was the fact that aging limits in transistors appear to stem from in-diffusion of Au over long periods of time; the gold coming from the bonded wires. The gold acts to reduce base lifetime, and thereby to reduce gain. For this reason, Holme's group has developed an all aluminum thermocompression bond which has a different geometry from those prevalent in the industry.

The laboratory has also developed an electropolishing technique for obtaining Si surfaces which are flat to within .01 μ. This procedure is expected to yield superior performance in integrated circuits and is completely described in an available publication. New devices being looked at are chiefly the metal base transistor and thin film hot-electron amplifier, although F. H. Reynolds, in charge of this aspect of the work, has not gone very far as yet.

Interesting work on the development of stable oxides of germanium which might lead to a Ge planar technology similar to that available for Si is now underway at GPO under the direction of J. Carasso and M. Faktor. A loose, hexagonal-structured GeO_2 is easy to form, but it is porous and water soluble, and therefore unsuitable as a masking agent. Faktor is working on a catalytic reaction to convert the hexagonal form to the tetragonal close-structured GeO_2 which is soluble only in strong NaOH. The group felt very encouraged in their efforts, and have already found methods to succeed in their aim which are only slightly outside acceptable limits of treatment of the Ge from a solid diffusion point of view.

Fundamental studies of the growth mechanisms of II-VI compounds and of the basic properties of CdS films and crystals are being conducted by G. R. Newns and by I. W. Stanley. Stanley has done Hall measurements on CdS thin films which corroborate the results reported in our laboratory at UC, and at the RCA Research Laboratories.

CONFERENCE ON THE PHYSICS OF SEMICONDUCTORS

The 1964 International Conference on the Physics of Semiconductors consisted of sixteen separate sessions in which 133 papers were delivered and another 46 papers were read by title. In addition, eight invited lectures were given which surveyed various fields in detail.

A quick and approximate count showed that 75 papers in the regular sessions, one of which was the author's, were submitted from the United States, 24 came from Russia, 18 were from France, 16 from England, 12 from Japan, 9 from Poland, 8 from the Netherlands, and 7 from West Germany. All other countries were represented by less than seven papers. All papers will be published in full in a bound volume to appear about January of 1965.

Also associated with the conference were three specialized symposia on Plasma Effects in Solids, Radiation Damage in Semiconductors and Radiative Recombination in Semiconductors. In these symposia, there were 14 lectures and 93 short presentations. Since a complete set of printed abstracts is available and the full papers will be published this fall, details of the presentations will not be given. Rather some further statistical data will attempt to assess the topics which were considered, and in this manner the interests of solid-state research scientists around the world.

To survey the scope of the reported experimental work on materials, it may be of interest to consider the division of papers among the various solids. The following table indicates roughly the number of papers dealing with the properties of a specific substance.

Subjects of Papers at the 1964 International Conference on the Physics of Semiconductors

Material	No. of Papers
Ge	33
Si	27
GaAs	24
InSb	17
CdS	10
SiC	5
II-VI's *	37
III-V's *	12
Other Materials**	25

In the main meeting, the papers at six sessions were devoted to electronic transport phenomena, two sessions were on optical phenomena, two on semiconducting materials, and one each on magneto-optical effects, band theory, impurities in semiconductors, photon-phonon interactions, excitors and photoconductivity. The program for the meeting is reproduced on the following pages.

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* Among the "other materials," Bi, diamond and Te all were discussed more than once.

** Other than materials specifically mentioned in the Table.

10 a.m. **OPENING SESSION - CHAIRMAN : P. AIGRAIN - OFFICIAL OPENING ADDRESSES**

11 a.m. **REPORT ON THE SYMPOSIUM ON RADIATIVE RECOMBINATION : H. EHRENREICH**

2 p.m. **INTRODUCTORY LECTURE ON TRANSPORT PHENOMENA : L. SOSNOWSKI**

2.30 SESSION ON TRANSPORT PHENOMENA I
CHAIRMAN : B. VUL

to be presented

T1-1 Some general consideration on the Hall constant. **R. KUBO**

T1-2 Theory of mobility and the Hall effect allowing for the field of charged impurity ions. **S.I. PEKAR**

T1-3 Transport properties of highly-doped oxidic semiconductors. **R.R. HEIKES, R.C. MILLER, B. KAGLE, R.W. URE, Jr**

T1-4 Strong field galvanomagnetic effects in n-type germanium. **L.J. NEURINGER**

T1-5 Longitudinal magnetoresistance of heavily doped n-Ge in high magnetic fields. **I.M. TSIDILKOVSKI, V.I. SOKOLOV**

T1-6 Transition of the anisotropy laws of galvanomagnetic effects in p-type silicon. **H. MIYAZAWA, H. MAEDA, K. SUZUKI**

T1-7 Electronic transport in heavily doped GeSi alloys. **A. AMITH.**

T1-8 The scattering of electrons in heavily-doped germanium **V.I. FISTUL, E.M. OMELYANOVSKY, D.G. ANDRIANOV, I.V. DAHOVSKY**

to be read by title

T1-9 The rigorous theory of p-n-junctions. **A. NUSSBAUM**

T1-10 Neutrality principal in excess carrier transport equations. **S. SIKORSKI**

T1-11 Modèle pour un semiconducteur ferromagnetique. **D. CALECKI**

T1-12 Théorie des diodes Esaki et des phénomènes physiques régissant leur fonctionnement aux très basses températures. **P. ANDRE**

2.30 SESSION ON OPTICAL PROPERTIES I
(Absorption on free carriers)
CHAIRMAN : R.A. SMITH

to be presented

O1-1 Optical non-linearities of III-V semiconductors **N. BLOEMBERGEN, R.K. CHANG, J. DUCUING, P. LALLEMAND**

O1-2 Influence of uniaxial stress on intervalence band transitions in germanium. **G.S. HOBSON, E.G.S. PAIGE**

O1-3 Effects of temperature and high electric field on the free carrier absorption by light holes in germanium **A.C. BAYNHAM, E.G.S. PAIGE**

O1-4 Free-carrier birefringence and dichroism in semiconductors. **G.P. SOARDO, J.K. FURDYNA**

O1-5 Electron-scattering in InSb at optical frequencies **F.R. KESSLER, E. SUTTER**

O1-6 Theory of absorption of electromagnetic radiation by hopping process in semiconductors. **J. BLINOWSKI, J. MYCIELSKI**

O1-7 Determination of effective masses from field-induced shift of the absorption edge. **E. GUTSCHE, H. LANGE**

O1-8 Field induced shift of the optical absorption edge of germanium in the space charge region of a p-n juction. **A. FROVA, P. HANDLER**

to be read by title

O1-10 Influence of uniaxial stress on the optical properties of CdSe. **M. GRYNBERG**

O1-11 The effect of an electric field on the reflectivity of germanium. **B.O. SERAPHIN**

5 p.m. **INTRODUCTORY LECTURE ON MAGNETO-OPTICAL EFFECTS : B. LAX**

8.30 SESSION ON MAGNETO OPTICAL EFFECTS
CHAIRMAN : E. BURSTEIN

to be presented

MO-1 Free carrier and interband Faraday rotation in gallium antimonide and gallium arsenide. **H. PILLER**

MO-2 The effect of uniaxial strain on Faraday rotation in Ge and InSb. **T. ARAI, C.J. SUMMERS, C.R. PIDGEON, S.D. SMITH**

MO-3 The anisotropic Voigt effect in cubic semiconductors **B. DONOVAN, J. WEBSTER**

MO-4 Microwave feee carrier Faraday and Voigt effects **A. BOUWKNEGT, J. VOLGER**

MO-5 Effet Faraday du tellure. **C. RIGAUX et J.L. CALLIES**

MO-6 The electron effective mass in hexagonal silicon carbide determined from infra-red Faraday rotation **T.S. MOSS, B. ELLIS**

MO-7 Absorption edge of CdS in a strong magnetic field **A. MISU, K. AOYAGI, G. KUWABARA, S. SUGANO**

MO-8 Magneto-optical band studies of epitaxial PbSe. **D.L. MITCHELL, E.D. PALIK, J.N. ZEMEL**

to be read by title

MO-9 Perturbation theoretical approach to magneto-optical phenomena in the non-absorbing région. **A. NEDOLUHA**

MO-11 Microwave galvanomagnetic measurements in semiconducting powders. **J.K. FURDYNA**

8.30 SESSION ON TRANSPORT PHENOMENA II
CHAIRMAN : A. GIBSON

to be presented

T2-5 Warm and hot-electron effects in silicon and germanium **M.H. JORGENSEN, N.I. MEYER, K.J. SCHMIDT-TIEDEMANN**

T2-6 Role of optical phonon interactions of hot carriers in p-type germanium. **R. BRAY, W.E. PINSON, D.M. BROWN**

T2-2 Anisotropie et piezoresistance des électrons chauds **J.P. MOREAU**

T2-4 Hot electrons in the zero point scattering limit. **F. BUDD**

T2-3 Hot electron effects and photoconductivity in InSb **E. H. PUTLEY**

T2-1 Measurement of the temperature of hot electrons in In Sb by electron spin resonance. **M. GUERON**

T2-8 Disturbance of phonon distribution by hot electrons in n-type indium antimonide. **A. ZYLBERSZTEJN**

T2-7 The conductivity of a degenerated semiconductor in a strong electric field. **V.A. CHUENKOV**

9 a.m. **INTRODUCTORY LECTURE ON BAND THEORY : F. HERMAN**

9.30 **SESSION ON BAND THEORY**
CHAIRMAN : W. KOHN

to be presented

B-1 Relativistic effects and the band structure of PbTe **G.W. PRATT Jr.**

B-2 Energy bands in PbTe. **L. KLEINMAN, PAY JUNE LIN**

B-3 Band structure of gray tin. **S. GROVES, W. PAUL**

B-4 Band edge structure of PbS, PbSe and PbTe **J.O. DIMMOCK, G.B. WRIGHT**

B-5 Theory of the imperfect crystal at higher concentrations using double time Green's functions. **D.W. TAYLOR**

B-6 On the irreversible thermodynamic theory of recombination and g-r noise in case of multielectron centers with may excited states. **G. PATAKI**

B-7 Magnetic properties of free carriers in non-parabolic and non-spherical energy bands. **W. ZAWADZKI**

B-8 Quantum theory of the valence band structure of germanium in external electric and magnetic fields. **T. SHINDO**

to be read by title

B-9 Crystal momentum theorem in the (n+1) - electron band theory of insulators. **H. HASEGAWA**

B-10 Cyclotron resonance of electrons in uniaxially stressed silicon. Energy bands near X in the diamond structure **J.C. HENSEL, H. HASEGAWA**

B-11 Electronic energy bands in $SrTiO_3$ and related oxide semiconductors. **A.H. KAHN, A.J. LEYENDECKER**

9.30 **SESSION ON TRANSPORT PHENOMENA III**
CHAIRMAN : W. SHOCKLEY

to be presented

T3-1 Phonon drag effect in hot electron problems **I. YAMASHITA**

T3-2 Investigation of Ge doped by Au in high electric fields **V.P. SONDAYEVSKY, I.I. KARAKUSHAN, V.I. STAFEEV.**

T3-3 Hot electron and negative resistance effects at 20°K in n-type germanium containing gold. **B.K. RIDLEY, R.G. PRATT**

T3-4 Theory of the negative resistance in p-i-n diodes. **W.P. DUMKE**

T3-5 Space - charge limited current in germanium **A. SHUMKA, M.-A. NICOLET**

T3-6 The growth of fluctuations and non-linear effects in the case of acoustical instability of semiconductors **V.L. GUREVICH, V.D. KAGAN, B.D. LAICHTMAN**

T3-7 Acoustoelectric effect in piezoelectric semiconductors. **H.N. LEIFER, A.I. CARLSON**

T3-8 Propriétés piézoélectriques du tellure **G. QUENTIN J.M. THUILLIER**

P-6 E Correlation of the temperature dependence of acoustoelectric current saturation in CdS with Hall measurements. **A.R. MOORE, R.W. SMITH**

to be read by title

T3-9 Bulk negative resistance effects in GaAs. **A.I. CARLSON, H.N. LEIFER**

T3-10 Lifetimes of nonequilibrium carriers in magnetic traps **B. ANCKER-JOHNSON, M.F. BERG**

T3-11 The drift of carriers from a narrow region of ionization in an insulator. **P.N. KEATING, A.C. PAPADAKIS**

2 p.m. **INTRODUCTORY LECTURE ON IMPURITY - EXCITON INTERACTIONS**

Optical Properties of bound excitons : J. J. HOPFIELD

2.30 **SESSION ON IMPURITIES IN SEMICONDUCTORS**
CHAIRMAN : H. BROOKS

to be presented

I-1 Some problems of paramagnetic resonance of local centres on semiconductors. **M.F. DEIGEN, V.Y. ZEVIN, V.M. MAYEVSKY, A.B. ROITSIN**

I-2 Energy levels and transition probabilities of donor acceptor pairs in semiconductors. **J. SHAFFER, F. WILLIAMS**

I-3 Electron paramagnetic resonance and electrical resistivity of boron carbide. **D. GEIST**

I-4 Theory of shallow impurity states for subsidiary valleys **G.A. PETERSON**

I-5 Combined resonance on impurity centres and in inhomogeneous magnetic fields. **S.I. PEKAR, E.I. RASHA, V.L. SHEKA**

I-6 On the theory of impurity levels. **G. CIOBANU**

I-7 Energy levels of transition metal impurities in semiconductors. **J.W. ALLEN**

I-8 The relaxation time and the width of the spin resonance line in semiconductors with degenerate bands **G.L. BIR, G.E. PIKUS**

to be read by title

I-9 Infrared absorption of copper impurities in II-VI semiconducting compounds. **E. DIETZ, H. KAMIMURA**

I-10 Influence of counterdoping on the distribution of Mn over substitutional and interstitial sites in Ge. **F.N. HOOGE**

I-11 Effect of uniaxial stress on the excitation spectra of donors in silicon. **R.L. AGGARWAL, A.K. RAMDAS**

I-12 Auger effect involving recombination centres **P.T. LANDSBERG, D.A. EVANS, C. RHYS-ROBERTS**

I-13 Properties of germanium in indium antimonide **W.M. BULLIS, V. HARRAP**

I-14 Impurity ionization parameters from thermal data **W.W. HARVEY**

2.30 **SESSION ON TRANSPORT PHENOMENA IV**
CHAIRMAN : V.L. BONCH-BRUEVICH

to be presented

T4-1 Pressure dependence of phonon assisted interband tunneling. **H. FRITZSCHE**

T4-2 Piezoresistance and piezo - Hall effect in bismuth **A.L. JAIN, R. JAGGI.**

T4-3 The effect of uniaxial strain on the transport phenomena in p-Si **G.L. BIR, A.I. BLOOM, U.V. ILISAVSKY**

T4-4 Piezoresistance of N-type Mg, Si **W.B. WHITTEN, G.C. DANIELSON**

T4-5 Stress induced donor deionization in GaAs **R.J. SLADEK**

T4-6 The influence of very strong point mechanical stresses on electrical properties of silicon. **J. SWIDERSKI**

T4-7 Defects induced by electron recombination in p-type GaAs. **R.L. ANDERSON**

T4-8 Formation and properties of impurity band in GaAs, InAs and InP. **D.N. NASLEDOV**

to be read by title

T4-9 Effect of hydrostatic pressure on Hall coefficient and resistivity of n and p type Bi_2Te_3. **A. SAGAR, R.W. URE**

T4-10 Equilibrium space charge : trap modification **L. GOLD**

T4-11 Admittance variation with frequency in insulators having traps subject to charge injection. **R.S. MULLER**

9 a.m. **INTRODUCTION LECTURE ON PHOTON - PHONON INTERACTIONS : M BALKANSKI**

9.30 SESSION ON PHOTON - PHONON INTERACTIONS
CHAIRMAN : R.F. WALLIS

to be presented

PP-2 Raman scattering and impurity absorption by the lattice of homopolar crystals
L.E. GUREVITCH, I.P. IPATOVA, A.A. KLOTCHIHIN

PP-4 Vibrational absorption of impurities in semiconductors
J.F. ANGRESS, T. ARAI, A.R. GOODWIN, S.T. SMITH

PP-7 The fundamental infrared lattice vibration spectra of GaAs **S. IWASA, I. BALSLEV, E. BURSTEIN**

PP-3 Far infrared absoption in PbS. **J.N. ZEMEL**

PP-5 Infrared lattice vibration spectra of magnesium stanide. **A. KAHAN H.G. LIPSON, E.V. LOEWENSTEIN**

PP-1 Critical point analysis of the phonon spectra of diamond, silicon and germanium. **R. LOUDON, F.A. JOHNSON**

PP-6 Infrared spectral emittance of indium phosphide
D.L. STIERWALT, R.F. POTTER

PP-8 Multiphonon infrared absorption in II-VI semiconductors. **S.S. MITRA, R. MARSHALL**

to be read by title

P-6 Reststrahlen frequencies for mixed Ga AS, Sb_x system.
R.F. POTTER, D.L. STIERWALT

PP-9 Modes couples dans le CdS dans l'infrarouge lointain
M. BALKANSKI, M. BESSON, R. LE TOULLEC

PP-10 Optical properties of transition metal oxides
R. MARSHALL, S.S. MITRA, P.J. GIELISSE, J.N. PLENDL

PP-11 Optically active lattice vibrations in NiF,
M. BALKANSKI, P. MOCH and G. PARISOT

9.30 SESSION ON SEMICONDUCTING MATERIALS I
CHAIRMAN : D.N. NASLEDOV

to be presented

M1-1 Electrical properties of binary transition metal compounds. **W. ALBERS**

M1-2 Semiconducting low carrier mobility manganites with spinelle structure. **M. ROSENBERG, P. NICOLAU**

M1-3 Magnon-drag, spin-disorder scattering and anomalous behaviour of the Hall constant in antiferromagnetic MnTe. **J.D. WASSCHER, A.M.J.H. SEUTER, C. HAAS**

M1-4 The conductivity and bandstructure of hexagonal selenium. **H. GOBRECHT, A. TAUSEND**

M1-5 Preparation and investigation of A III B VI single crysta
G.A. AKHUNDOV, GB. ABDULLAYEV, G.D. GUSEINOV, K.F. MECKHTIEV, M. Kh. ALIYEVA

M1-6 Some electrical transport studies of CdF,
J.S. PRENER, H.H. WOODBURY

M1-7 Conductivity of reduced rutile at low temperatures
R.R. HASIGUTI, N. KAWAMIYA, E. YAGI

M1-8 Mechanical and dielectric relaxation in transition metal oxides. **A.J. BOSMAN, S. VAN HOUTEN**

to be read by title

M1-9 Semiconductivity in pyrite, marcasite and arsenopyrite phases. **F. HULLIGER, E. MOOSER**

M1-10 Hall and resistivity measurements on thin films of SnO_2 and In_2O_3
F. VAN DER MAESEN and C.H.M. WITMER

M1-11 Local levels in glassy semiconductors
B.T. KOLOMIEC, E.A. LEBEDEV, T.F. MAZEC, T.N. MAMONTOVA, G.I. STEPANOV

M1-12 Some regularities in the properties of defective diamond like semiconductors. **S.I. RADAOUTSAN**

9 a.m. **INTRODUCTORY LECTURE ON COMPOUND SEMICONDUCTORS : C. HILSUM**

9.30 **SESSION ON SEMICONDUCTORS MATERIALS II**
CHAIRMAN : H. WELKER

to be presented

M2-1 A comparison of doping effects of transition elements in gallium arsenide. **R.W. HAISTY, G.R. CRONIN**

M2-2 Proprietes des alliages HgTe - CdTe
M. RODOT, H. RODOT, C. VERIE

M2-3 Preparation et propriétés de structures à largeur de bande interdite variable
Y. MAREAING, G. COHEN-SOLAL, F. BAILLY

M2-4 Effective mass of holes in InSb
J. KOLODZIEJCZAK

M2-5 Electrical properties of Semiconducting Cd, $Hg_{1-x}Te$
W. GIRIAT, Z. DZIUBA, R. GALAZKA, T. ZAKRZEWSKI

M2-6 Conductivity in lead telluride. **A. KOBAYASHI, Y. SATO, M. FUJIMOTO**

M2-7 The semimetal graphite : electron-energy bands in relation to electron-transport phenomena **C.A. KLEIN**

M2-8 Impurity distribution near a p-n juction **J.J. BROPHY**

to be read by title

M2-9 Microwave absorption of impurity pairs in silicon at 24 Gc low temperatures. **S. TANAKA, M. KOBAYASHI, K. UCHINOKURA**

M2-10 GaAs and Gap phase diagrams. **D. THURMOND**

M2-11 Bonding and decomposition in IIIb-V compounds. **C.D. HANEMAN, G.J. RUSSEL, H.K. Ip**

M2-12 Structure and galvanomagnetic properties of two-phase recrystallized InSb-In layers. **H.H. WIEDER, A.R. CLAWSON**

M2 13 Electrical properties of bismuth telluride containing excess tellurium. **C.H. CHAMPNESS, A.L. KIPLING**

M2-14 Sur la préparation des monocristaux du bore. **T. NIOMYSKI, I. PRACKA, R. SZCZORBINSKI, Z. FRUKACZ**

9.30 **SESSION ON EXCITONS**
CHAIRMAN : E.F. GROSS

to be presented

E-1 Rotatory dispersion of direct exciton in germanium. **Y. NISHINA, J. KOLODZIEJCZAK, B. LAX**

E-2 Exciton structure and / or phonon effects in zinc sulfide. **R.G. WHEELER, J.C. MIKKOSZ**

E-4 Excitons in germanium in high magnetic field. **M. SUFFCZYNSKI**

E-5 Modulation of exiton emission in CdS-crystals by electric fields. **H.E. GUMLICH, I. BROSER, C.E. BLEIL**

E-6 Exciton transport and the temperature dependence of exciton emission in cadmium sulfide. **C.E. BLEIL, I. BROSER**

E-7 The vibrational spectrum of a bound exciton complex in CdS **D.C. REYNOLDS, C.W. LITTON, R.G. WHEELER**

E-8 Semi-empirical calculations of the vibrational spectrum of a exciton complex in CdS. **T.C. COLLINS, C.W. LITTON, D.C. REYNOLDS**

E-9 Exciton instability and crystallographic anomalies in semiconductors. **J. DES CLOIZEAUX**

E-9 bis Presentation on some results on exciton studies in the laboratory of Professor Nikitine. **S. NIKITINE.**

to be read by title

E-10 Energy gaps in the SiC polytypes and absorption measurements on the new polytype SiC 24 R
G. ZANMARCHI

E-11 Optical properties of 4 H SiC. **W.J. CHOYKE, D.R. HAMILTON, L. PATRICK**

E-12 Effet des dimensions des cristallites sur l'observation des raies excitoniques. **S. NIKITINE, Mme L. WENGER-WURSTEISEN, C. SCHWAB**

E-13 Etude quantitative de l'influence du champ électrique sur le spectre excitonique du Cu_2O, à 4,2 °K. **S. NIKITNE, J.L. DEISS, K.S. SONG**

E-14 Intrinsic optical absorption of indium phosphide. **W.J. TURNER, W.E. REESE**

2 p.m. **INTRODUCTORY LECTURE : Optical properties in the fundamental absorption region : M. CARDONA**

2.30 **SESSION ON OPTICAL PROPERTIES II**
CHAIRMAN : D.L. DEXTER

to be presented

O2-1 Theory of the quantum efficiency in InSb. **E. ANTONCIK**

O2-2 Reflectivity of pure and heavily doped silicon in the energy range 0.5-6ev. **F. LUKES, E. SCHMIDT**

O2-3 Pouvoir reflecteur et émission photoélectrique des monocristaux de tellure. **J. ROBIN**

O2-4 Proprietes optiques des composés II-VI dans l'ultra violet. **M. BALKANSKI, Y. PETROFF**

O2-5 Optical properties and band structure of wurtzite-type semiconductors and rutile. **M. CARDONA, G. HARBEKE**

O2-6 Optical properties of CdSb
A. ABRAHAM, M. MATYAS, J. TAUC, B. VELICKY, M. ZAVETOVA

O2-7 Band Structure in GaAs, P_{1-x}, crystals
W.K. SUBASHIEV, S.A. ABAGYAN

O2-8 Optical absorption in small gap semiconductors HgTe and HgTe-CdTe. **M.D. BLUE**

to be read by title

O2-9 Investigation of the band structure of layer compounds such as GaS and GaSe. **F. BASSANI, G. FISCHER, D.L. GREENAWAY**

O2-10 The optical absorption edge in layer structures
J.L. BREBNER

O2-11 Pressure effects on the bandstructure of II-VI compounds with zincblende structure. **D. LANGER**

O2-12 Conservation of crystal momentum in photoelectric emission. **G.W. GOBELI, F.G. ALLEN, E.O. KANE**

O2-13 Reversible light-induced blackening by charge transfer in zinc sulphide single crystals
J. DIELEMAN, C.Z. VAN DOORN, S.H. DE BRUIN and J.H. HAANSTRA

2.30 **SESSION ON TRANSPORT PHENOMENA V**
CHAIRMAN : G. BUSCH

to be presented

T5-1 Thermomagnetic and galvanomagnetic effects in bismuth at 77°K **G.E. SMITH, R. WOLFE, S.E. HASZKO**

T5-2 Galvano thermomagnetic phenomena in bismuth
T.C. HARMAN, J.M. HONIG, B.M. TARMY

T5-3 Shubnikov-de Haas effect in bismuth at very low temperatures. **M. SUZUKI, S. KIKUCHI, G.M. HATOYAMA**

T5-4 The investigation of a new type oscillations in the magneto-resistance
V.L. GUREVICH, R.V. PARFENIEV, Yu. A. FIRSOV, S.S. SHALYT

T5-5 Mass anisotropy in the conduction band of lead sulfide
R.S. ALLGAIER, B.B. HOUSTON, Jr., R.F. BIS J. BABISKIN, P.G. SIEBENMANN

T5-6 Magnetoresistance oscillations in n-GaSb
W.M. BECKER, H.Y. FAN

T5-7 Shubnikow - de Haas effect in p-type Bi_2Te_3
G. LANDWEHR, P. DRATH

T5-8 Band parameters in PbTe, PbSe and PbS
V.R. ELLETT, K.F. CUFF, C.D. KUGLIN

to be read by title

T5-9 An experimental investigation of the thermoelectric power of n-InSb in high magnetic fields.
I.L. DRICHKO, I.V. MOCHAN

T5-10 Size effect of electrical conduction in bismuth
J.E. AUBREY, C. JAMES, J.E. PARROTT

T5-11 Relation between thermomagnetic effects and thermoelectric power and their dependence upon shape
H. WEISS

9 a.m. INTRODUCTORY LECTURE : Photoelectrical effects related with recharging of impurity centers : S.M. RYVKIN

9.30 SESSION ON PHOTOCONDUCTIVITY
CHAIRMAN : A. ROSE

to be presented

P-1 Photoconductivity in germanium due to the optical transitions between the impurity centers
SH. M. KOGAN, T.M. LIFSHITS, V.I. SIDOROV

P-2 Fast recombination processes in single crystals of CdS and CdSe
V.E. LASHKAREV, E.A. SALKOV, M.K. SHEINKMAN

P-10 Photoconductivity of CdS excited by quenching infrared radiation
J.P. MICHENAUD, A. LUYEKX, F. LEPRINCE

P-4 Quantum theory of optical beating in photoconductors
C. M. PENCHINA

P-5 Photoelectric effect in semiconductors. D. BRUST

P-7 Photoconductivity of U.V. excited diamonds
A. HALPERIN, J. LEVINSON

P-8 Layer-like field inhomogeneities in photoconductors in the pre-breakdown range. K.W. BOER

P-9 Effets photoélectrique et photomagnétoélectrique dans Cu_2O à 77°K. A. CORET, J.P. ZIELINGER

to be read by title

P-3 The investigation by the photoconductivity and luminescence method of the exciton states near the edge and in the depth of the fundamental absorption in crystals
J. Kh. AKOPJAN, E.F. GROSSE, F.I. DREINGOLD, B.V. NOVIKOV, R.A. TITOV, R.I. SHERKHMAMETIEV

P-11 Capture cross-sections of nickel recombination centres in p-type germanium. C. CONSTANTINESCU, E. IVAN

P-12 The investigation of the recombination processes in single crystals of Si, Ge
M.I. IGLITZIN, G.I. VORONKOVA, V.W. VORONKOV, R.I. GLARIOSOVA, E.V. SOLOVYEVA, V.P. SUSHKOV, E.S. UHROVA

9.30 SESSION ON TRANSPORT PHENOMENA VI
CHAIRMAN : W.H. BRATTAIN

to be presented

T6-1 Sur la théorie de la méthode du gain moyen d'énergie
J. TAVERNIER

T6-2 Phonon scattering by electrons in germanium-silicon alloys. E.F. STEIGMEIER, B. ABELES

T6-3 Theory of phonon assisted tunneling in semiconductors
J.J. TIEMANN

T6-4 Change of thermal conductivity of the crystal lattice at uniaxial elastic stress or at the introduction of impurities and thermal imperfections
E.D. DEVYATKOVA, A.V. IOFFE, B.A. KUTASOV, B.U. MOYZES, I.A. SMIRNOV, E.A. GURIEVA

T6-5 On the theory of electric conduction in amorphous semiconductors. L. BANYAI

T6-6 Band structure and electrical conductivity in amorphous Ge. R. GRIGOROVICI, N. CROITORU, A. DEVENYI, E. TELEMAN

T6-7 Interaction électron-réseau dans les structures en couches semiconductrices. R. FIVAZ, E. MOOSER

T6-8 Phonon scattering in doped GaAs from magneto-thermal conductivity studies. M.G. HOLLAND

T6-9 Cyclotron resonance line broadening due to electron-hole interaction in germanium
H. KAWAMURA, M. FUKAI, I. IMAI, M. SAJI

2 p.m. REPORT ON THE CONFERENCE ON PHYSICS AND CHEMISTRY OF SOLID SURFACES : H.E. FARNSWORTH

CLOSING ADDRESS : P. AIGRAIN

CHAIRMAN : M. BALKANSKI

10 a.m. OPENING SESSION - CHAIRMAN : P. AIGRAIN - OFFICIAL OPENING ADDRESSES

11 a.m. REPORT ON THE SYMPOSIUM ON RADIATIVE RECOMBINATION . H. EHRENREICH

2 p.m. INTRODUCTORY LECTURE ON TRANSPORT PHENOMENA . L. SOSNOWSKI

2.30 SESSION ON TRANSPORT PHENOMENA I
CHAIRMAN : B. VUL

to be presented

T1-1 Some general consideration on the Hall constant. **R. KUBO**

T1-2 Theory of mobility and the Hall effect allowing for the field of charged impurity ions. **S.I. PEKAR**

T1-3 Transport properties of highly-doped oxidic semiconductors. **R.R. HEIKES, R.C. MILLER, B. KAGLE, R.W. URE, Jr**

T1-4 Strong field galvanomagnetic effects in n-type germanium. **L.J. NEURINGER**

T1-5 Longitudinal magnetoresistance of heavily doped n-Ge in high magnetic fields. **I.M. TSIDILKOVSKI, V.I. SOKOLOV**

T1-6 Transition of the anisotropy laws of galvanomagnetic effects in p-type silicon. **H. MIYAZAWA, H. MAEDA, K. SUZUKI**

T1-7 Electronic transport in heavily doped GeSi alloys. **A. AMITH.**

T1-8 The scattering of electrons in heavily-doped germanium **V.I. FISTUL, E.M. OMELYANOVSKY, D.G. ANDRIANOV, I.V. DAHOVSKY**

to be read by title

T1-9 The rigorous theory of p-n-junctions. **A. NUSSBAUM**

T1-10 Neutrality principal in excess carrier transport equations. **S. SIKORSKI**

T1-11 Modèle pour un semiconducteur ferromagnetique. **D. CALECKI**

T1-12 Théorie des diodes Esaki et des phénomènes physiques régissant leur fonctionnement aux très basses températures. **P. ANDRE**

2.30 SESSION ON OPTICAL PROPERTIES I
(Absorption on free carriers)
CHAIRMAN : R.A. SMITH

to be presented

O1-1 Optical non-linearities of III-V semiconductors **N. BLOEMBERGEN, R.K. CHANG, J. DUCUING, P. LALLEMAND**

O1-2 Influence of uniaxial stress on intervalence band transitions in germanium. **G.S. HOBSON, E.G.S. PAIGE**

O1-3 Effects of temperature and high electric field on the free carrier absorption by light holes in germanium **A.C. BAYNHAM, E.G.S. PAIGE**

O1-4 Free-carrier birefringence and dichroism in semiconductors. **G.P. SOARDO, J.K. FURDYNA**

O1-5 Electron-scattering in InSb at optical frequencies **F.R. KESSLER, E. SUTTER**

O1-6 Theory of absorption of electromagnetic radiation by hopping process in semiconductors. **J. BLINOWSKI, J. MYCIELSKI**

O1-7 Determination of effective masses from field-induced shift of the absorption edge. **E. GUTSCHE, H. LANGE**

O1-8 Field induced shift of the optical absorption edge of germanium in the space charge region of a p-n juction. **A. FROVA, P. HANDLER**

to be read by title

O1-10 Influence of uniaxial stress on the optical properties of CdSe. **M. GRYNBERG**

O1-11 The effect of an electric field on the reflectivity of germanium. **B.O. SERAPHIN**

5 p.m. INTRODUCTORY LECTURE ON MAGNETO-OPTICAL EFFECTS : B. LAX

8.30 SESSION ON MAGNETO OPTICAL EFFECTS
CHAIRMAN : E. BURSTEIN

to be presented

MO-1 Free carrier and interband Faraday rotation in gallium antimonide and gallium arsenide. **H. PILLER**

MO-2 The effect of uniaxial strain on Faraday rotation in Ge and InSb. **T. ARAI, C.J. SUMMERS, C.R. PIDGEON, S.D. SMITH**

MO-3 The anisotropic Voigt effect in cubic semiconductors **B. DONOVAN, J. WEBSTER**

MO-4 Microwave feee carrier Faraday and Voigt effects **A. BOUWKNEGT, J. VOLGER**

MO-5 Effet Faraday du tellure. **C. RIGAUX et J.L. CALLIES**

MO-6 The electron effective mass in hexagonal silicon carbide determined from infra-red Faraday rotation **T.S. MOSS, B. ELLIS**

MO-7 Absorption edge of CdS in a strong magnetic field **A. MISU, K. AOYAGI, G. KUWABARA, S. SUGANO**

MO-8 Magneto-optical band studies of epitaxial PbSe. **D.L. MITCHELL, E.D. PALIK, J.N. ZEMEL**

to be read by title

MO-9 Perturbation theoretical approach to magneto-optical phenomena in the non-absorbing region. **A. NEDOLUHA**

MO-11 Microwave galvanomagnetic measurements in semiconducting powders. **J.K. FURDYNA**

8.30 SESSION ON TRANSPORT PHENOMENA II
CHAIRMAN : A. GIBSON

to be presented

T2-5 Warm and hot-electron effects in silicon and germanium **M.H. JORGENSEN, N.I. MEYER, K.J. SCHMIDT-TIEDEMANN**

T2-6 Role of optical phonon interactions of hot carriers in p-type germanium. **R. BRAY, W.E. PINSON, D.M. BROWN**

T2-2 Anisotropie et piezoresistance des électrons chauds **J.P. MOREAU**

T2-4 Hot electrons in the zero point scattering limit. **F. BUDD**

T2-3 Hot electron effects and photoconductivity in InSb **E. H. PUTLEY**

T2-1 Measurement of the temperature of hot electrons in In Sb by electron spin resonance. **M. GUERON**

T2-8 Disturbance of phonon distribution by hot electrons in n-type indium antimonide. **A. ZYLBERSZTEJN**

T2-7 The conductivity of a degenerated semiconductor in a strong electric field. **V.A. CHUENKOV**

9 a.m. INTRODUCTORY LECTURE ON BAND THEORY : F. HERMAN

9.30 SESSION ON BAND THEORY
CHAIRMAN : W. KOHN

to be presented

B-1 Relativistic effects and the band structure of PbTe **G.W. PRATT Jr.**

B-2 Energy bands in PbTe. **L. KLEINMAN, PAY JUNE LIN**

B-3 Band structure of gray tin. **S. GROVES, W. PAUL**

B-4 Band edge structure of PbS, PbSe and PbTe **J.O. DIMMOCK, G.B. WRIGHT**

B-5 Theory of the imperfect crystal at higher concentrations using double time Green's functions. **D.W. TAYLOR**

B-6 On the irreversible thermodynamic theory of recombination and g-r noise in case of multielectron centers with may excited states. **G. PATAKI**

B-7 Magnetic properties of free carriers in non-parabolic and non-spherical energy bands. **W. ZAWADZKI**

B-8 Quantum theory of the valence band structure of germanium in external electric and magnetic fields. **T. SHINDO**

to be read by title

B-9 Crystal momentum theorem in the (n+1) - electron band theory of insulators. **H. HASEGAWA**

B-10 Cyclotron resonance of electrons in uniaxially stressed silicon. Energy bands near X in the diamond structure **J.C. HENSEL, H. HASEGAWA**

B-11 Electronic energy bands in $SrTiO_3$ and related oxide semiconductors. **A.H. KAHN, A.J. LEYENDECKER**

9.30 SESSION ON TRANSPORT PHENOMENA III
CHAIRMAN : W. SHOCKLEY

to be presented

T3-1 Phonon drag effect in hot electron problems **J. YAMASHITA**

T3-2 Investigation of Ge doped by Au in high electric fields **V.P. SONDAYEVSKY, E.I. KARAKUSHAN, V.I. STAFEEV.**

T3-3 Hot electron and negative resistance effects at 20°K in n-type germanium containing gold. **B.K. RIDLEY, R.G. PRATT**

T3-4 Theory of the negative resistance in p-i-n diodes. **W.P. DUMKE**

T3-5 Space - charge limited current in germanium **A. SHUMKA, M.-A. NICOLET**

T3-6 The growth of fluctuations and non-linear effects in the case of acoustical instability of semiconductors **V.L. GUREVICH, V.D. KAGAN, B.D. LAICHTMAN**

T3-7 Acoustoelectric effect in piezoelectric semiconductors. **H.N. LEIFER, A.I. CARLSON**

T3-8 Propriétés piézoélectriques du tellure **G. QUENTIN J.M. THUILLIER**

P-6 E Correlation of the temperature dependence of acoustoelectric current saturation in CdS with Hall measurements. **A.R. MOORE, R.W. SMITH**

to be read by title

T3-9 Bulk negative resistance effects in GaAs. **A.I. CARLSON, H.N. LEIFER**

T3-10 Lifetimes of nonequilibrium carriers in magnetic traps **B. ANCKER-JOHNSON, M.F. BERG**

T3-11 The drift of carriers from a narrow region of ionization in an insulator. **P.N. KEATING, A.C. PAPADAKIS**

2 p.m. INTRODUCTORY LECTURE ON IMPURITY - EXCITON INTERACTIONS

Optical Properties of bound excitons : J. J. HOPFIELD

2.30 SESSION ON IMPURITIES IN SEMICONDUCTORS
CHAIRMAN : H. BROOKS

to be presented

I-1 Some problems of paramagnetic resonance of local centres on semiconductors. **M.F. DEIGEN, V.Y. ZEVIN, V.M. MAYEVSKY, A.B. ROITSIN**

I-2 Energy levels and transition probabilities of donor acceptor pairs in semiconductors. **J. SHAFFER, F. WILLIAMS**

I-3 Electron paramagnetic resonance and electrical resistivity of boron carbide. **D. GEIST**

I-4 Theory of shallow impurity states for subsidiary valleys **G.A. PETERSON**

I-5 Combined resonance on impurity centres and in inhomogeneous magnetic fields. **S.I. PEKAR, E.I. RASHA, V.L. SHEKA**

I-6 On the theory of impurity levels. **G. CIOBANU**

I-7 Energy levels of transition metal impurities in semiconductors. **J.W. ALLEN**

I-8 The relaxation time and the width of the spin resonance line in semiconductors with degenerate bands **G.L. BIR, G.E. PIKUS**

to be read by title

I-9 Infrared absorption of copper impurities in II-VI semiconducting compounds. **E. DIETZ, H. KAMIMURA**

I-10 Influence of counterdoping on the distribution of Mn over substitutional and interstitial sites in Ge. **F.N. HOOGE**

I-11 Effect of uniaxial stress on the excitation spectra of donors in silicon. **R.L. AGGARWAL, A.K. RAMDAS**

I-12 Auger effect involving recombination centres **P.T. LANDSBERG, D.A. EVANS, C. RHYS-ROBERTS**

I-13 Properties of germanium in indium antimonide **W.M. BULLIS, V. HARRAP**

I-14 Impurity ionization parameters from thermal data **W.W. HARVEY**

2.30 SESSION ON TRANSPORT PHENOMENA IV
CHAIRMAN : V.L. BONCH-BRUEVICH

to be presented

T4-1 Pressure dependence of phonon assisted interband tunneling. **H. FRITZSCHE**

T4-2 Piezoresistance and piezo - Hall effect in bismuth **A.L. JAIN, R. JAGGI.**

T4-3 The effect of uniaxial strain on the transport phenomena in p-Si **G.L. BIR, A.I. BLOOM, U.V. ILISAVSKY**

T4-4 Piezoresistance of N-type Mg, Si **W.B. WHITTEN, G.C. DANIELSON**

T4-5 Stress induced donor deionization in GaAs **R.J. SLADEK**

T4-6 The influence of very strong point mechanical stresses on electrical properties of silicon. **J. SWIDERSKI**

T4-7 Defects induced by electron recombination in p-type GaAs. **R.L. ANDERSON**

T4-8 Formation and properties of impurity band in GaAs, InAs and InP. **D.N. NASLEDOV**

to be read by title

T4-9 Effect of hydrostatic pressure on Hall coefficient and resistivity of n and p type Bi_2Te_3. **A. SAGAR, R.W. URE**

T4-10 Equilibrium space charge : trap modification **L. GOLD**

T4-11 Admittance variation with frequency in insulators having traps subject to charge injection. **R.S. MULLER**

9.m. **INTRODUCTION LECTURE ON PHOTON - PHONON INTERACTIONS : M BALKANSKI**

9.30 SESSION ON PHOTON - PHONON INTERACTIONS
CHAIRMAN : R.F. WALLIS

to be presented

PP-2 Raman scattering and impurity absorption by the lattice of homopolar crystals
L.E. GUREVITCH, I.P. IPATOVA, A.A. KLOTCHIHIN

PP-4 Vibrational absorption of impurities in semiconductors
J.F. ANGRESS, T. ARAI, A.R. GOODWIN, S.T. SMITH

PP-7 The fundamental infrared lattice vibration spectra of GaAs. **S. IWASA, I. BALSLEV, E. BURSTEIN**

PP-3 Far infrared absoption in PbS. **J.N. ZEMEL**

PP-5 Infrared lattice vibration spectra of magnesium stanide. **A. KAHAN H.G. LIPSON, E.V. LOEWENSTEIN**

PP-1 Critical point analysis of the phonon spectra of diamond, silicon and germanium. **R. LOUDON, F.A. JOHNSON**

PP-6 Infrared spectral emittance of indium phosphide
D.L. STIERWALT, R.F. POTTER

PP-8 Multiphonon infrared absorption in II-VI semiconductors. **S.S. MITRA, R. MARSHALL**

to be read by title

P-6 Reststrahlen frequencies for mixed Ga AS$_x$ Sb$_{1-x}$ system.
R.F. POTTER, D.L. STIERWALT

PP-9 Modes couples dans le CdS dans l'infrarouge lointain
M. BALKANSKI, M. BESSON, R. LE TOULLEC

PP-10 Optical properties of transition metal oxides
R. MARSHALL, S.S. MITRA, P.J. GIELISSE, J.N. PLENDL

PP-11 Optically active lattice vibrations in NiF$_2$
M. BALKANSKI, P. MOCH and G. PARISOT

9.30 SESSION ON SEMICONDUCTING MATERIALS I
CHAIRMAN : D.N. NASLEDOV

to be presented

M1-1 Electrical properties of binary transition metal compounds. **W. ALBERS**

M1-2 Semiconducting low carrier mobility manganites with spinellic structure. **M. ROSENBERG, P. NICOLAU**

M1-3 Magnon-drag, spin-disorder scattering and anomalous behaviour of the Hall constant in antiferromagnetic MnTe. **J.D. WASSCHER, A.M.J.H. SEUTER, C. HAAS**

M1-4 The conductivity and bandstructure of hexagonal selenium. **H. GOBRECHT, A. TAUSEND**

M1-5 Preparation and investigation of A III B VI single crystals
G.A. AKHUNDOV, GB. ABDULLAYEV. G.D. GUSEINOV, R.F. MECKHTIEV, M. Kh. ALIYEVA

M1-6 Some electrical transport studies of CdF$_2$
J.S. PRENER, H.H. WOODBURY

M1-7 Conductivity of reduced rutile at low temperatures
R.R. HASIGUTI, N. KAWAMIYA, E. YAGI

M1-8 Mechanical and dielectric relaxation in transition metal oxides. **A.J. BOSMAN, S. VAN HOUTEN**

to be read by title

M1-9 Semiconductivity in pyrite, marcasite and arsenopyrite phases. **F. HULLIGER, E. MOOSER**

M1-10 Hall and resistivity measurements on thin films of SnO$_2$ and In$_2$O$_3$
F. VAN DER MAESEN and C.H.M. WITMER

M1-11 Local levels in glassy semiconductors
B.T. KOLOMIEC, E.A. LEBEDEV, T.F. MAZEC, T.N. MAMONTOVA, G.I. STEPANOV

M1-12 Some regularities in the properties of defective diamond like semiconductors. **S.I. RADAOUTSAN**

9 a.m. INTRODUCTORY LECTURE ON COMPOUND SEMICONDUCTORS : C. HILSUM

9.30 SESSION ON SEMICONDUCTORS MATERIALS II
CHAIRMAN : H. WELKER

to be presented

M2-1 A comparison of doping effects of transition elements in gallium arsenide. R.W. HAISTY, G.R. CRONIN

M2-2 Propriétés des alliages HgTe - CdTe
M. RODOT, H. RODOT, C. VERIE

M2-3 Preparation et propriétés de structures à largeur de bande interdite variable
Y. MARFAING, G. COHEN-SOLAL, F. BAILLY

M2-4 Effective mass of holes in InSb
J. KOLODZIEJCZAK

M2-5 Electrical properties of Semiconducting $Cd_xHg_{1-x}Te$
W. GIRIAT, Z. DZIUBA, R. GALAZKA, T. ZAKRZEWSKI

M2-6 Conductivity in lead telluride. A. KOBAYASHI, Y. SATO, M. FUJIMOTO

M2-7 The semimetal graphite : electron-energy bands in relation to electron-transport phenomena C.A. KLEIN

M2-8 Impurity distribution near a p-n juction J.J. BROPHY

to be read by title

M2-9 Microwave absorption of impurity pairs in silicon at 24 Gc low temperatures. S. TANAKA, M. KOBAYASHI, K. UCHINOKURA

M2-10 GaAs and Gap phase diagrams. D. THURMOND

M2-11 Bonding and decomposition in IIIb-V compounds. C.D. HANEMAN, G.J. RUSSEL, H.K. Ip

M2-12 Structure and galvanomagnetic properties of two-phase recrystallized InSb-In layers. H.H. WIEDER, A.R. CLAWSON

M2 13 Electrical properties of bismuth telluride containing excess tellurium. C.H. CHAMPNESS, A.L. KIPLING

M2-14 Sur la préparation des monocristaux du bore. T. NIOMYSKI, I. PRACKA, R. SZCZORBINSKI, Z. FRUKACZ

9.30 SESSION ON EXCITONS
CHAIRMAN : E.F. GROSS

to be presented

E-1 Rotatory dispersion of direct exciton in germanium
Y. NISHINA, J. KOLODZIEJCZAK, B. LAX

E-2 Exciton structure and Zeeman effects in zinc sulfide
R.G. WHEELER, J.C. MIKLOSZ

E-4 Excitons in germanium in high magnetic field.
M. SUFFCZYNSKI

E-5 Modulation of exiton emission in CdS-crystals by electric fields. H.E. GUMLICH, I. BROSER, C.E. BLEIL

E-6 Exciton transport and the temperature dependence of exciton emission in cadmium sulfide. C.E. BLEIL, I. BROSER

E-7 The vibrational spectrum of a bound exciton complex in CdS D.C. REYNOLDS, C.W. LITTON, R.G. WHEELER

E-8 Semi-empirical calculations of the vibrational spectrum of a exciton complex in CdS. T.C. COLLINS, C.W. LITTON, D.C. REYNOLDS

E-9 Exciton instability and crystallographic anomalies in semiconductors. J. DES CLOIZEAUX

E-9 bis Presentation on some results on exciton studies in the laboratory of Professor Nikitine. S. NIKITINE.

to be read by title

E-10 Energy gaps in the SiC polytypes and absorption measurements on the new polytype SiC 24 R
G. ZANMARCHI

E-11 Optical properties of 4 H SiC. W.J. CHOYKE, D.R. HAMILTON, L. PATRICK

E-12 Effet des dimensions des cristallites sur l'observation des raies excitoniques. S. NIKITINE, Mme L. WENGER-WURSTEISEN, C. SCHWAB

E-13 Etude quantitative de l'influence du champ électrique sur le spectre excitonique du Cu_2O à 4,2 °K. S. NIKITNE, J.L. DEISS, K.S. SONG

E-14 Intrinsic optical absorption of indium phosphide. W.J. TURNER, W.E. REESE

2 p.m. INTRODUCTORY LECTURE : Optical properties in the fundamental absorption region : M. CARDONA

2.30 SESSION ON OPTICAL PROPERTIES II
CHAIRMAN : D.L. DEXTER

to be presented

O2-1 Theory of the quantum efficiency in InSb.
E. ANTONCIK

O2-2 Reflectivity of pure and heavily doped silicon in the energy range 0.5-6ev. F. LUKES, E. SCHMIDT

O2-3 Pouvoir réflecteur et émission photoélectrique des monocristaux de tellure. J. ROBIN

O2-4 Propriétés optiques des composés II-VI dans l'ultra violet. M. BALKANSKI, Y. PETROFF

O2-5 Optical properties and band structure of wurtzite-type semiconductors and rutile. M. CARDONA, G. HARBEKE

O2-6 Optical properties of CdSb
A. ABRAHAM, M. MATYAS, J. TAUC, B. VELICKY, M. ZAVETOVA

O2-7 Band Structure in GaAs, P_{1-x} crystals
W.K. SUBASHIEV, S.A. ABAGYAN

O2-8 Optical absorption in small gap semiconductors HgTe and HgTe-CdTe. M.D. BLUE

to be read by title

O2-9 Investigation of the band structure of layer compounds such as GaS and GaSe. F. BASSANI, G. FISCHER, D.L. GREENAWAY

O2-10 The optical absorption edge in layer structures
J.L. BREBNER

O2-11 Pressure effects on the bandstructure of II-VI compounds with zincblende structure. D. LANGER

O2-12 Conservation of crystal momentum in photoelectric emission. G.W. GOBELI, F.G. ALLEN, E.O. KANE

O2-13 Reversible light-induced blackening by charge transfer in zinc sulphide single crystals
J. DIELEMAN, C.Z. VAN DOORN, S.H. DE BRUIN and J.M. HAANSTRA

2.30 SESSION ON TRANSPORT PHENOMENA V
CHAIRMAN : G. BUSCH

to be presented

T5-1 Thermomagnetic and galvanomagnetic effects in bismuth at 77°K G.E. SMITH, R. WOLFE, S.E. HASZKO

T5-2 Galvano-thermomagnetic phenomena in bismuth
T.C. HARMAN, J.M. HONIG, B.M. TARMY

T5-3 Shubnikov-de Haas effect in bismuth at very low temperatures. M. SUZUKI, S. KIKUCHI, G.M. HATOYAMA

T5-4 The investigation of a new type oscillations in the magneto-resistance
V.L. GUREVICH, R.V. PARFENIEV, Yu. A. FIRSOV, S.S. SHALYT

T5-5 Mass anisotropy in the conduction band of lead sulfide
R.S. ALLGAIER, B.B. HOUSTON, Jr., R.F. BIS
J. BABISKIN, P.G. SIEBENMANN

T5-6 Magnetoresistance oscillations in n-GaSb
W.M. BECKER, H.Y. FAN

T5-7 Shubnikow - de Haas effect in p-type Bi_2Te_3
G. LANDWEHR, P. DRATH

T5-8 Band parameters in PbTe, PbSe and PbS
V.R. ELLETT, K.F. CUFF, C.D. KUGLIN

to be read by title

T5-9 An experimental investigation of the thermoelectric power of n-In-Sb in high magnetic fields.
I.L. DRICHKO, I.V. MOCHAN

T5-10 Size effect of electrical conduction in bismuth
J.E. AUBREY, C. JAMES, J.E. PARROTT

T5-11 Relation between thermomagnetic effects and thermo-electric power and their dependence upon shape
H. WEISS

9 a.m. INTRODUCTORY LECTURE : Photoelectrical effects related with recharging of impurity centers . S.M. RYVKIN

9.30 SESSION ON PHOTOCONDUCTIVITY
CHAIRMAN : A. ROSE

to be presented

P-1 Photoconductivity in germanium due to the optical transitions between the impurity centers
SH. M. KOGAN, T.M. LIFSHITS, V.I. SIDOROV

P-2 Fast recombination processes in single crystals of CdS and CdSe
V.E. LASHKAREV, E.A. SALKOV, M.K. SHEINKMAN

P-10 Photoconductivity of CdS excited by quenching infrared radiation
J.P. MICHENAUD, A. LUYEKX, F. LEPRINCE

P-4 Quantum theory of optical beating in photoconductors
C. M. PENCHINA

P-5 Photoelectric effect in semiconductors. D. BRUST

P-7 Photoconductivity of U.V. excited diamonds
A. HALPERIN, J. LEVINSON

P-8 Layer-like field inhomogeneities in photoconductors in the pre-breakdown range. K.W. BOER

P-9 Effets photoélectrique et photomagnétoélectrique dans Cu_2O à 77°K. A. CORET, J.P. ZIELINGER

to be read by title

P-3 The investigation by the photoconductivity and luminescence method of the exciton states near the edge and in the depth of the fundamental absorption in crystals
J. Kh. AKOPJAN, E.F. GROSSE, F.I. DREINGOLD, B.V. NOVIKOV, R.A. TITOV, R.I. SHERKHMAMETIEV

P-11 Capture cross-sections of nickel recombination centres in p-type germanium. C. CONSTANTINESCU, E. IVAN

P-12 The investigation of the recombination processes in single crystals of Si, Ge
M.I. IGLITZIN, G.I. VORONKOVA, V.W. VORONKOV, R.I. GLARIOSOVA, E.V. SOLOVYEVA, V.P. SUSHKOV, E.S. UHROVA

9.30 SESSION ON TRANSPORT PHENOMENA VI
CHAIRMAN : W.H. BRATTAIN

to be presented

To-1 Sur la théorie de la methode du gain moyen d'energie
J. TAVERNIER

T6-2 Phonon scattering by electrons in germanium-silicon alloys. E.F. STEIGMEIER, B. ABELES

T6-3 Theory of phonon assisted tunneling in semiconductors
J.J. TIEMANN

T6-4 Change of thermal conductivity of the crystal lattice at uniaxial elastic stress or at the introduction of impurities and thermal imperfections
E.D. DEVYATKOVA, A.V. IOFFE. B.A. KUTASOV, B.U. MOYZES, I.A. SMIRNOV, E.A. GURIEVA

T6-5 On the theory of electric conduction in amorphous semiconductors. L. BANYAI

T6-6 Band structure and electrical conductivity in amorphous Ge. R. GRIGOROVICI, N. CROITORU, A. DEVENYI, E. TELEMAN

T6-7 Interaction electron-reseau dans les structures en couches semiconductrices. R. FIVAZ, E. MOOSER

T6-8 Phonon scattering in doped GaAs from magneto-thermal conductivity studies. M.G. HOLLAND

T6-9 Cyclotron resonance line broadening due to electron-hole interaction in germanium
H. KAWAMURA, M. FUKAI, I. IMAI, M. SAJI

2 p.m. REPORT ON THE CONFERENCE ON PHYSICS AND CHEMISTRY OF SOLID SURFACES : H.E. FARNSWORTH

CLOSING ADDRESS : P. AIGRAIN

CHAIRMAN : M. BALKANSKI