

BOOK REVIEWS

PROBLEMS OF SEMICONDUCTORS

Halbleiterprobleme, IV. Herausgegeben von W. Schottky, Pp. VII+381. Verlag Friedr. Vieweg u. Sohn, Braunschweig, 1958. Preis DM 46.80.

STARTING with 1953, the Commission on Semiconductors (Halbleiterrausschuss) of the Union of German Physics Societies has been organizing annual conferences, at which well known specialists deliver surveys on their fields of activity. These papers were published in 1953 – 1955 in three collections, under the title "Problems of Semiconductors," edited by Prof. W. Schottky. In 1956, instead of the usual conferences, an international colloquium was held on the subject "Semiconductors and Phosphors," and a separate volume was published. A regular conference was again held in 1957, and its transactions were published as Volume IV of "Problems of Semiconductors," reviewed here. This volume contains seven surveys, devoted to several important physical and technical problems. Each survey contains a discussion of the theoretical and experimental aspects of the problem and an extensive bibliography.

The collection begins with a survey by Haken, "Present Status of Research on Excitons in Semiconductors." The concept of the exciton, introduced by Ya. I. Frenkel' almost 30 years ago, was unusually helpful to the understanding of optical and photoelectric properties of semiconductors and dielectrics. Attention to this group of problems was attracted recently by the well known work of Gross and his associates and of S. Nikitin (in Strasbourg) and his associates, who observed a hydrogen-like "exciton spectrum" in cuprous oxide and several other semiconductors. While the experimental results are well treated in the reviews of Gross (see, for example, *Usp. Fiz. Nauk* **63**, 575, 1957) and Nikitin (*Journal de Chimie Physique*, November, 1958), articles that cover both theoretical problems and a summary of experimental data were lacking. Haken's survey fills this gap.*

Two other surveys in the collection are devoted to the optical problems, one by Kosvig and Stasiv, "Spectral Position of the Absorption Bands of the Electrons of Imperfections in Ionic Lattices" and the other by Schoen, "On the Kinetics of Photocon-

ductivity and Phosphorescence Processes."

A feature of the reviewed collection is the rarely encountered active participation of its editor in the discussion of the surveys. Thus, Prof. Schottky has appended to the foregoing articles by Haken, Stasiv, and Schoen appendices containing discussions, which were just as long as the surveys themselves. Naturally, the opinions of so great a specialist as Prof. Schottky are of considerable interest.

From among the articles of technical character, we note the exceedingly interesting surveys by Lautz, on the technical use of thermal emf's, and by Dosse on present status of the use of transistors. In the first of these articles the author deals with the recent practical utilization, made possible by improvement in the technology of semiconducting materials, of two long-known thermoelectric effects: the Peltier effect (thermoelectric cooling) and the Seebeck effect (thermoelectric generation of power). It is interesting that both effects were discovered more than a hundred years ago (the Seebeck effect in 1822 and the Peltier effect in 1834) but could not find practical application until quite recently, and that even thirty years ago they were considered interesting but useless phenomena. The reason for this was that the materials previously used to produce these effects had exceedingly unfavorable properties: the metals used had for the most part low thermal emf's and high thermal and electric conductivities, while the "classical" semiconductors used had large high emf's but high resistivities. As a result, the two materials were equally incapable of yielding results of practical use. Yet in principle the practical utilization of both effects, was quite alluring. In fact, the possibility of producing refrigerators or thermostatic ovens without moving parts and without strong chemical agents (through the use of the Peltier effect) or the possibility of producing thermopiles operated by a kerosene lamp or by sunlight (through the use of the Seebeck effect) were highly attractive. It is only through the use of particularly favorable materials (as regards the combination of high thermoelectric properties with good electric conductivity)

*This survey was published in expanded form as "Die Theorie des Exzitons im Festen Körper," *Fortschr. Physik* **6**, 271 (1958); Russ. transl. *Usp. Fiz. Nauk* **68**, 565 (1959).

namely "semimetals" (bismuth or antimony) and "degenerate semiconductors," has made substantial progress possible in recent years. We can note with satisfaction the important and quite notable role played in this new vigorous development of the important practical field by Soviet

scientists, principally A. F. Ioffe and the staff of the Institute of Semiconductors that he has founded (Zhuze, Stil'bans, Iordanishvili, and others).

— É. Shpol'skiĭ

Usp. Fiz. Nauk **68**, 561-562 (July, 1959).