## Mechanisms of electrical conduction in solids

S.É. Esipov

Usp. Fiz. Nauk 158, 750-751 (August 1989)

C. Hamann, H. Burghardt, and T. Frauenheim. Electrical Conduction Mechanisms in Solids, VEB Deutscher Verlag der Wissenschaften, Berlin, 1988–290pp.

The book under review is part of the series "Physics Monographs" edited by V. Ebeling and H. Weissmantel. The principal feature of the book cannot be expressed more accurately than in the words of K. D. Ushinsky: "German pedagogy—if not a science, then it is, at least, the way towards it, the threshold of the temple of science. Its entire goal consists of leading a person as quickly as possible into the world of science and acquainting him with all its divisions and nooks and crannies, not forgetting a single one.... In the most elementary education they already try, as far as possible, to carry out this task, and all their elementary textbooks aim to be microcosms and in ten or twenty pages to acquaint the child with the whole world" (cf. Selected pedagogic essays [In Russian]. Uchpedgiz RSFSR, M., 1983, V. 1, pp. 103–104).

In the "Introduction" we read: "In writing this book the authors had in mind the many chemists, engineers, biophysicists and students..., who are not well prepared in physics or electronics, but who are anxious to acquire modern concepts of the principal phenomena of the flow of electrical current, or to obtain the necessary knowledge in order to ask sensible questions of their colleagues who are specialists in physics or electronics".

The following special features of the monograph attract our attention. The mechanisms of electrical conduction of metals, semiconductors and insulators are presented within the framework of a single book. The chapters are to a considerable degree independent. The depth of the material varies from chapter to chapter, but this is usually due to the physics of the phenomenon being presented. The physical meaning of the phenomena is described very briefly, and this is compensated to some degree by numerous formulas. The greater part of them the authors derive in the course of presentation, and discuss in detail and accurately physically significant special cases. In those cases where a formula cannot be obtained without a considerable digression, references are given to the original most fundamental articles and books the content of which, it must be said, frequently is inaccessible to the reader mentioned in the "Introduction". (For example, references to the famous "green book" by A. A. Abrikosov, L. P. Gor'kov, and I. E. Dzyaloshinskiĭ "Methods of Quantum Field Theory in Statistical Physics" or the well-known review by T. Ando, A. B. Fouler, and F. Stern "Electronic Properties of Two-dimensional systems".)

The first four chapters contain a propaedeutic course on solid state physics that is needed for the subsequent presentation of the mechanisms of electrical conduction. In particular, Ch. 2 deals with electrons in solids, and gives the approximation of free, almost bound, and bound electrons. The kinetic equation and scattering mechanisms form the contents of Ch. 3. In Ch. 4 the concept of quasiparticles is introduced and their main types are discussed. Chapters 5-8 present conduction in conductors, in low-dimensional conductors, in semiconductors and in insulators. The range of topics discussed is very broad: from Ohm's law and properties of a p-n junction to the fractional quantum Hall effect and Anderson traps. Chapter 9 contains a collection of topics selected by the authors: superionic conduction, the Josephson effect, percolation, dimensional effects, etc. In Ch. 10 the authors describe photoconductivity including solar batteries. The last Ch. 11 contains an analysis of a number of experimental methods and derives quite a few useful formulas applicable to them.

The monograph is not free of inaccuracies and ambiguities. For example, in the formula (3.75) for the time of piezoelectric scattering by acoustic phonons and everywhere in the subsequent text the piezomodulus has been omitted. Defects of the Schottky type are repeatedly mentioned in the book without having been defined (section 8.1) and are later included in the alphabetical index, etc.

On the whole, the book will doubtlessly be useful for physicists, particularly with respect to topics which previously they had no occasion to encounter. For readers mentioned in the "Introduction" the book in our opinion is too complex for a first introduction to the subject. In can be used effectively as a reference book.

Translated by G. M. Volkoff

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