Organic Conductors, Fibers, Thin Films...

One-Dimensional Conductors. (Springer Series in Solid State Science 72.) By *S. Kagoshima, H. Nagasawa* and *T. Sambongi*. Springer-Verlag Berlin 1988. xii, 235 pp., hard cover, DM 99.—ISBN 3-540-18154-7

This volume is a very good introduction to the physics and electronic properties of one-dimensional conductors. After a brief introduction describing the features of one-dimensional conductors the basic theoretical aspects of a one-dimensional electron system are explained. Thus the important concepts of the one-dimensional conduction band, the Peierls instability and transition, the electron-phonon coupling and Kohn anomaly, the nesting of the Fermi surface, charge density waves, fluctuations in one dimension, and the role of the Coulomb interaction are described and discussed. In addition, a comparison of the conditions in two and three dimensions is made. This chapter serves as an excellent introduction to the field for graduate and undergraduate students of physics and chemistry, as well as for researchers in other fields of solid state physics.

In Chapters III to VII the chemical and physical properties of typical one-dimensional conductors are reviewed. The review starts with TTF-TCNQ and related materials, giving a reasonably complete survey of their properties, starting with crystal growth, followed by the electrical and magnetic properties and the behavior of the charge density wave. This part is important because it was in crystals of TTF-TCNQ that more or less all the typical one-dimensional phenomena were first experimentally observed. In addition, this chapter contains descriptions of the properties of some other TTF salts, as well as of the Bechgaard salts $(TMTSF)_2X$. For the latter in particular the superconducting properties of the $(TMTSF)_2PF_6$ and $(TMTSF)_2AsF_6$ salts under pressure are explained. The superconductivity at ambient pressure in $(TMTSF)_2ClO_4$ is mentioned only briefly, and the properties of the many important BEDT-TTF radical salts discovered since 1982 are discussed only on one page, giving some cause for criticism. The original text was written in 1981 in Japan and printed there in 1982. The review on the various materials is therefore more or less complete up to 1980. In the preface the authors mention that in rewriting the volume for the Springer Series in Solid State Science they revised the contents and updated each chapter in the light of recent developments in this field. The updating of all the chapters is, however, by far too short and incomplete, so that in all cases the newest ideas and developments in the field are more or less lacking. In this sense the contents of the volume unfortunately do not represent the "state of the art".

In Chapters IV and V the properties of the inorganic materials MX_3 ($NbSe_3$, TaS_3, $TaSe_3$ etc.) and of the Krogmann salts KCP are described, with an emphasis on the important concept of charge density waves. The optical and magnetic properties, as well as some structural aspects of one-dimensional systems, are also discussed with an account of some experimental results. In the next very short chapter the properties of the linear chain polymers $(CH)_x$ and $(SN)_x$ are presented. Here again the latest experimental results and theoretical ideas on polyacetylene are missing, but the reader is certainly introduced to the problems, and especially to the concept of solitons in polymers. In the last chapter the synthesis, structure, conductivity and superconductivity of the linear chain mercury compounds are discussed.

Despite some criticism, mainly regarding the scant coverage of experimental results since 1980, the volume certainly achieves its aim of providing an introduction to the field of one-dimensional conductors, and it was high time that such a survey was written.

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Graphite Fibers and Filaments. Springer Series in Materials Science, Vol. 5. By *M. S. Dresselhaus, G. Dresselhaus, K. Sugihara, I. L. Spain* and *H. A. Goldberg*. Springer, Berlin/Heidelberg 1988. x, 382 pp., hard cover, DM 122.00.—ISBN 3-540-18938-6

News of the publication of "Graphite Fibers and Filaments" might lead one to ask whether it is really necessary or desirable to add yet another volume to the already existing monographs and review articles on carbon fibers. However, after looking more closely through the contents of this book one can answer yes to the question. One important reason is the topicality of this progress report, as the whole field is certainly still undergoing rapid development; an additional reason of even more crucial importance is that the book concentrates on the physical properties of the fibers.

The idea of writing this book arose at a specialist conference, and the names of the team of authors, from MIT, Colorado State University and Hoechst Celanese, were a guarantee that the material would be competently covered. In doing so the authors have not hesitated to include their original contributions to fill gaps in the literature that became apparent.

Following a brief description of the existing types of fibers, their manufacture is treated in the second chapter. The synthesis of the types of carbon fibers derived from rayon, polyacrylonitrile and mesophase pitch as precursors is briefly covered. More space is given to the preparation and the mechanism of growth of carbon filaments produced by

thermal decomposition of hydrocarbons in the presence of metallic catalysts, the so-called CCVD (catalytic chemical vapor-deposited) filaments.

In the chapter "Structure" a basis is laid down for all the discussions that follow concerning the properties of the fibers. Starting from the crystal structure of graphite and the structural defects that are observed, the different types of filaments with partially graphitic structure are described, as well as highly disordered fibers. The picture thus developed is supported by results from X-ray diffraction, small angle scattering and electron microscopy.

The chapter "Lattice Properties" begins with a description of the lattice dynamics of single crystal graphite and the related elastic constants, and goes on to develop models for the fibers, taking into account the effects of defects. Techniques for structural characterization are described, in particular Raman spectroscopy which provides a sensitive method for non-destructive analysis of the spatial distribution of lattice disorder in carbon fibers.

After the preparatory treatment of fundamentals, the central theme of the book is reached, namely the thermal, mechanical, electronic, magnetic and high-temperature properties of carbon fibers (138 pp.). The anomalous temperature dependence of the in-plane lattice constants and the corresponding temperature dependence of the thermal expansion coefficient are taken as a basis for understanding the experimental behavior of fibers from different sources. The mechanical properties are of crucial importance for technological applications. Although the theoretical tensile strength and elastic modulus of an ideal graphite lattice are not fully realized in practice, the strength-to-mass ratios of fibers and fiber-resin composites are superior to those of metals. The degree of orientation, nature of defects, stacking arrangement of the fibrils, and uniformity of stress within the fiber influence the models and are shown to determine the experimental properties of the technical fibers.

The high degree of ordering in CCVD fibers ensures that, in every chapter of the book, this type is given preferential treatment compared with the fibers based on pitch and polyacrylonitrile which are currently used in engineering applications. The authors expect the production costs of vapor-grown fibers to fall to comparable levels in the future, with market penetration into all areas of application where the short fiber length is adequate.

Special chapters are devoted to intercalation and ion implantation. The intercalation reaction starts at the free ends of the fibers and is facilitated by a high degree of structural order, so here again vapor-grown fibers dominate the discussion. The applications of fibers and composites receive only a condensed treatment in the last chapter (35 pp.).

Of the 500 literature references listed, a large proportion are for the years 1984 to 1987. The detailed subject index (22 pp.) greatly facilitates using the book as a work of reference. However, it would have been desirable to include a summary of the numerical properties of fibers and filaments made by different processes and after-treatments in the form of an appendix table. This well produced book can be recommended without reservation, and has the potential to become a standard work on the physical properties of carbon fibers, especially if the authors are also prepared to take on the job of updating the treatment in the future.

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Thin Liquid Films. Edited by *I. B. Ivanov*. Marcel Dekker Inc, New York 1988. 1160 pp., bound, US $ 295.— ISBN 0-8247-7763-8

The editor has undertaken the tremendous task of bringing together 23 leading experts in the field of liquid films, to contribute to this volume which is intended to cover comprehensively and systematically the major aspects of this rapidly developing field.

Thin liquid films are very important in many technological and biological areas such as oil recovery, coating, the etching or protection of microelectronic elements and cell communication in biology, but these subjects are not covered by this book. Instead it considers basic principles and processes, and there is definitely a need for a well-founded collection and critical evaluation of the status of research in this fundamental area.

The book is organized into 15 chapters with the first six arranged in a logical way whereas the others are important but could partly be presented in a different order. At the beginning there are two chapters on thermodynamics followed by one on the statistical mechanics of inhomogeneous films. Then van der Waals interactions, electrostatic interactions and steric interactions are analyzed and described in consecutive chapters. Very important for the theoretical understanding are the problems of drainage and hydrodynamic stability and this is presumably the reason why these specialized areas are presented following the fundamental theory.

Then a separate chapter is devoted to quasielastic light scattering from liquid films, because this technique shows great promise in the study of dynamic properties. The coalescence of dispersions is then considered theoretically for various practical situations and the results are compared extensively with experimental data. The same holds for the chapter on equilibrium properties of free films and the stability of foams and emulsions. The section on interfacial rheological properties of surfactant films then presents experimental data and briefly relates them with theoretical models.

The next chapter then considers ordering processes and forces in liquid crystalline films, comparing theory and experiment. A long chapter on black lipid membranes then mostly concentrates on electrochemical and photochemical studies displaying relevant theories and drawing many conclusions about biological processes (bioenergetics and physiology). In the final chapter the electrical breakdown of bilayer lipid membranes is analyzed theoretically. This process