

fects, including the evidence for their existence, and methods for establishing their density, but must also include discussion of such related categories as the means by which the defects are created, how they can be avoided, and their influence on basic properties of the crystal. To abstract the principal features from such an extensive discipline and to present the details in a coherent exposition, and within the confines of a volume that hopefully can be acquired by the average scientist, calls for considerable organizational ability on the part of the author. Rhodes has met this challenge quite admirably. By restricting the scope to phenomena of importance in germanium and silicon, he has achieved significant abridgment. This does not preclude references to other materials when a point is to be illustrated; indeed numerous results are quoted for alkali halides as well as various metals, but it does avoid consideration of various phenomena unique to certain compounds—for example, polar effects and faceting.

The organization of the book is such that the introductory chapter, which is devoted to definitions and qualitative explanations of various concepts, is followed by three chapters concerned with dislocations and their detection and with various aspects of plastic deformation. The next three chapters treat the growth of single crystals, the distribution and control of impurities, and the chemical and physical behavior of impurities, including diffusion and precipitation phenomena. The next chapter reviews, in fair detail, the salient findings from radiation damage studies on germanium and silicon, including annealing behavior. The final chapter deals with etching and the nature of various types of etch pits and includes a list of some of the principal etchants for germanium and for silicon.

Throughout the volume metallurgy and chemistry are emphasized—for example, in the discussion of the physics of transport processes we must accept the author's word when he makes the following statement in the preface: "It has been assumed that the reader will have some prior acquaintance with the subject of semiconductors. Electronic transport processes and solid-state device behaviour have already been comprehensively discussed in the literature and are adequately covered in the other monographs of this Series." In fact, in view of the

scope of the book, the discussion of electrical properties is, for the most part, adequate to bring out the influence of the chemical and physical defects. But, in several places, the rudimentary presentation might lead uninitiated readers astray. For example (p. 209), Rhodes gives an expression for resistivity which is valid when both holes and electrons participate in the conduction process, although he states that the equations are valid only in the *extrinsic* conduction range (that is, one type of carrier only). On the next page he gives an expression for the Hall coefficient which is valid strictly for a single-type carrier. This restriction might, however, be missed if the reader is unfamiliar with the equation. Recent findings concerning certain "hard" superconductors have apparently been responsible for the statement: "The possibility also exists that the dislocations act as high-conductivity channels, the electrons moving from one free bond to another along the dislocation line" (p. 263). But here we are dealing with semiconductors, and I assume the author does not mean to imply that inducing the right dislocation in the right semiconductor might yield a superconductor.

But these are isolated instances. The book is exceptionally well put together, with an unusual paucity of ambiguities and typographical errors. It is valuable as an up-to-date review article, containing some 550 references (of which 425 cover work during the last decade). Its lucid and detailed presentation will make the volume useful as a teaching aid for students, scientists, engineers, and technologists whose interests encompass semiconductors and related solid-state fields.

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Mathematics

Differential Equations with Applications. Herman Betz, Paul B.urcham, and George M. Ewing. Harper and Row, New York, ed. 2, 1964. xiv + 354 pp. Illus. \$7.50.

In this country there seems to be a trend toward divorcing mathematics from its applications. This is an unfortunate trend which would present a subject like differential equations as a sterile and static logical exercise in

axiomatics instead of presenting it as a dynamic and fertile subject whose existence and development is inexorably intertwined with the physical sciences. Therefore, it is good to see the second edition of a book on differential equations, for this is a book in which a great variety of applications form an integral part of the presentation. In the first edition, the applications covered included motion of a particle, mechanical and electrical vibrations of one and two degrees of freedom, and the law of mass action, and biological genetics. In the second edition, rocket motion and planetary motion have been added.

In most respects the second edition is better than its predecessor. The authors have put somewhat more emphasis on "concepts" and less on "formal dexterity." This is to be commended. However, in my opinion, the authors could have gone even farther in this direction. Somewhat more emphasis could have been placed on the fundamental existence theory. There is no reason why theory and application cannot be treated in the same book.

In balance, the book is a good one and should continue to find considerable use in a first course in differential equations for scientists and engineers.

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Physics

Laser Abstracts. vol. 1. A. K. Kamal. Plenum Press, New York, 1964. viii + 177 pp. \$12.50.

Several bibliographies of publications related to lasers have been published during the last few years. However, the number of papers listed is large, and the reader must rely on the information contained in the titles in deciding which papers he wishes to investigate. A collected set of abstracts seems desirable, as long as the number of volumes required does not become too large.

Kamal's *Laser Abstracts* appears to give quite complete coverage of the papers in the field up to mid-1963. The large majority of the 731 abstracts are well written and accurate. On the average, the abstract is about twice as long as the reference citation. The cross indexes provided by the publisher