Introduction to the Electronic Properties of Materials, *2nd Ed.*

David Jiles (Nelson Thornes Ltd., Cheltenham, UK, 2001)
xxiii + 418 pages
ISBN 0-7487-6042-3

David Jiles provides an excellent introduction to the electronic properties of materials, clearly linking these properties to macroscopic as well as microscopic observables. The author treats the material on a broad, comprehensive level, rather than digging deeply into any one topic. This provides a very nice introduction for undergraduate students with little advanced coursework or for others with no experience in condensed-matter physics, but it lacks some of the more thorough explanations. For example, Jiles shows the bcc and fcc reciprocal lattices and states the symmetry points, but does not explain why the L point in reciprocal lattice space is described by ⟨1/2, 1/2, 1/2⟩. There is no mathematical or physical demonstration of how fcc and bcc lattices are reciprocals of one another, although it is verbally stated in the text.

The subject matter is divided into appropriate sections and subsections, each with an introductory question that helps to target the point of the particular section. There are a number of occasions in which Jiles makes statements that appear unsubstantiated, but often the conclusion that is drawn is more fully developed in a later section of the text. While a forward reference to the upcoming discussions would be useful, the patient reader will find a relatively complete discussion of most concepts that are introduced. Figures are simple and relatively straightforward, although often they lack explanation of the finer details. There are references and suggested readings at the end of each chapter, and the applications chapters contain updated, recent references.

Jiles first develops the free electron model from the classical picture (i.e., equations of motion) before moving to the quantum mechanical picture in Chapter 4. This is a very nice touch for an undergraduate course, where the students' facility with quantum mechanics is limited. Many introductory texts become very obtuse when it comes to optical properties, but Jiles presents these concepts at an accessible level for the reader new to the subject, with a particularly nice development of optical reflectivity. While the first 10 chapters focus on basics, the final five chapters highlight more contemporary topics and applications. The selection of topics and the inclusion of many basic definitions provide an excellent foundation for the reader to take off and pursue the topics that pique his or her interest, including topics that many classic introductory texts neglect, such as high-temperature superconductivity, magnetic recording media, semiconductor lasers, and fiber optics.

This book would be useful for self-study or for use in an introductory solid-state physics course at the sophomore/junior level. The selection of exercises at the end of each of the first 10 chapters is extensive and appropriately varied, and the worked solutions are thorough—of great benefit to the student who has already seriously attempted the problems. Since most of the discussion in the text is qualitative, with appropriate equations interspersed, this book would provide a solid foundation for a lecture course into which an instructor could infuse derivations and deeper quantitative discussions where appropriate and desirable.

Reviewer: *Linda Olafsen is an assistant professor in the Department of Physics and Astronomy at the University of Kansas and is a member of the Materials Research Society Book Review Board. Her semiconductor physics research is focused on the study of optical and electronic properties of antimonide-based heterostructures for the development of more efficient high-temperature semiconductor lasers and detectors.*

Silicon Processing for the VLSI Era
Volume 4: Deep-Submicron Process Technology

Stanley Wolf
(Lattice Press, Sunset Beach, Calif., 2002)
xxii + 806 pages, $199.95
ISBN 0-9616721-7-X

Volume 4 of Stanley Wolf's series on *Silicon Processing for the VLSI Era* is an impressive compilation of processing technology descriptions and device structures used in "deep-submicron" (0.18 μm and smaller) integrated circuits. The content of Volume 4 is aimed at the practicing semiconductor process or device engineer who would benefit from a single-reference compilation of published work in the field. The "integration" of material from over 900 references and the presentation of that material in a coherent way form the primary value of this book. Key topics included in the book are device structures (e.g., metal oxide semiconductor field-effect transistors, shallow trench isolation, heterojunction bipolar junction transistors, and silicon-on-insulator complementary metal oxide semiconductors) and fabrication processes (e.g., chemical–mechanical polishing, thin gate dielectrics, high-κ dielectrics, low-κ dielectrics, advanced lithography, multilevel interconnects, contacts, and copper technology).

This is the first book written exclusively on deep-submicron device structures and technology. The book is also unique in its approach at integrating the requirements for improved semiconductor device performance with fabrication technology solutions. However, Volume 4 is distinctly different from the previous three volumes written by Wolf. I have used Volume 1 (first and second editions) in my graduate course in silicon processing since 1986. Despite the large number of books on silicon fabrication technology, Wolf's Volume 1 contains fundamentals and basics that are suitable for a graduate course. Wolf has a unique ability to read the literature and then to compile relevant information in an understandable format for others to digest. Volume 4, which does not overlap much with the other three volumes, is more about technology than fundamentals. For example, Chapter 8 is on chemical–mechanical polishing (CMP) and covers 120 pages with 105 references. CMP is currently a key technology and is widely practiced by semiconductor manufacturers. Chapter 8 mainly covers practical issues such as CMP equipment, cleaning issues, metrology, polisher tool reliability, and processes for polishing various materials such as metals and dielectrics. All of these topics are suitable for a reference book on the subject and less suitable for a textbook. By contrast, Chapter 12 on multilevel interconnections for ultralarge-scale integration is only about 25 pages long and covers design issues and the historical aspects of interconnects. This significant topic is covered more completely in Volumes 1 and 2. Perhaps one of the more important, unique topics covered is copper interconnect process technology in Chapter 16. Wolf gives a greatly expanded treatise on copper (76 pages) over what is in Volume 1 (second edition). Eighty-five references are cited for additional investigation.

Thus, the true value of *Silicon Processing for the VLSI Era*, Volume 4, is twofold: (1) It serves as a reference for gaining an overview on how today's semiconductor technologies are practiced, and (2) the book is also a pointer to additional sources of background and details in the extensive scientific and engineering literature cited at the end of each chapter.

Reviewer: *Richard B. Fair is a professor of electrical and computer engineering at Duke University. He is a fellow of the Institute of Electrical and Electronics Engineers (IEEE) and of the Electrochemical Society (ECS). He is a recipient of the IEEE Third Millennium Medal (2000) and the 2003 Solid-State Science and Technology Prize and Medal from ECS.*

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Structure and Bonding in Crystalline Materials

Gregory S. Rohrer
(Cambridge University Press, Cambridge, UK, 2001)
540 pages, $45.00
ISBN 0-521-66379-2

The request to review this book came at a great time. I found out I was going to teach crystallography for the first time and I was looking for a text. There are, of course, a number of excellent books on crystallography, including many sentimental favorites. Unfortunately, many of these classics are out of print, so the number of useable texts is small. I had great hopes when I received this book in the mail, and I am glad to say they have been mostly satisfied.

The text is based on a course G.S. Rohrer developed that combines an understanding of bonding with the resulting crystal structures. Instead of a very formal treatment, he stresses the physical elements that lead to crystal formation. The first half is organized similarly to other standard texts on crystallography—starting with a brief discussion of bonding, followed by chapters on the basic concepts of crystallinity, symmetry, a review of crystal structures, and a discussion of x-ray diffraction. The second half of the text is reserved for a more extensive treatment of bonding. Because of the emphasis on bonding in the second half, the first chapters are not as detailed as some other texts, but the description is adequate and clear. The chapters on bonding served as an excellent resource and a way to go into certain concepts in more detail.

Most of the issues that I wanted to include in the course could be found in the text. One great strength of the book is the many useful tables of data provided. The tables of compounds that have the same crystal structure make it easy to understand trends across the periodic table. There are also a large number of worked problems in the text. The biggest drawback is that there is no solutions manual to the problems.

Although I would recommend this book primarily as a text for a course, the practitioner who wants a reference or wants to learn more about crystallography will find it readable, easy to use, and informative. With the cost of books being what they are, I only require texts if I think they will be ones that the students will want to have on their shelves to pull down as references in the future. I think this is one that my students will be glad to have up there.

Reviewer: *Eric Chason is an associate professor in the Division of Engineering at Brown University. His research has focused on the evolution of surfaces and thin films during materials processing.* □

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