PREFACE

THIRD EDITION

The textbook represents a first course in electronic materials and devices for undergraduate students. With the additional topics in the accompanying CD, the text can also be used in a graduate introductory course in electronic materials for electrical engineers and material scientists. The third edition is an extensively revised and extended version of the second edition based on reviewer comments, with many new and expanded topics and numerous new worked examples and homework problems. While some of the changes appear to be minor, they have been, nonetheless, quite important in improving the text. For example, the intrinsic concentration n_i in Si is now taken as 1×10^{10} cm^{-3}, instead of the usual value of 1.45×10^{10} cm^{-3} found in many other textbooks; this change makes a significant difference in device-related calculations. A large number of new homework problems have been added, and more solved problems have been provided that put the concepts into applications. Bragg's diffraction law that is mentioned in several chapters is now explained in Appendix A for those readers who are unfamiliar with it.

The third edition is one of the few books on the market that has a broad coverage of electronic materials that today's scientists and engineers need. I believe that the revisions have improved the rigor without sacrificing the original semiquantitative approach that both the students and instructors liked. Some of the new and extended topics are as follows:

Chapter 1	Thermal expansion; atomic diffusion
Chapter 2	Conduction in thin films; interconnects in microelectronics; electromigration
Chapter 3	Planck's and Stefan's laws; atomic magnetic moment; Stern–Gerlach experiment
Chapter 4	Field emission from carbon nanotubes; Grüneisen's thermal expansion
Chapter 5	Piezoresistivity; amorphous semiconductors
Chapter 6	LEDs; solar cells; semiconductor lasers
Chapter 7	Debye relaxation; local field in dielectrics; ionic polarizability; Langevin dipolar polarization; dielectric mixtures
Chapter 8	Pauli spin paramagnetism; band model of ferromagnetism; giant magnetoresistance (GMR); magnetic storage
Chapter 9	Sellmeier and Cauchy dispersion relations; Reststrahlen or lattice absorption; luminescence and white LEDs
Appendices	Bragg's diffraction law and X-ray diffraction; luminous flux and brightness of radiation

ORGANIZATION AND FEATURES

In preparing the text, I tried to keep the general treatment and various proofs at a semiquantitative level without going into detailed physics. Many of the problems have been set to satisfy engineering accreditation requirements. Some chapters in the text have additional topics to allow a more detailed treatment, usually including quantum mechanics or more mathematics. Cross referencing has been avoided as much as possible without too much repetition and to allow various sections and

chapters to be skipped as desired by the reader. The text has been written to be easily usable in one-semester courses by allowing such flexibility.

Some important features are

- The principles are developed with the minimum of mathematics and with the emphasis on physical ideas. Quantum mechanics is part of the course but without its difficult mathematical formalism.
- There are more than 170 worked examples or solved problems, most of which have a practical significance. Students learn by way of examples, however simple, and to that end nearly 250 problems have been provided.
- Even simple concepts have examples to aid learning.
- Most students would like to have clear diagrams to help them visualize the explanations and understand concepts. The text includes over 530 illustrations that have been professionally prepared to reflect the concepts and aid the explanations in the text.
- The end-of-chapter questions and problems are graded so that they start with easy concepts and eventually lead to more sophisticated concepts. Difficult problems are identified with an asterisk (*). Many practical applications with diagrams have been included. There is a regularly updated online extended *Solutions Manual* for all instructors; simply locate the McGraw-Hill website for this textbook.
- There is a glossary, *Defining Terms*, at the end of each chapter that defines some of the concepts and terms used, not only within the text but also in the problems.
- The end of each chapter includes a section *Additional Topics* to further develop important concepts, to introduce interesting applications, or to prove a theorem. These topics are intended for the keen student and can be used as part of the text for a two-semester course.
- The end of each chapter also includes a table *CD Selected Topics and Solved Problems* to enhance not only the subject coverage, but also the range of worked examples and applications. For example, the selected topic *Essential Mechanical Properties* can be used with Chapter 1 to obtain a broader coverage of elementary materials science. The selected topic *Thermoelectric Effects in Semiconductors* can be used with Chapters 5 and 6 to understand the origin of the Seebeck effect in semiconductors, and the reasons behind voltage drift in many semiconductor devices. There are numerous such selected topics and solved problems in the CD.
- The text is supported by McGraw-Hill's textbook website that contains resources, such as solved problems, for both students and instructors. Updates to various articles on the CD will be posted on this website.

CD-ROM ELECTRONIC MATERIALS AND DEVICES: THIRD EDITION

The book has a CD-ROM that contains all the figures as large *color diagrams* in *PowerPoint* for the instructor, and class-ready notes for the students who do not have to draw the diagrams during the lectures. In addition, there are numerous *Selected Topics* and *Solved Problems* to extend the present coverage. These are listed in each chapter, and also at the end of the text. I strongly urge students to print out the CD's *Illustrated Dictionary of Electronic Materials and Devices: Third Student Edition,* to look up new terms and use the dictionary to refresh various concepts. This is probably the best feature of the CD.

ACKNOWLEDGMENTS

My gratitude goes to my past and present graduate students and postdoctoral research fellows, who have kept me on my toes and read various sections of this book. I have been fortunate to have a colleague and friend like Charbel Tannous

who, as usual, made many sharply critical but helpful comments, especially on Chapter 8. A number of reviewers, at various times, read various portions of the manuscript and provided extensive comments. A number of instructors also wrote to me with their own comments. I incorporated the majority of the suggestions, which I believe made this a better book. No textbook is perfect, and I'm sure that there will be more suggestions for the next edition. I'd like to personally thank them all for their invaluable critiques, some of whom include (alphabetically):

Çetin Aktik University of Sherbrooke

Emily Allen San Jose State University

Vasantha Amarakoon New York State College of Ceramics at Alfred University

David Bahr Washington State University

David Cahill University of Illinois

David Cann Iowa State University

Mark De Guire Case Western Reserve University

Joel Dubow University of Utah

Alwyn Eades Lehigh University

Stacy Gleixner San Jose State University

Mehmet Günes Izmir Institute of Technology

Robert Johanson University of Saskatchewan

Karen Kavanagh Simon Fraser University

Furrukh Khan Ohio State University

Michael Kozicki Arizona State University

Eric Kvam Purdue University

Hilary Lackritz Purdue University

Long C. Lee San Diego State University

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Pierre Pecheur University of Nancy, France

Aaron Peled Holon Academic Institute of Technology, Israel

John Sanchez University of Michigan, Ann Arbor

Christoph Steinbruchel Rensselaer Polytechnic Institute

Charbel Tannous Brest University, France

Linda Vanasupa California Polytechnic State University

Steven M. Yalisove University of Michigan, Ann Arbor

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"The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them."

Sir William Lawrence Bragg

To Nicolette