Fundamentals of Polymer Engineering, *2nd Ed., Revised and Expanded*

Anil Kumar and Rakesh K. Gupta
(Marcel Dekker, 2003)
712 pp.; $175.00
ISBN 0-8247-0867-9

This textbook is an updated and expanded version of the original book by the same authors, titled *Fundamentals of Polymers*. The text provides all of the expected content for an introductory course on polymer science, as seen in other texts like *Introduction to Polymers* (CRC Press, 1991) by R.A. Young and P.A. Lovell or *Fundamentals of Polymer Science* (CRC Press, 1997) by P. Painter and M. Coleman. There is a substantial background on polymer chemistry (much more than in Painter and Coleman), as well as an extensive discussion of reaction engineering using polymerizations. Also included are discussions of molecular-weight characterization techniques, thermodynamics of mixing, and rubber elasticity. There is a section on polymer crystallization, and a detailed discussion of the mechanical properties of polymer solids. There is also an extended treatment of polymer diffusion and flow behavior. The book concludes with an overview of polymer processing techniques, with a particularly detailed treatment of fiber spinning. Overall, there is a similar amount of chemical detail as that seen in Young and Lovell, with some of the processing details found in earlier editions of the F. Rodriguez text on *Principles of Polymer Systems* (Taylor & Francis, 1996), which has itself been recently upgraded and expanded.

Topics new to this edition by Kumar and Gupta are dendrimers, recycling, solubility parameters, and inorganic nanocomposites. There are brief discussions of liquid-crystalline polymers, and the information on x-ray diffraction is short, but still present. There is a nice section on birefringence and optical microscopy and its application to oriented polymer filaments.

Somewhat disappointing is the lack of discussion on spectroscopic characterization techniques such as nuclear magnetic resonance and Fourier transform infrared spectroscopy. While there is a chapter on molecular-weight characterization, no information about matrix-assisted laser desorption ionization–time-of-flight mass spectrometry techniques is presented, even though this recently developed high-resolution approach has revolutionized the detailed analysis of the detailed molecular weight of polymer mixtures. Clearly the focus of the text is on engineering issues, as is now directly reflected in the modified title.

Overall, this text provides an excellent overview of the field, and the extended sets of problems given at the end of every chapter should facilitate its use in a first course on polymer science and engineering. Furthermore, the expanded content on processing should also make it useful as a reference book and in courses that focus more on rheology and manufacturing. Perhaps the only serious limitation is that it is not yet available in a paperback version.

Reviewer: *David Martin is director of macromolecular science and engineering and a professor of materials science and engineering and biomedical engineering at the University of Michigan. He is a member of* MRS Bulletin*'s Book Review Board.*

Silicon: Evolution and Future of a Technology

P. Siffert and E. Krimmel
(Springer, 2004)
549 pp.; $139.00
ISBN 3-540-40546-1

Silicon: Evolution and Future of a Technology provides an interesting historical perspective on the semiconductor industry. As Si technology matures, this book looks back at some of the challenges faced by early researchers in this field. A collection of articles written by experienced researchers who have made seminal contributions, this book is a must for anyone interested in the evolution of Si technology. The initial sections of the book provide an overview of various technologically significant forms of Si (e.g., single-crystal Si, polycrystalline Si, amorphous hydrogenated Si, and porous Si), their properties, growth, and application to electronic devices. Subsequent sections deal with such varied topics as defect spectroscopy, doping techniques, the effect of impurities, and the pivotal role of Si in the development of novel scientific techniques such as scanning electron microscopy.

The latter half of the book provides an overview of the impact of Si on semiconductor power devices and looks at the future of Si technology from a device perspective. This section of the book discusses novel concepts with the potential to revolutionize the semiconductor industry and possibly replace Si. Emerging device concepts such as carbon-nanotube-based switching devices, alternate computing schemes using electron spin, and the possible amalgamation of conventional semiconductor circuits with biological circuits are discussed.

With the range of topics covered, this book should be of interest to a wide audience, from materials scientists to device engineers and anyone with an interest in the history of the semiconductor industry. Despite the number of contributors to this work, a consistent standard and an underlying thread of continuity between chapters have been maintained. The articles, intended to provide a high-level overview of the various topics covered, do not require a high level of expertise in the field and can be understood at the advanced undergraduate level.

Reviewer: *Dinkar V. Singh is a research staff member at the IBM T. J. Watson Research Center. His research focuses on exploratory complementary metal oxide semiconductor device scaling concepts.*

Field Mathematics for Electromagnetics, Photonics, and Materials Science: A Guide for the Scientist and Engineer *(Tutorial Texts in Optical Engineering, Vol. TT64)*

Bernard J. Maxum
(SPIE Press, 2004)
272 pp.; $56.00
ISBN 0-8194-5523-7

The *Tutorial Texts* series, to which this book belongs, features expository material followed by detailed examples that further explain the concepts presented. Maxum stayed faithful to this style and has provided an excellent reference text for students, educators, and professionals alike. The organization of the book facilitates its use. The table of contents lists, in detail, the sections and subsections of five chapters, four appendices, examples, and applications, ensuring that the reader does not need to search the full text for the desired topic. From the introduction, through vector algebra, tensor analysis, and vector calculus differential and integral forms, the author has thoughtfully covered the essential mathematics necessary to understand the growing fields of photonics and materials science, with the appendices extending and supporting the material encountered in the main text.

The format of the text also leads to leisurely reading, with an enlightening use of figures and appropriate featuring of important points. Maxum's extensive experience in electrical engineering and optical communications and as a teacher is evident in the text. With clear and concise language, the author explains the physical implications of mathematical equations. Even those who have not been introduced to tensor analysis will feel at ease with the subject after reading the thorough introduction to the field in the first chapter. The author has taken special care with notation, highlighting the meaning it carries and the diverse representations of mathematical entities. Every chapter includes simple applications and

examples that clarify the importance of the concept just exposed.

The overriding objective of the book is to offer a review of vector calculus needed for physical sciences and engineering, which it clearly fulfills. Beyond that role, this book is especially beneficial to those interested in understanding the application of nonlinear optical effects in optical systems. If one is in search of a sole reference to the mathematics of the field of photonics, this text is certainly an excellent choice. (Downloadable sample pages are available from the SPIE Web site at www.spie.org.)

Reviewer: *Suely M. Black is a computational chemist and a member of the Center for Materials Research at Norfolk State University, coordinating the center's educational programs. She teaches general chemistry and mathematical methods and logic for physical sciences. Her research interests are in the influence of long-range interactions on electro-optical properties.*

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