Biomaterials Science: An Introduction to Materials in Medicine, *2nd Ed.*

Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, and Jack E. Lemons, Eds.
(Elsevier Academic Press, 2004)
851 pages; $95.00
ISBN 0–12–582463–7

Biomaterials science is a multidisciplinary field encompassing various research areas including materials science, materials engineering, biology, biochemistry, and medicinal chemistry. The second edition of *Biomaterials Science: An Introduction to Materials in Medicine* is the most thorough textbook available, covering most aspects of biomaterials science. The authors are experts in each bio-related research field and wrote their specialized sections from recent journal articles of their own and others. Therefore, the book provides the most up-to-date and in-depth information on biomaterial developments.

The second edition, like the first, is composed in three parts: (1) materials science and engineering; (2) biology, biochemistry, and medicine; and (3) practical aspects of biomaterials. The first part of the book covers general properties of various commonly used classes of materials in medicine. The second part focuses on basic concepts in biology, host reactions, biomaterial testing methods, tissue engineering, and the applications of biomaterials. The last part addresses development-related issues such as ethical issues and implant and device failure. However, the last two chapters of the second part would be better if they were combined with the third part to form an "individual applications" part. The book would then be more naturally and logically structured with materials–general, bio–general, and individual applications parts.

The second edition is nearly twice as thick as the first edition. The increased volume of the first part covers more surface-focused materials science and polymeric materials, for example, non-fouling surfaces and smart polymers. A newly added chapter in the second part introduces a hot topic in biomaterials science: tissue engineering and its applications. The biomaterials applications chapter has also been extended to cover various individual applications of biomaterials, including intraocular lens implants, implantable cardiac devices, and extracorporeal artificial organs, as well as biosensors, sutures, drug delivery, dental and orthopedic applications, and skin substitutes.

The 851-page textbook with a double-column layout contains such extensive information that it could be challenging for a student who does not have enough background in the related matters to read this book without guidance. I have used this book for a senior course, "Design and Applications of Biomaterials," since last year. The most important take-home messages were extracted from the book and assembled into a course package. The book then became an excellent reference. The thorough reference lists at the end of each section are great resources for students to find actual research papers related to topics of interest.

One additional note: all of the figures and artwork in the book are in black and white. Although 16 pages featuring color versions of some images are inserted in the middle of the book, I wish the publisher had used color artwork throughout the text.

Reviewer: *Jinsang Kim is an assistant professor of Materials Science and Engineering, Chemical Engineering, Macromolecular Science Engineering, and Biomedical Engineering at the University of Michigan, Ann Arbor. Kim's research group is developing conjugated polymer-based biosensors with support from the National Science Foundation.*

Principles of Quantum Computation and Information, *Volume I*: Basic Concepts

Benenti Guiliano, Guilio Casati, and Guiliano Strini
(Imperial College Press, 2004)
272 pages; $58.00
ISBN 981-238-830-3

The authors present the basic principles of quantum computation and quantum information in a very clear and concise way. The first volume consists of about 250 pages, dealing with the basics of classical computation, quantum mechanics, quantum computation, and quantum communication. As technical and mathematical details are omitted, the book is very well suited as a guide to an introductory course in quantum computation and information for undergraduate and graduate students in physics, mathematics, and physics-related disciplines. Students and researchers who are interested in learning more details can find very useful information about recent publications in the guide to the bibliography at the end of each chapter.

Chapter 1 gives an easy-to-read introduction to classical computation, including the classical Turing machine, classical logical operations and their circuit diagrams, classical computational complexity, and the connection between classical information theory and physics. Chapter 2 gives a brief introduction to the basic quantum mechanics needed to understand the superposition of quantum states and the entanglement of two particles. Chapter 3 presents the basic principles of quantum computation, going from explaining the quantum bit (qubit) by means of the Bloch sphere, over universal quantum gates to quantum algorithms, such as Deutsch's algorithm, Grover's quantum search algorithm, and Shor's quantum prime factorization algorithm. Chapter 4 starts with an introduction to classical cryptography and segues via the no-cloning theorem into the theories of quantum cryptography, dense coding, and quantum teleportation. Last, but not least, the appendix gives all the solutions to the exercises in the book, which is very helpful for students.

This book is not only easy to read, but also highly recommendable to busy scientists and researchers who want to get a quick introduction into the fields of quantum computation and information in a short amount of time.

Reviewer: *Michael N. Leuenberger is an assistant professor in theoretical physics at the Nanoscience Technology Center and the Department of Physics at the University of Central Florida.*

Principles of Lithography, *2nd Ed.*

Harry J. Levinson
(SPIE Press, 2005)
438 pages; $84.00
ISBN 0–8194–5660–8

This book covers various aspects of photolithography; mask, stepper optics, photoresist, and the attendant resist processing steps; and inspection and metrology. It also briefly covers immersion lithography, which is the most recent approach for extending optical lithography. The timing of this book is excellent because it has been just in the last two years that liquid immersion lithography has gone from being a dark horse in the litho races to being the front runner. In addition, the author briefly reviews alternatives to optical lithography, such as electronic beam, x-ray, extreme ultraviolet, and imprint lithography. One chapter covers cost of ownership issues, which is key in an industry where the exposure and inspection tools costs are measured in the tens of millions of dollars.

Principles of Lithography is intended to provide an overview of optical lithography, and it succeeds. I found this book very easy to read. Having one author bring all this material together, compared with the alternative approach of having a different author for each chapter, has its advantages. There is no problem locating where in the book to find a particular graph or figure. The index is a little light, but the organization of the book is clear and the table of contents is very good, so I was always able to find information I was looking for quickly. The book is also designed to be used as a textbook for graduate-level instruction, with problem sets at the back of each chapter.

This book does not try to treat each subject exhaustively, but gives an introduction and some analysis of the important lithography topics. There are extensive references at the back of each chapter. It is a good idea to hang on to other lithography books that treat some topics in more detail, but since this field is advancing rapidly, it is probably best that only the basics are covered in this book, with the reader needing to consult the latest literature for "fast-breaking" news. *Principles of Lithography* is an excellent book for anyone interested in getting an introduction to microlithography. It also serves as a good reference book for lithographers and as a guide to the broad literature supporting microlithography. I will keep it handy on my bookshelf.

Reviewer: *Don Pettibone is a principal design engineer at KLA-Tencor, a manufacturer of semiconductor inspection and metrology equipment. He received his PhD degree in applied physics from Stanford University, and has worked at KLA-Tencor for seven years in the photomask and wafer inspection divisions.*

Welding Metallurgy and Weldability of Stainless Steels

John C. Lippold and Damian J. Kotecki
(Wiley-Interscience, 2005)
357 pages; $115.00
ISBN 0–471–47379–0

The early chapters provide a concise overview of the physical metallurgy of stainless steels that would benefit undergraduate students as well as engineers in industrial practice. The authors introduce the definition of stainless steel at the outset and clarify certain myths (e.g., that stainless steels do not corrode). In Chapter 2, the authors introduced phase diagrams and eloquently describe the appropriate binary and ternary diagrams for stainless steels. A clear description of various alloying elements, carbide formers, and a comparison of austenite- and ferrite-promoting elements form the heart of Chapter 3. The concept of constitution diagrams for wrought as well as weld microstructures is presented with very good diagrams for explanation. Also included are introductions to austenitic–martensitic and ferritic–martensitic alloy systems.

Chapters 4–8 provide individual discussions of martensitic, ferritic, austenitic, duplex, and precipitation-hardening stainless steels, respectively. Each chapter is sufficiently detailed in describing the standard alloys and consumables, physical and mechanical metallurgy, welding metallurgy, mechanical properties of weldments, and weldability, and each includes a case study. This approach makes the book reader-friendly; it is a delight to read. A complete chapter is dedicated to dissimilar welding of stainless steel and is pertinent for those who assume that any two materials can be welded. The inherent problems frequently encountered in welding dissimilar materials are clearly explained. Chapter 10 contains issues related to the testing of welds. The appendices provide an abundance of data and excellent reference material on the composition of stainless steels and etching techniques for them.

It surely would have been useful if the authors had included a separate chapter on different welding techniques to introduce readers to the topic of welding and its practice. This would have provided an overview to complement the rest of the book.

To conclude, the book has a wealth of information and is written in a concise, informative manner, making it easy to read and digest. The topics covered are wonderfully illustrated with graphs, photomicrographs, and tables.

Reviewer: Sudhi Sant is president and founder of Twin Technologies Inc. in Garden Grove, California, and has more than 15 years of materials science and metallurgical engineering experience, covering a range of processes and applications.

Introductory Applied Quantum and Statistical Mechanics

Peter L. Hagelstein, Stephen D. Senturia, and Terry P. Orlando
(John Wiley & Sons, 2004)
785 pages; $99.95
ISBN 0–471–20276–2

Richard Feynman concludes his famous *Lectures on Physics* by telling his readers he wanted to give them "some appreciation of the wonderful world and the physicist's way of looking at it, which, I believe, is a major part of the true culture of modern times." The book that Hagelstein, Senturia, and Orlando have produced is a wonderful tool for teaching quantum mechanics to engineering students, and continues the mission to which Feynman contributed so well for physics students.

The approach of this book is refreshingly hands-on, where proofs are not given, but concepts are described and discussed carefully (too tersely at times), and several practical guides to the solution of problems are found throughout. There are also a number of historical descriptions on the origin of ideas, and comparisons with classical problems or limits when appropriate. The authors' approach is very intuitive, and bootstraps several quantum concepts from basic considerations on the classical notions, Fourier expansions, or general other mathematical concepts. The chapters flow in an easy-to-read fashion, and one gets the sense that the authors have purposely kept the cumbersome notation to a minimum. There are few items that are intended to be controversial or that dwell in the interpretation of quantum mechanics. The quantum nature of matter and its consequences is taken as such. They "*describe* the behavior of a quantum mechanical particle" rather than *explain* it, and that philosophy of teaching contributes to the ease of reading. I would prefer, however, to find a few strategic footnotes directing the interested student to issues on interpretation or quantum measurement, for example.

The book makes a number of contributions that are most interesting, especially at the first-year graduate level at which this is directed. The description of squeezed states and the quantization of the LC circuit, as well as the introduction of Bloch equations and Rabi oscillations for two-level systems, and the concept of logical quantum gates, are all clearly and physically motivated, and very up to date. These topics bring students nearly to a point where they can read the current literature on a variety of areas, including optical pumping, coherent oscillations of quantum systems, and mesoscopic superconducting structures. On the other hand, the book makes no mention of Landau levels (or the quantum Hall effect!), the Aharonov–Bohm effect, or flux quantization, to name but a few topics in current use in the literature.

I found Chapter 16, Finite Basis Approximation, to be extremely useful, even for seasoned students. In my experience, most students do not fully grasp the notion that a truncated basis is essentially a variational approach for the solution of a problem, and this chapter describes it beautifully. Similarly, the collection of problems at the end of each chapter is very good and at times quite creative. It complements the material in the text very well.

In short, this book is a great contribution to the hands-on approach of teaching quantum mechanics. I would recommend this book as a useful and brief introduction for materials scientists interested in quantum aspects. I also strongly recommend it to physics students preparing for a final or qualifying exam. They can read briefly about the important topics and remind themselves of basic concepts and how to practically approach problems.

Reviewer: Sergio Ulloa is professor of physics at Ohio University and often teaches courses in quantum and statistical mechanics. He works on the theoretical description of quantum dots and other nanostructures and their interaction with external fields.

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