

BOOK REVIEWS

Nanophotonics

Paras N. Prasad, 432 pages, ISBN 0-471-64988-0, John Wiley & Sons, Hoboken, New Jersey (2004), \$84.95 hardcover.

Reviewed by Barry R. Masters, Fellow of SPIE and OSA, consultant. E-mail: brmail2001@yahoo.com

Nanophotonics is a burgeoning discipline that embraces the intersection of nanotechnology and photonics—focusing on the manipulation of atoms and molecules on the nanometer scale in order to formulate new materials with unique optical and electronic properties. It is a multifaceted field incorporating quantum dots, surface plasmon resonance, near-field optics, nonlinear optical materials, laser technology, bandgap devices, nanosensors, and integrated optical devices for diagnostics and therapy. In his book *Nanophotonics*, Paras N. Prasad highlights three major components of the field: nanoscale confinement of radiation, nanoscale confinement of matter, and nanoscale photoprocesses.

Prasad is a well-suited author for this multifaceted subject. He is the SUNY Distinguished Professor of Chemistry, Physics, Electrical Engineering, and Medicine and the Executive Director of the Institute for Lasers, Photonics, and Biophotonics at the University of Buffalo where he conducts research and teaches courses on biophotonics. Prasad has also taught multidisciplinary courses on nanophotonics at Buffalo and at SPIE meetings.

In *Nanophotonics*, Prasad provides his readers with an introductory-level, multifaceted description of the field. He intended this book to be used as either a textbook or a reference book. However, since Prasad seeks to address a range of readers, he provides the essence of theory with too few equations and qualitative descriptions of the physical processes. While that may succeed on one level, the mathematically oriented sections are compromised because they are not developed to sufficient depth. An alternative approach would have been to expect all readers to have an introductory background in both quantum mechanics and solid-state physics. Then the theoretical/mathematical chapters could be more rigorously developed.

An ancillary aim of Prasad's approach is to stimulate collaboration between scientists, industry, and business that will result in technology transfer across this multidisciplinary field. With that in mind, he has designed a book with a common language that he believes will ease cross-disciplinary communication regarding nanophotonics. He covers key topics including near-field interactions, nanomaterials, photonic crystals, nanoscale optical interactions, biomaterials and their hybrids, nanolithography for nanofabrication, and applications in biomedical research and therapy.

The book is roughly divided into two parts—theoretical aspects and material science aspects of nanomaterials. The

general format follows that of Prasad's highly recommended *Introduction to Biophotonics*. Each chapter begins with a brief introduction highlighting the content and ends with a summary, followed by a list of references for further pertinent details. A useful index is also provided.

Prasad is very clear in his development of the first half of the book. For example, in Chapter 2, "Foundations for Nanophotonics," the development of electron-electron, electron-hole, and photon-photon interactions are clearly described. Similarly, his discussion of nonlinear optical effects, the consequences of the nanometer confinement of optical interactions, is an excellent exposition for students at the introductory level. Prasad's use of analogies between the confinement of photons and electrons, quantum mechanical tunneling, and the physics of bandgap devices are examples of his writing at its best. He employs logical and comprehensive writing in the chapters on near-field interactions and microscopy, quantum-confined materials, and surface plasmon resonance localized at interfaces.

There is, however, a disparity between the first part of the book dealing with theoretical concepts, and the second part of the book that discusses nanomaterials, their synthesis, architectures, and applications. While the first chapters are rich in logical development, comparison, critical evaluation, and synthesis of disparate concepts, the latter chapters are essentially descriptive summaries of published papers and experimental findings.

The quality of the illustrations and the clarity of accompanying legends are critical to the overall quality of any textbook. The illustrations in *Nanophotonics* vary from high-quality, high-resolution drawings with clear text, units, and legends, to low-quality figures and graphs. Some figure legends resonate with detail and explanation; others are so brief they are difficult to interpret. Perhaps the lack of consistent quality is due to the fact that 21 individuals helped supply the images. Nonetheless, the majority of Prasad's illustrations and legends are well-conceived and helpful.

The quality of Prasad's text becomes questionable at times as well. The occurrence of several errors in the text becomes distracting. For example, on page 95 the Kramers-Kronig equation is incorrectly printed, while on page 339 it is correctly printed. Kramers' name is incorrectly spelled. There are several other misspellings and some chemical structures are incorrectly illustrated.

While *Nanophotonics* may serve as a textbook for tutorial courses, its lack of comprehensive development of theoretical foundations precludes my recommending it for a comprehensive course at either the undergraduate or the graduate level. At its best, I think that *Nanophotonics*, with its emphasis on elucidating concepts with minimal mathematical details, is best suited as an introductory undergraduate text.