

BOOK REVIEW

Optical Properties and Spectroscopy of Nanomaterials

Jin Zhong Zhang, 383 pages, ISBN 978-981-283-664-9 (hc) and 978-981-283-665-6 (pbk), World Scientific, New Jersey (2009), \$64.00 (hc) and \$38.00 (pbk)

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In general terms, a book devoted to the “optical properties of nanomaterials and related spectroscopic techniques for upper level undergraduate and beginning graduate students” as claimed by the author, is greatly needed. Today, many books are found on general aspects of nanomaterials, but very few are devoted to the optical properties of such materials, and it is hard to find books on this subject at an introductory level. As such, this book perfectly covers a niche market.

After the introduction, the book starts with Chapter 2 (Spectroscopic Techniques for Studying Optical Properties of Nanomaterials), which contains a presentation of several spectroscopic techniques. Interestingly, each section includes schematic diagrams of the various characterization systems, thus helping visualizing the experimental setup required for characterization. For UV-visible spectroscopy and photoluminescence, the author discusses the operating principles, provides a full description of the instrumentation as well as a thorough interpretation of the characteristic experimental spectra. By following this pattern, these two techniques are discussed in detail, thus providing the guidelines which would help students and researchers in interpreting their results. However, this approach is just followed for the first two techniques discussed. It is considered that this approach should have been followed for the rest of the techniques discussed in that chapter, i.e., infrared/Raman spectroscopy, time-resolved optical spectroscopy, etc.

Some other widely-used techniques should be added to a future edition of this book, including reflectance/transmittance spectrometry and ellipsometry. Although these can be considered somewhat traditional techniques, they provide a great deal of information on the optical properties of nanostructures.

Chapter 3 (Other Experimental Techniques: Electron Microscopy and X-ray) presents some of the techniques used for the non-spectroscopic characterization of nanomaterials, i.e., morphological and chemical characterization. Chapter 3 also provides many references that would help the reader to complement the information given by the author. Although this is an interesting chapter, it appears unnecessary in light of the stated scope of the book. It would have sufficed to refer to other books or review papers on general characterization techniques.

Chapter 4 (Synthesis and Fabrication of Nanomaterials) presents a thorough study of several chemical methods used for the fabrication of nanomaterials, while most physical methods are barely discussed. In particular, it is noticeable that just one paragraph is devoted to nanolithography techniques (Section 4.3), which are widely used for the fabrication of nanomaterials, both in the industry and in the academia.

As with the previous chapter, the need for this one does not seem quite justified. These two subjects, i.e., fabrication and non-spectroscopic characterization of nanomaterials, are sufficiently covered by general books on nanomaterials. In addition to this, Chapter 4 should have preceded Chapter 2: fabrication of the nanomaterials should come before their characterization.

The following chapters are devoted to the optical properties of several nanomaterials, including semiconductors, metal oxides, metals, and composites. These chapters provide a full picture of the state-of-the-art of the field of nanomaterials used for optical applications. These chapters contain specific results of actual nanomaterials and by themselves justify the publication of the book.

It must be pointed out that Chapter 5 (Optical Properties of Semiconductor Nanomaterials) starts with a very handy review of the basic properties and concepts related to semiconductors, including energy bands, effective mass, density of states, exciton, etc. It is also worth noting that Chapter 7 (Optical Properties of Metal Nanomaterials) includes a thorough discussion on Surface Plasmon Resonance (SPR) and Surface Enhanced Raman Scattering (SERS), two of the most notable optical effects arising from nanomaterials.

Chapter 8, entitled “Optical Properties of Composite Nanostructures,” makes a lot of sense, as new research directions point the usage of inorganic/organic, inorganic/biological, etc. systems for several applications, many of them in the field of medicine. One well-known example is the use of quantum-dot conjugates for optical biosensing.

Chapter 9 (Charge Carrier Dynamics in Nanomaterials) is a remarkable contribution to the book since the *static* (or equilibrium) properties are usually studied, but the dynamic properties of nanomaterials are many times overlooked. The analysis of the dependence of several optical phenomena with time (blinking for instance) contributes to the understanding of basic processes at the nanoscale. As such, a great deal of information can be obtained from carrier dynamics.

The book includes at the end a very interesting chapter titled “Applications of the Optical Properties of nanostructures” (Chapter 10). Although it is nearly impossible to cover all current and potential applications of nanomaterials, the most significant ones are discussed in Chapter 10.

In summary, this is a very interesting, well-documented and well-written introductory text to the optical properties of nanomaterials. The information is presented in a comprehensive manner, making the book attractive for the reader. All the key aspects related to the optical nanomaterials are covered. The book contains a considerable list of references that would complement some of the aspects not discussed in detail in it. Also, the insertion of color figures improves readability. The quality of some of the figures, specially some of the line diagrams, does need to be improved in the next edition.

However, the book has more information than required for the objectives stated by the author. As such, the inclusion of the chapters on fabrication of nanomaterials and other characterization techniques beyond the optical ones was not necessary. In contraposition, the book would have benefited from a chapter on future perspectives on optical nanomaterials, i.e., the field or fields that are expected to have more activity in the years to come.