

Nanoparticles: From Theory to Application. Edited by Günter Schmid (University of Duisberg-Essen). Wiley-VCH Verlag GmbH & Co. KGaA: Weinheim, Germany. 2004. x + 434 pp. \$210.00. ISBN 3-527-30507-6.

The “make it smaller” edict echoed in Feynman’s visionary speech about nanotechnology is one that has changed the world. Indeed, *Forbes* has called it the next big idea. From faster and cheaper computation to sol–gel encapsulated suntan lotions to new cancer therapies to the nano-enhanced tennis balls introduced at the 2002 Davis Cup, our lives have been changed in big (and small!) ways forever. Mirroring this technological revolution, the National Science Foundation predicts that nanotechnology could be a \$1 trillion market by 2015. Not surprisingly, the nanoparticle, the basic building block of things “nano”, has been paid homage in a number of volumes.

Among the latest books to appear on this topic, *Nanoparticles: From Theory to Application* provides a detailed snapshot of contemporary nanoparticle research. It is a compilation of major advances and an up-to-date treatment of topics not covered in its 1994 predecessor, *Clusters and Colloids: From Theory to Applications*, Wiley-VCH, also edited by Schmid. The title lays claim to an immense field. So many important advancements have occurred during the past decade in a field still far from mature that a truly comprehensive treatise of this topic seems unlikely. Indeed, the editor states in the opening chapter that “this book will need a successor in a couple of years”. It is the nature of any print medium that some content might quickly become outdated. Nevertheless, the editor has assembled a group of internationally renowned contributors and produced an attractive and valuable volume that will serve as a useful introduction and historical survey.

Overall, the chapters are part tutorial and part review, with good uniformity and minimal overlap among them. Some overlap has been allowed, however, so as not only to maintain the continuity of the discussion, but also to underscore the important concepts by repeating them in different contexts. As expected, some topics are covered in thorough detail, whereas others are presented at a more basic level. This book is attractively produced, and the chapters include ample literature references. Most chapters contain many references up to the year 2001, with some references to publications from 2002, and only a handful from 2003. The style is generally crisp, clear, and easy to follow.

Chapter 2, “Quantum Dots” by Parak, Manna, Simmel, Gerion, and Alivisatos, provides an introduction to the basic theory required to understand the effects of quantum confinement within zero-dimensional systems and provides a short survey of popular fabrication approaches based on lithography, epitaxial self-assembly, and colloidal growth. Optical and electron-transport properties are briefly discussed.

An in-depth treatment of wet chemical methods for making nanoparticles is given in Chapter 3, “Syntheses and Characterizations” by Eychmüller, Banin, Dehnen, Eichhöfer, Corrigan, Fenske, Bradley, Schmid, Talapin, Shevchenko, and Weller, and comprises half of the book. Particular attention is devoted to the preparation of II–VI (CdS, CdSe, CdTe, ZnS, ZnSe), III–V (GaN, GaP, GaAs, InP, InAs), and Ib–VI (chalcogen-bridged molecular clusters of the coinage metals) semiconductor nanoparticles. Traditional synthetic routes to noble metal nanoparticles are also briefly summarized. The chapter concludes with a presentation of magnetic nanoparticle synthesis and size- and shape-dependent properties, focusing primarily on Co and CoPt₃ nanocrystals. Several familiar systems, such as nickel-, Prussian blue-, or magnetite-based systems, are not included, however.

Chapter 4, “Organization of Nanoparticles” by Eychmüller, Schmid, Talapin, and Shevchenko, is a description of contemporary efforts to generate superstructures that are organized in three or two dimensions and, to a lesser extent, one- or quasi one-dimensional assemblies based on semiconductor or metal nanocrystals as building blocks. Such methods of guided formation, including Langmuir–Blodgett deposition, layer-by-layer assembly, and dip-pen nanolithography, are of vital importance in the development of nanoelectronic sensory, storage, and memory devices.

Chapter 5, “Properties” by Banin, Millo, Dehnen, Eichhöfer, Corrigan, Fenske, and Simon, deals predominantly with the electronic, optical, and thermal properties of the classes of nanoparticle introduced in Chapter 3. More advanced topics, which appear to be directed at a physics or engineering audience, are also included, such as optical gain and single-electron tunneling and charging.

The concept of nanobiotechnology based on functional biomaterial-nanoparticle hybrids, an area of intense recent interest, is beautifully reviewed in Chapter 6, which is entitled “Biomaterial-Nanoparticle Hybrid Systems” and is written by Katz, Shipway, and Willner. The last chapter, “Conclusions and Perspectives”, co-written by all of the authors, embodies a description of frontier research and provides further enticement and direction in the general field of nanoparticle research.

Topics that were marginalized or expressly neglected but should be incorporated into a future edition include one-dimensional assemblies (e.g., nanorods, nanowires, nanobelts) and nanostructured surfaces not involving nanoparticle decoration, among others. Although the quality of the images is substandard in a few places, the figures are not unreadable and typographical errors are few. On another note, providing the full titles of cited works would have increased the value of this book, in this reviewer’s opinion.

In summary, the editor has succeeded in bringing together contributions from recognized experts in the field to produce a homogeneous, integrated, well-crafted, and highly readable volume. *Nanoparticles: From Theory to Application* is suitable as a primary text or primer for graduate students or advanced

undergraduates. I strongly recommend that instructors take a serious look at this text when planning for future courses. With over 1500 total references (and few redundancies) and a carefully prepared subject index, it is also of extraordinary value as a resource for the established researcher in the field. Moreover, it is a good entry point for nonspecialists, such as R&D staff in industry, who must come up to speed on the topic in a short period of time.

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JA040954F

10.1021/ja040954f

Fieser's Reagents for Organic Synthesis, Volume

22. By Tse-Lok Ho (National Chiao Tung University, Republic of China). John Wiley & Sons, Inc.: Hoboken. 2004. xiv + 608 pp. \$99.95. ISBN 0-471-28515-3.

The current volume of this classic series covers reagent literature from 2001 to 2002. Reagents are listed in alphabetical order, and each entry includes a concise description, structural formulas and examples of applications, where possible, and references to the current literature as well as to earlier volumes in the series. An author index and a subject index complete the book.

JA040979E

10.1021/ja040979e

Organic Reactions, Volume 64. Edited by Larry E. Overman (University of California, Irvine). John Wiley & Sons, Inc.: Hoboken. 2004. viii + 640 pp. \$125.00. ISBN 0-471-68262-4.

This volume of *Organic Reactions* contains three chapters: "Additions of Allyl, Allenyl, and Propargylstannanes to Aldehydes and Imines" by Gung; "Glycosylation with Sulfoxides and Sulfinates as Donors or Promoters" by Crich and Lim; and "Addition of Organochromium Reagents to Carbonyl Compounds" by Takai. There is also a list of cumulative chapter titles by volume, an author index for volumes 1–64, and a chapter and topic index for volumes 1–64.

JA0409816

10.1021/ja0409816

Handbook of Infrared Spectroscopy of Ultrathin

Films. By Valeri P. Tolstoy (St. Petersburg State University, Russia), Irina V. Chernyshova (St. Petersburg State Polytechnical University, Russia), and Valeri A. Skryshevsky (Kyiv National Taras Shevchenko University, Ukraine). John Wiley and Sons, Inc.: Hoboken. 2003. xxvi + 710 pp. \$250.00. ISBN 0-471-35404-X.

This book contains a wealth of information on the collection and interpretation of infrared (IR) spectra of ultrathin films. The chapters are well cited with up-to-date and useful references. It

is also an invaluable reference for the practicing spectroscopist and can serve as a guide for the dedicated novice to learn the fundamentals of thin-film IR spectroscopy. This book seems to have it all, from a review of the physics that govern the absorption and reflection of infrared radiation by ultrathin films, to a discussion about selecting the optimum conditions for spectral analysis. It truly has a "handbook" feel to it: I could see myself-flipping through the pages looking for information to help make sense of something observed in the laboratory.

The authors begin by defining the term "ultrathin films" to mean submonolayers to several monolayers, thus restricting the thickness to a few nanometers or less. The geometric form of the film substrates ranges from planar to particulate, thus covering a wide range of important structures in research and technology.

Chapter 1 is a comprehensive discussion of the theory behind the absorption and reflection of infrared radiation by ultrathin films. The approach is based essentially on the boundary-value solutions to Maxwell's equations, in which the response of a structure to electromagnetic (EM) radiation is governed by the geometry and polarization of the incoming radiation and the dielectric properties of the component materials. The theory includes a description of matrix methods for calculating mean-square electric fields in parallel-layer media, which then leads to very useful methods for simulating spectral responses for these structures. The discussion also covers topics such as phonons in crystalline lattices and the use of effective medium approximations to describe the EM response of a uniform, composite material in terms of the optical properties of the components. Overall, this is an excellent chapter that will provide the interested reader with a review of the basics of EM interactions with samples, and act as a guide for those who want to learn how to do simulations of thin-film spectra for various modes, such as external reflection.

Based on the principles developed in Chapter 1, Chapters 2–4 provide the reader with the information necessary to collect and interpret infrared spectra of ultrathin films. Chapter 2 reviews optimum experimental conditions, e.g., angles of incidence and polarization, for obtaining the best quality spectra for a variety of sample types, ranging from well-defined planar thin films to rough surfaces and powders. Chapter 3 is a discussion of methods for interpreting the spectra in terms of detailed structural and chemical information for a variety of films, including electrolyte layers and ordered molecular films. In Chapter 4, experimental setups for obtaining useful spectra are described, and details of the optics for transmission and reflection, including specular, total internal, and diffuse modes, are provided. Advanced topics are also presented at the end of the chapter and include polarization modulation for reflection from metal surfaces, reflection spectroscopy of the air–water interface, and time-resolved Fourier transform spectroscopy.

Chapters 6–8 are reviews of selected applications of thin-film IR spectroscopy, which will be of interest to readers who work in these areas, but which can also serve as further examples of how this technique can be used for problem solving in different areas of research and technology. Chapter 6 covers applications to interfaces and thin dielectric layers in the semiconductor field. Chapter 7, a review of IR applications in the general area of interfaces, deals with a variety of fundamental phenomena in surface chemistry, such as chemisorption,

catalysis, electrochemistry, and biofilms. Given this breadth, this chapter should be of interest to a wide range of readers working in surface chemistry who are interested in using IR spectroscopy in their work.

Overall, I would highly recommend this book for workers in the field of IR spectroscopy of thin films and for those interested

in learning about the area. It will serve as an excellent reference as well as a rich source of published articles in the field.

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JA0335770

10.1021/ja0335770