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BOOK REVIEW

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Book Review of Nanoparticles: From Theory to Application, Second, Completely Revised and Updated Edition

Nanoparticles: From Theory to Application, Second, Completely Revised and Updated Edition. Edited by Günter Schmid (Universität Duisburg-Essen, Germany). WILEY-VCH Verlag GmbH & Co. KGaA: Weinheim. 2010. xiv + 522 pp. $215. ISBN 978-3-527-32589-4.

The second edition of *Nanoparticles: From Theory to Application* has not only a new and inviting cover but also significantly updated content that provides a comprehensive introduction to the science of nanoparticles, from a fundamental understanding to practical applications. The editor has successfully assembled a group of distinguished experts in their respective fields. As stated by Schmid in the introductory and concluding chapters, the focus is on semiconductor quantum dots and metallic nanoparticles. Although it is a daunting, if not impossible, task to include everything in one volume, some readers may find that excluding other types of nanoparticles only makes one desire more information, especially in this era of explosive growth in nanoscience and nanotechnology. My definition of nanoparticles is much broader, encompassing all materials and biological systems and including all types of shapes. I also felt that the book emphasized the importance of "quantum confinement" and provided little information about the surface properties of nanoparticles. With decreasing sizes, the surface properties of all types of nanoparticles become important in controlling their function and behavior—this is especially true for catalysis and for sensing of molecules. Overall, however, *Nanoparticles* is a useful resource for all researchers, practitioners, and students who are interested in the science and technology of the topic.

As in the first edition, Chapter 2, "Quantum Dots", is a concise presentation of the fundamentals of quantum confinement and its effects on the properties of nanoparticles using illustrations. This chapter could be used as a classical textbook for advanced undergraduate or graduate students who are interested in nanoscience and nanotechnology. The unusually large Chapter 3, "Syntheses and Characterizations", encompasses the major part of the book. Here, both traditional and new approaches to synthesize nanoparticles of various materials systems are described. Syntheses of semiconducting, metallic, and magnetic nanoparticles are discussed in detail. The section on magnetic nanoparticles is extensive, and the discussion of their potential applications is exciting and captivating. I was less impressed by the section on nanoclusters, which I felt was out of sync with the rest of the book, although valuable to those who work in the field. Cluster science is a different field that seems to be beyond the scope of this book. A new section on Zintl ions was added to this chapter, providing valuable information on this specific class of clusters, although I do wish more information on how to connect the process of cluster linking and polymeric assembly to the formation of nanoparticles or other types of nanostructures had been included. The authors also briefly discuss characterization techniques, such as X-ray diffraction, optical spectroscopy, and magnetization. Electron microscopy images were used throughout the book; however, there was no discussion of aberration-corrected electron microscopy, which is considered one of the most important advances in atomic scale characterization during the past decade, especially for characterizing nanoparticles and nanoclusters.

Compared to Chapter 3, Chapter 4, "Organization of Nanoparticles", is remarkably brief. In fact, this is one of the most exciting areas of research and may provide unforeseen applications. Self-assembly or facilitated assembly of nanoparticles is discussed, and patterning of nanoparticles and the formation of superlattices are presented with examples. I found the discussions of geometrical manipulation of nanoparticle arrangement by magnetic fields and the DNA-guided assembly of nanoparticles to be most thought-provoking. The next chapter, "Properties", is a comprehensive discussion of the effect of quantum confinement on the optical and electrical properties of nanoparticles. As in Chapter 2, this chapter could be used as a classical text for classroom instruction on the effect of quantum confinement in practical systems. Unfortunately, the authors did not elaborate on other unique properties of nanoparticles, such as catalytic or mechanical properties.

Chapter 6, "Semiconductor Quantum Dots for Analytical and Bioanalytical Applications", is new and replaces "Biomaterial-Nanoparticle Hybrid Systems" in the first edition of the book. It thoroughly covers how to utilize semiconducting quantum dots as photonic labels in biological research or as sensors/detectors for diagnosis. The medical applications of nanoparticles, especially metallic nanoparticles, for the detection of diseases or for drug delivery, etc. were not elaborated on. The last chapter of the book, "Conclusions and Perspectives", by the editor sums up the views of the authors on nanoscience and nanotechnology in general and nanoparticles in particular.

In general, I am not in favor of reading multiauthored, edited books because the content among the chapters of such books is often redundant, and smooth, logical transitions from one chapter to another are infrequent. Although there are some redundancies in this book, Schmid has integrated the chapters in a way that makes their reading less difficult. I enjoyed reading it and gained new knowledge on nanoparticles. The revised and updated edition of *Nanoparticles: From Theory to Application* is timely and should find a broad audience of scientists and engineers who are interested in the fundamentals and practices of nanoparticle technology.

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