

Edited by
Kurt E. Geckeler and Hiroyuki Nishide

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Advanced Nanomaterials

Volume 1



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Preface

Nanotechnology has found an incredible resonance and a vast number of applications in many areas during the past two decades. The resulting deep paradigm shift has opened up new horizons in materials science, and has led to exciting new developments. Fundamentally, nanotechnology is dependent on the existence or the supply of new nanomaterials that form the prerequisite for any further progress in this new and interdisciplinary area of science and technology. Evidently, nanomaterials feature specific properties that are characteristic of this class of materials, and which are based on surface and quantum effects.

Clearly, the control of composition, size, shape, and morphology of nanomaterials is an essential cornerstone for the development and application of nanomaterials and nanoscale devices. The complex functions of nanomaterials in devices and systems require further advancement in the preparation and modification of nanomaterials. Such advanced nanomaterials have attracted tremendous interest during recent years, and will form the basis for further progress in this area. Thus, the major classes of novel materials are described in the twenty-eight chapters of this two-volume monograph.

The initializing concept of this book was developed at the *3rd IUPAC International Symposium on Macro- and Supramolecular Architectures and Materials (MAM-06): Practical Nanochemistry and Novel Approaches*, held in Tokyo, Japan, 2006, within the framework of the biannual MAM symposium series. This monograph provides a detailed account of the present status of nanomaterials, and highlights the recent developments made by leading research groups. A compilation of state-of-the-art review chapters, written by over sixty contributors and well-known experts in their field from all over the world, covers the novel and important aspects of these materials, and their applications.

The different classes of advanced nanomaterials, such as block copolymer systems including block copolymer nanofibers and nanotubes, smart nanoassemblies of block copolymers for drug and gene delivery, aligned and ordered block copolymers, helical polymer-based supramolecular films, as well as novel composite materials based on gold nanoparticles and carbon nanotubes, are covered in the book. Other topics include the synthesis of inorganic nanotubes, metal nanoparticle-attached electrodes, radical polymers in organic polymer batteries, oxidation catalysis by nanoscale gold, silver, copper, self-assembling

nanoclusters, optically responsive polymer nanocomposites, renewable thermoplastic matrices based on phyllosilicate nanocomposites, amphiphilic polymer-clay intercalation and applications, the synthesis and catalysis of mesoporous alumina, and nanoceramics for medical applications.

In addition, this book highlights the recent progress in the research and applications of structural ceramics, the ecological toxicology of engineered carbon nanoparticles, carbon nanotubes as adsorbents for the removal of surface water contaminants, molecular imprinting with nanomaterials, near-field Raman imaging of nanostructures and devices, fullerene-rich nanostructures, nanoparticle-cored dendrimers and hyperbranched polymers, as well as the interactions of carbon nanotubes with biomolecules. The book is completed with a series of chapters featuring concepts in self-assembly, nanostructured organogels via molecular self-assembly, the self-assembly of linear polypeptide-based block copolymers, and information-guided self-assembly by structural DNA nanotechnology.

The variety of topics covered in this book make it an interesting and valuable reference source for those professionals engaged in the fundamental and applied research of nanotechnology. Thus, scientists, students, postdoctoral fellows, engineers, and industrial researchers, who are working in the fields of nanomaterials and nanotechnology at the interface of materials science, chemistry, physics, polymer science, engineering, and biosciences, would all benefit from this monograph.

The advanced nanomaterials presented in this book are expected to result in commercial applications in many areas. As the science and technology of nanomaterials is still in its infancy, further research will be required not only to develop this new area of materials science, but also to explore the utilization of these novel materials. All new developments impart risks, and here also it is important to evaluate the risks and benefits associated with the introduction of such materials into the biosphere and ecosystem.

On behalf of all contributors we thank the publishers and authors on behalf of all contributors for granting copyright permissions to use their illustrations in this book. It is also very much appreciated that the authors devoted their time and efforts to contribute to this monograph. Last, but not least, the major prerequisite for the success of this comprehensive book project was the cooperation, support, and understanding of our families, which is greatly acknowledged.

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