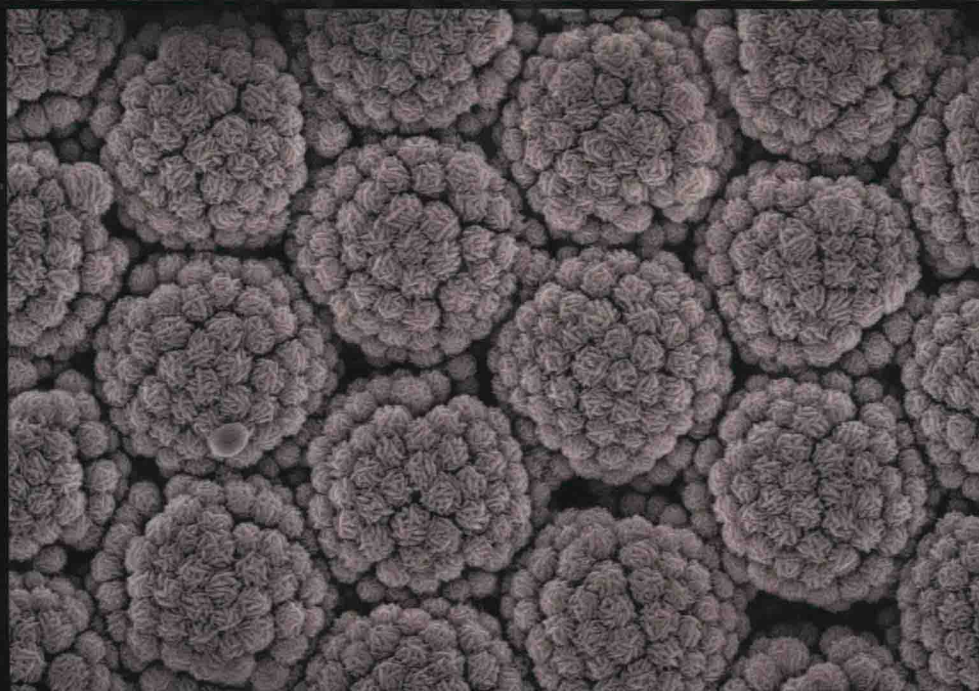
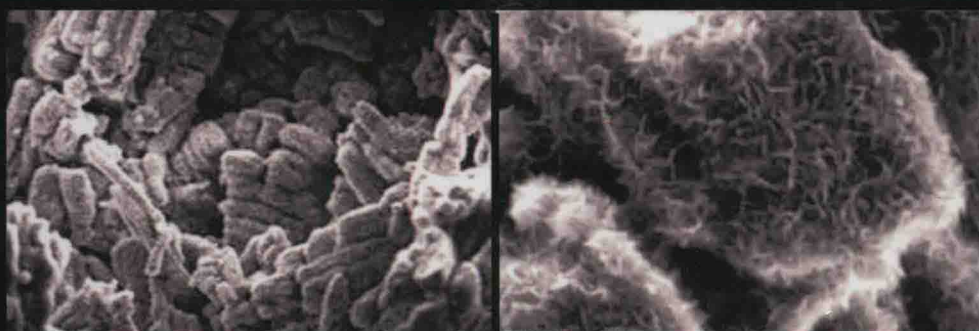


Hierarchical Micro/ Nanostructured Materials

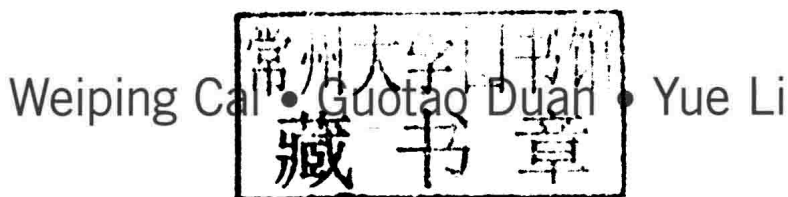
Fabrication, Properties, and Applications



Weiping Cai • Guotao Duan • Yue Li

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Summary: "Nanomaterials and nanotechnology have attracted much attention and been extensively studied for three decades due to their promising applications and scientific significance. Great progresses have been achieved in this field. The researchers in this area have the experiences from the creation of new structure in the early stage to the controlled growth, property and performance's study, and device fabrication and applications in the past decade"-- Provided by publisher.

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Hierarchical Micro/ Nanostructured Materials

Fabrication, Properties, and Applications

Advances in Materials Science and Engineering

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As series editor, I would like to thank all authors and editors of the books in this series for their noble contributions to the advancement of materials science and engineering and to the advancement of humankind.

Sam Zhang

Preface

Nanomaterials and nanotechnology have attracted much attention and been extensively studied for three decades because of their promising applications and scientific significance. Great progress has been achieved in this field. The researchers in this area have experienced the creation of new structures in early stages to controlled growth, property and performance studies, and device fabrication and applications in the past decade. Nanomaterial synthesis experienced changes from simple and unitary nanostructures to the complicated nanostructures and superstructures, from nanopowders to assemblies, from nanoparticles to hollow structures, from inorganic to organic materials, from zero to multidimension, from random to regular growth, from disordered arrangement to the periodic arrays, and so forth.

Hierarchical micro/nanostructured materials, which are composed of microsized objects with nanostructures, have been considered in the recent decade. Such structured materials show the surface activity and specific surface area of nanomaterials, and the structural stability and robustness of the bulk materials. They combine the advantages of both nanostructured and bulk materials. Hierarchical micro/nanostructured materials can exist in the forms of powders and regularly ranged arrays.

Micro/nanostructured object powders have large surface-to-volume ratios, high stability against aggregation, and are very easily separated from solution. These materials exhibit strong structurally enhanced properties, such as enhanced adsorption and catalysis performances compared with nanopowders or bulk ones, and hence could be good candidates for new environmental materials for high-efficient removal of contaminants in the environment. Further, if micro/nanostructured objects are arranged into a pattern on a substrate in some way, hierarchical micro/nanostructured arrays will be formed. Such arrays could be the important bases of the next generation of devices. There exist great potential applications in many fields, such as catalysis, integrated nanophotonics, optical devices, super-high-density storage media, sensors, nanobiotechnology, surface-enhanced Raman scattering (SERS) substrates, and so forth.

Although morphology- and structure-controlled growth and synthesis of these materials remain a promising challenge, a great deal of work in establishing parallel micro/nanofabrication techniques, performance exploration, and related applications has been done. Our group has also been in this field for nearly 10 years and focused on the development of new fabrication methods, exploration of structurally enhanced performance, surface properties, device applications, and so forth.

In this book, we will mainly present recent research progress of our group in the hierarchical micro/nanostructured materials, including two sections: Hierarchical Micro/Nanostructured Powders and Hierarchical Micro/Nanostructured Arrays in fabrication, properties, and applications, and hope to reflect and show the perspectives of the hierarchical micro/nanostructured materials in fundamental research and applications.

This book consists of 12 chapters. In addition to the general introduction of hierarchical micro/nanostructured materials in Chapter 1, we introduce, in detail, the mass production methods for hierarchical micro/nanostructured powders in Chapters 2 through 4, including solvothermal routes, template-etching strategies, and electrospinning technology, followed by structurally enhanced photocatalytic and adsorption performance in Chapters 5 and 6, respectively. Further, we introduce the modified colloidal lithography-based solution, electrodeposition strategies, and so forth, for fabrication of hierarchical micro/nanostructured object arrays and their devices in Chapters 7 and 8. In Chapters 9 through 12, we introduce and discuss the structure-dependent properties and performance of the micro/nanostructured arrays, including surface wettability, optical properties, gas-sensing performance, SERS performance, and detection applications. This book also introduces applications of hierarchical micro/nanostructured materials in environmental remediation and detection devices, and reviews the future trend of these materials in research and applications.

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