PREFACE

Our ability to engineer novel structures at the molecular and supramolecular levels has led to unprecedented opportunities in materials design. It has fueled rapid development in nanotechnology for the past decade, leading to the creation of new materials with interesting nanometer-scale features. This volume presents the latest advances in this exciting interdisciplinary field, with contributions from chemical engineers, chemists, physicists, materials scientists, and bioengineers. It describes a "bottom-up" approach to designing nanostructured systems for a variety of chemical, physical, and biological applications.

Specifically, this volume focuses on the synthesis, processing, and structural tailoring of nanocrystalline and nanoporous materials. *Nanocrystalline materials* possess unique hybrid properties characteristic of neither the molecular nor the bulk solid-state limits and may be confined in nanometer-sized domains in one, two, or three dimensions for unusual size-dependent behavior. *Nanoporous materials,* characterized by well-defined pores or cavities in the nanometer size regime and controlled pore diameter and structure, give rise to unique molecular sieving capabilities and ultrahigh internal surface areas. Nanoporous structures also act as hosts and templates for the fabrication of quantum dots and quantum wires.

The chapters in this volume present detailed insights into the synthesis–structure–properties relationships of nanostructured materials. In particular, the catalytic and photocatalytic properties of nanoclusters and nanostructured materials with ultrahigh surface-to-volume ratio are demonstrated. The gas absorption characteristics and surface reactivity of nanoporous and nanocrystalline materials are shown for various separation and reaction processes. In addition, the structural manipulation, quantum confinement effects, transport properties, and modeling of nanocrystals and nanowires are described. The biological functionality and bioactivity of nanostructured ceramic implants are also discussed.

It is our hope that this volume illustrates the potential of nanostructured materials with multifunctionalities for a wide variety of applications. Chemical engineers, with their broad training in chemistry, processing, systems engineering, and product design, are uniquely positioned to play a pivotal role in this burgeoning field of nanotechnology. Active efforts in this research direction will impact how we tailor novel materials for areas such as catalysis and separations and how we integrate miniaturized systems such

as microreactors, fuel cells, sensors, and batteries. Research in this exciting frontier will also lead to new devices for optical, electronic, magnetic, thermoelectric, and biomedical applications.

This volume is dedicated to Professor James Wei on the occasion of his 70th birthday, for his leadership in *Advances in Chemical Engineering* and his vision for our profession.

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VOLUME EDITOR