

Special Issue on Ceramics Processing

Advanced ceramics processing crosses many disciplines, with chemical engineering paramount in the areas of synthesis of precursor powders and fibers, derivation of thin films, catalyst supports and ceramic membranes, and processing of precursor powders into bulk structures. This special issue reports on various aspects of ceramics processing, which collectively represents an interdisciplinary area critical to our evolving profession. It is the first of its kind for the *AIChE Journal*. The articles contained in it were selected from those presented at the AIChE Topical Conference on Advanced Ceramics Processing held in San Diego, July 1996. As part of the Fifth World Congress of Chemical Engineering, this conference helped advance the global communications among the researchers and technology experts in this increasingly important area. All the articles from the 12 symposia in the conference underwent the same rigorous review as those in the regular issues.

The articles were grouped under six topics. *Vapor-phase processing* is a subject which has engaged chemical engineers in reactor design, high-temperature kinetics and aerosol chemistry. Recent research is devoted to precursor chemistry for multicomponent oxide synthesis, and processing of particles with well defined size, morphology and crystalline phase. Also examined are flame spray pyrolysis, thermal pyrolysis and turbulent jet for controlled nucleation and growth of ceramic particles.

Several articles on *nanoparticle synthesis* discuss size-dependent characteristics such as ultrahigh surface reactivity in catalysis, quantum confinement effects in optoelectronic materials, and enhanced sinterability and mechanical reliability of ceramics. Processing techniques recently developed include counterflow diffusion flame combustion, laser ablation, plasma-induced clustering reactions, and electrostatic adhesion forces. *In-situ* monitoring capability of structure-processing relationships and innovative reactor design for large-scale generation of nanoparticles are addressed. These developments, along with further advances in tailoring multicomponent nanoparticles toward specific ceramic and catalytic applications, will critically impact progress in nanotechnology.

Sol-gel and wet chemical synthesis research has been growing with an increased interest in materials tailoring on the molecular level. By understanding the processing chemistry, metastable, multicomponent materials with unique structure and surface chemistry can be obtained in low-temperature synthesis with excellent compositional homogeneity. Recent development in-

cludes the use of molecular and supramolecular templates to derive zeolites and mesoporous molecular sieves. Dopant and cluster introduction as well as organic functionalization further expand the use of porous oxides in catalytic and optical applications.

In the *ceramic membranes and thin films* area, materials processing holds the key for new applications. Composite porous membranes consisting of zeolites are explored for gas separations based on the principles of molecular sieving effects. Recently, ceramic materials are considered often in nonequilibrium membrane-assisted reactions with controlled introduction of reactants. For example, in oxidative reactions with multicomponent perovskite membranes, the challenge is to process these structures with excellent stability under reaction conditions, fast oxygen permeation, and high selectivity. Thin films are also investigated and fabricated for gas sensing and catalytic applications.

This issue also has several articles on *ceramic fibers and composites* describing the precursor design and formation of unique morphologies and microstructures. The articles on *functional ceramics* describe complex composition and crystal structure, necessitating careful synthesis to obtain phase-pure multicomponent oxides. These specialized materials often require defect-free processing in the form of thin films for applications such as capacitors, transducers, and superconductors.

The 37 articles in this issue offer an overview of what ceramics processing encompasses and its importance in existing and exciting new applications in chemical engineering. It is our hope that this issue contributes to the growing interest in this field.

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