

Preface

Modern science and technology constantly require new and novel materials with special properties. Over the past decade, ceramic materials have received significant attention as an active material in components from sensors to biomaterials, electronics devices to fuel cells, magnets to structural parts, cutting tools to substrates. These nanocrystalline ceramics have applications in many areas such as industrial sectors, health, defense, energy, manufacturing, and transport. These nanocrystalline ceramics exhibit unique properties such as super-plasticity at elevated temperatures, optical transparency for opaque materials, increased strength and toughness, bioactivity due to the fine-grain size, abundant grain boundaries, and controllable crystallinity as well as revolutionary electronic and ionic properties.

The aim of this book is to present the research and development work conducted on nanostructure ceramics and their composites. Significant advancement has been made in the development of sol-gel based nanoceramic materials, which exhibit either special optical properties or exceptional mechanical characteristics, such as high strength and toughness and various other engineering and materials properties.

The present book describes the recent and expected challenges along with potential solutions for sol-gel based nanostructure ceramics. Both experimental and fundamental theories based chapters have been included in the present book. There are 10 chapters. Chapter 1 provides a general introduction of sol-gel based nanoceramics whereas Chap. 2 contains the advance techniques for the synthesis of zirconia-based ceramics for thermal barrier application. Chapter 3 is based on the synthesis of nanostructure ceramics and their composites, while Chap. 4 describes the structure, stabilities and electronic properties of smart ceramic composites. Chapter 5 deals with a broader discussion on the advancement of glass ceramic materials for photonic applications while Chap. 6 describes about ceramic nanocomposites for oxide fuel cells. Chapter 7 contains a review on nanoceramic materials for use in ceramic matrix composite and Chap. 8 contains the application of hydroxyapatite-based nanoceramic in wastewater treatment. Chapter 9 describes sol-gel derived organic–inorganic hybrid ceramic materials for heavy metal removal and Chap. 10 has the details of properties and applications of hybrid ceramic materials for photocatalytic applications.

The book has been conceived to offer a broad selection of key processing techniques and applications for sol-gel based nanoceramic materials. The readers of this book will thus be able to find at one place the state of the art and the comprehensive information on various approaches, techniques, and methods for processing, fabrication, and application of advanced ceramics and ceramic composites.

The present book will be more beneficial to scientists, engineers, technologists, and researchers working in the industry, national research laboratories, and academia with interest in traditional and advanced ceramics as well as ceramic composites. Researchers registered for their postgraduate/graduate/undergraduates degree in the area of nanoceramics, materials science, and engineering will also be equally benefitted.

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Sol-gel Based Nanoceramic Materials: Preparation,
Properties and Applications

Mishra, A.K. (Ed.)

2017, XV, 297 p. 112 illus., 57 illus. in color., Hardcover

ISBN: 978-3-319-49510-1