Chemistry of
Nanocrystalline Oxide Materials
Combustion Synthesis, Properties and Applications

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Chemistry of **Nanocrystalline Oxide Materials**

Combustion Synthesis, Properties and Applications

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Dedicated to our spouses

<i>Prabha</i>	<i>Malati</i>	<i>Sanjay</i>	<i>Mahesh</i>
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Foreword

Nanoscience and technology has emerged as a frontier area of research today. A great deal of stimulating progress is being made in the world of nanoscience every other day. Research in “Nanochemistry,” chemistry of nanomaterials, has resulted in the developments of newer methods of synthesis of materials with desired structure, composition, and properties of nanomaterials and their related applications. With this rich array of knowledge available, the question arises as to how does a student, a researcher, or materials scientist get an actual feel of nanopowders and get down to the science and art of making them?

Chemistry deals with the synthesis and analysis both being complementary are equally important. Prof KC Patil with his training in Inorganic Synthesis and Propellant Chemistry has found a novel and simple method of tailor-making oxide materials. Prof Patil’s method is distinctly different from the other known methods. I am particularly impressed by the simplicity of the process and the choice of the reactants to prepare a variety of oxide materials from alumina to zirconia and their composites.

Self-propagating high-temperature synthesis where simple chemical processes are used to study complex chemical reactions is of interest from both theoretical and practical point of view. The solution combustion method of Prof Patil is of interest from the investigations of the mechanism of the physico-chemical processes involved, dynamics of the product formation, their stability limit, and control of the process. These studies will no doubt bring out new and important results and better understanding. I trust the contributions and

the achievements described in the book will stimulate further investigations in the area of Nanoscience and Technology.

I wish this book all success it deserves.

Prof AG Merzhanov

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Preface

Developing new routes to nanocrystalline materials is a challenging task for solid-state chemists and materials scientists. The book on *Chemistry of Nanocrystalline Oxide Materials (Combustion Synthesis, Properties, and Applications)* is the result of the research work carried out by the authors and their PhD students during the last two and half decades. This book introduces an innovative pathway to the synthesis of oxide materials. The interest in nano-oxides is due to their technological applications in fields like microelectronics, catalysis, coatings, energy storage, and environment protection and remediation. Synthesis of nano-oxides along with their characterization, physicochemical properties, and applications is of interest to students, teachers, researchers, and materials scientists alike.

Chemists carrying out reactions with ions in solution have been practicing nanochemistry for centuries. The technique of making nanocrystalline oxide materials by “combustion process” is an integrated approach, combining both breaking-down and building-up processes of producing nanomaterials. “Catalysis” is a classical example of “nanotechnology.” The solution combustion synthesis method has already made inroads into nanoscience and nanotechnology but never before it has been documented and made available to researchers working in this field. This book is an endeavor to comprehensively put together all the published work of the authors in one treatise. This method of making oxide materials being simple and fast is being practiced by many individuals and groups around the world. No attempt is made here to quote the work done by others.

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We appreciate the support and cooperation of Prof Arun Umarji and Dr GT Chandrappa while writing the book. Sincere thanks are due to Mr Sanjay Rattan and Dr Madhavi for their invaluable contributions in editing and proof reading the book from conception to completion.

We thank the American Chemical Society for granting us the permission to reproduce some of the figures as such. The authors would like to thank World Scientific editors especially Lim Sook Cheng and Lee Kok Leong, for all their hard work and patience in correcting and editing the manuscript.

Finally, sincere and grateful thanks are due to Prof AG Merzhanov who readily agreed to write the foreword and has been a source of constant support and encouragement.

We hope the book will serve students and researchers working in the field of Materials Science and Engineering and NanoChemistry.

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