

Preface

Our book not only covers many interesting and important issues of the current research in the field of complex functional materials (e.g., metal oxides, semiconductors, porous materials, carbon-based materials as well as polymeric materials and devices) but also includes important fabrication methods, materials properties, and their potential applications in the several fields of nanotechnology. Hence, there are enormous benefits to a deeper understanding of the physical and chemical behavior of complex functional materials at the nanoscale.

In order to achieve this goal, crystalline materials are treated in greater wealth of detail than the amorphous as well as the partially crystalline materials, mainly due to the various physical and chemical behaviors related to the structural and electronic order-disorder effects (i.e., at the short-, medium-, and long range) to understand novel complex functional materials, which in principle, is as an important parameter to a rational control of their physical and chemical properties at the nanoscale. Analyzing the importance of structural and electronic defects and their effects on the materials properties, this point of view has a still very unexplored origin, which allows us to explore even more the capacity we have always had to transform great challenges into new opportunities from a modern viewpoint of physics, chemistry, and materials engineering. In this context, this book is very interesting for all scientific community.

With scientific developments in the last century, new and important advances have been observed in recent years, in turn, opening a wide range of the technological applications and thus generating infinite possibilities, producing ever more refined knowledge for the future. Hence, we explore new approaches to understand the physical and chemical properties of emergent complex functional materials, revealing a close relationship between their structures and properties at the molecular level. In particular, this book is subdivided into three fundamental parts. The primary focus of this book is the ability to synthesize materials with a controlled chemical composition, a crystallographic structure, and a well-defined morphology. Also more importantly, different strategies of the analysis and characterization are discussed in detail, being an important tool for students and researchers to develop research involving a modern and attractive logic in the different fields of

knowledge. Special attention is also given to the interplay of theory, simulation, and experimental results, to interconnect theoretical knowledge and experimental approaches, which can reveal new scientific and technological directions in several fields, expanding the versatility to yield a variety of new complex materials with desirable applications and functions.

Some of the challenges and opportunities in this field are also discussed, targeting the development of new emergent complex functional materials with tailored properties to solve problems related to renewable energy, health, and environmental sustainability. A more fundamental understanding of the physical and chemical properties of new emergent complex functional materials is essential to achieve more substantial progress in some technological fields. We believe this book can, in principle, offer new possibilities for acquiring fundamental and innovative knowledge that can accelerate the process of discovering new complex materials with completely new and interesting properties for a wide variety of applications in emerging technologies.

In short, we hope that this book will serve as a facilitating tool for learning. This book was written with the help of experts in various fields of knowledge. Without their help, this book would not have been completed. With this goal in mind, the editors invited acknowledged specialists to contribute chapters covering a broad range of disciplines. Good reading!

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Recent Advances in Complex Functional Materials

From Design to Application

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