

Preface

In recent times, nanoengineering approach has made possible the tailoring of physical properties of oxide materials at the nanoscale. For example, enormous progresses have been achieved controlling the interface structure and energy in heterostructures or incorporating nanodefects with controlled size and distribution in superconducting thin films. Nanostructures of oxide materials can be controlled by several techniques, like pulsed laser deposition, chemical vapor deposition, metal-organic deposition, molecular beam epitaxy in the case of thin films and heterostructures, and melt textured growth in the case of bulk oxides.

This book gives a deep insight into the intriguing science of nanostructured oxides. It is devoted to cover the most recent advances and review the state of the art of nanoengineering approach in several categories of oxide materials, involving superconductors, thermoelectrics, optoelectronics, and photocatalysts.

It serves as a fundamental information source on the techniques and methodologies involved in oxide thin film and bulk growth, characterization, and device processing, as well as on the rich topic of heterostructures. This book will be invaluable to the experts to consolidate their knowledge and provide insight and inspiration to beginners wishing to learn about nanoengineered oxides.

In detail, the book is divided into four parts.

1. First part involves six contributions on nanostructured superconducting oxides, ranging from thin films for energy applications to heterostructures and interface engineering, and melt-textured materials. A variety of bottom-up techniques for the nanostructuration of oxide thin films and bulks is presented, and a top-down approach to obtain nanodevices is also illustrated. Nanostructured superconducting oxides were devoted to thousands of fundamental and applicative studies in the past 27 years and are mature for practical applications in several cases (coated conductors and magnets based on bulk oxides). This is the reason why the first part is wider than other parts.

Contribution of M. Miura is related to $\text{REBa}_2\text{Cu}_3\text{O}_y$ and other cuprate superconducting films prepared by metal organic deposition for applications in high external magnetic field. K. Endo and P. Badica propose deep insight on the

spin-coating technique approach for the growth of epitaxial BSCCO thin films with potential for electronics applications. G. Balestrino and D. Di Castro enlighten the engineering of heterostructures and superlattices made by stacking high-temperature superconducting oxides with different magnetic and conductivity properties. S. Saini and S.-J. Kim illustrate the advanced nanomachinery approach to fabricate nanodevices (like Josephson junctions) from whiskers and thin films of superconducting oxides. K. Iida summarizes several techniques to improve the magnetic properties for nanocomposite RE-Ba-Cu-O bulk superconductors for practical applications, and S. Miryala describes the design and development of a levitation train model built using melt-textured nanocomposite oxides.

2. Second part covers nanostructured thermoelectric oxides. These materials are promising for energy harvesting, but at early stage if compared with metallic thermoelectrics and oxide superconductors. Two complementary contributions compose this part.

Contribution of M. Ohtaki reviews the current aspects of bulk oxide thermoelectric materials and proposes some strategies for selective reduction of the lattice thermal conductivity. P. Mele gives an overview of thermoelectric properties of oxide thin films, discussing nanostructuration and artificial nanodefects engineering approaches to enhance the conversion efficiency.

3. Third part shows how nanoengineering of oxide multilayers and interfaces is able to tailor electronic and thermal properties of superconductors, thermoelectrics, and insulators.

M. Karppinen and T. Tynell show how layered hybrid inorganic-organic structures with a high degree of controllability over the thickness and composition of individual layers influence properties such as thermal conductivity or the electronic band structure. M. Salluzzo overviews the research on the interface between two insulating oxides (LaAlO_3 and SrTiO_3) focusing on its peculiar electronic properties. K. Develos-Bagarinao presents a review of investigations on CeO_2 films with nanostructured surfaces as buffer layers in multilayers to improve the properties of superconducting thin films.

4. Fourth part is related to nanostructured oxides for optoelectronic and photocatalysts applications to give solutions to environmental problems.

C. Li, X. Li, and D. Wang illustrate low-temperature deposition technique to fabricate high-quality ZnO thin film and nanostructures for applications in the thin film transistor, sensor, and dye-sensitized solar cell in the near future. R. Mohan and J. Hubalek discuss the photocatalytic activities of various hybrid oxide nanostructures and metal oxides hybrid with carbon-based materials like carbon nanotubes and graphene. V. Menendez reviews oxide nanomaterials as photocatalysts for air remediation or solar cells applications.

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