Preface

Metal oxides are known to possess unique functionalities that are absent or inferior in other solid materials. Their nanostructures have emerged as an important class of materials with a rich collection of properties and great potential for device applications. These include transparent electrodes, high-mobility transistors, gas sensors, photovoltaics, photonic devices, energy harvesting and storage devices, and non-volatile memories. The research interest in oxide nanostructures is reflected by the exponential growth of publications in this field in recent years, as shown in Fig. 1. The impact of these publications is broad, as manifested by their large number of citations. In line with this growth, there have always been symposia dedicated to the field of oxide nanostructures in all of the recent Spring and Fall Materials Research Society meetings. From these meetings we have witnessed great excitement in this field, as these symposia attracted a large group of attendees from around the world.

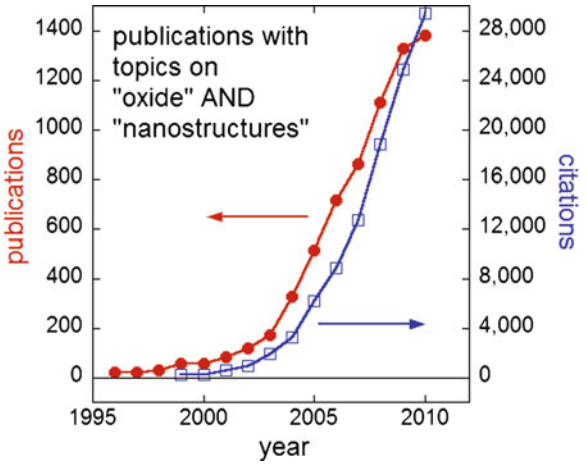

Fig. 1 Growth of the number of publications with topics on "oxide" and "nanostructures" and their citations. Statistics from ISI Web of Knowledge

We therefore invited some of the most active researchers to contribute book chapters on topics that are at the frontiers in this field.

This book is divided into three parts: Basic Properties, which includes Chaps. 1–7; Synthesis and Processing, which includes Chaps. 8–10; and Applications, which includes Chaps. 11–14. Chapter 1 is focused on an important effect, strain, in oxide nanostructures. Chapters 2–4 describe conductivity control in oxide semiconductors, effects of point defects, and electron transport in oxide nanostructures, respectively. Chapter 5 reviews spectroscopic investigations and Chap. 6 discusses electronic properties of oxide surfaces. This part ends with a case study in Chap. 7: electronic and magnetic properties of strontium ruthenate ultra-thin layers. In the Synthesis and Processing part, the widely used solution processing is detailed in Chap. 8 with titania as an example. Chapter 9 presents a review of biologically templated oxide nanostructure growth, while Chap. 10 details epitaxial stabilization of low-dimensional oxide layers. The Applications section is comprised of reviews of three major applications of metal oxide nanostructures: Catalysis (Chap. 11), batteries (Chaps. 12 and 14), and memory (Chap. 12).

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