Foreword

The structure of ultrathin films of oxides has attracted considerable attention in recent years, both from an experimental as well as from a theoretical perspective. This is documented by an exponential increase in published original papers in the field within the last decade. Originally driven by semiconductor device research, where the famous amorphous silica film on top of silicon played an important role, via the thin insulating oxide films in storage devices, it has become obvious that the detailed structure of oxide films will influence the properties with respect to transport and electronic structure decisively. The latest account on ultrathin oxide films has been edited a few years ago by Gianfranco Pacchioni and Sergio Valeri entitled "Oxide Ultrathin Films: Science and Technology" and it collected chapters mainly on applications of ultrathin films in a number of important technological areas, such as electronic devices or heterogeneous catalysis.

The present book approaches the topic with 13 chapters from a different, more fundamental angle by focusing on the structural aspects of ultrathin oxide films, however, not without pointing out relations to applications. To this end, Falko Netzer and Alessandro Fortunelli have put together an impressive list of chapters addressing a number of important fundamental issues in ultrathin oxide film research. Netzer and Surnev introduce in the beginning structure concepts for two-dimensional materials, based on their own experience mainly on examples involving transition metal oxides. Fortunelli and collaborators address in Chap. 2 the electronic structure of nanostructured oxides by particularly pointing out the fruitful collaboration of experiment and theory in this area of research. I would like to stress that this is an important factor in the success of the field and its fast expansion, since the interplay between theory and experiment has helped to proceed faster, and direct research towards the decisive scientific issues. The third chapter by Pacchioni underlines the fact that the structure of ultrathin oxide films is considerably more flexible than bulk oxides, which leads to interesting new physical phenomena, for example, upon adsorption on those surfaces, to stabilization of the adsorbate via a polaronic distortion of the ultrathin film. While Pacchioni's chapter mainly deals with simple oxides, in the following chapter Luches and D'Addato

concentrate on reducible ultrathin oxide films. Wu and Castell report studies on a variety of ultrathin oxide films on Au (111) as a substrate and discuss the large variety of observed structures, which is another manifestation of the structural richness of such systems. Again, in the following sixth chapter by Rocca and collaborators flexibility is addressed via studies of phonons in thin oxide films. This connects beautifully Chaps. 4–6 and provides a basis for understanding. Noguera and Goniakowski outline their pioneering work with respect to the influence of electrostatics and polarity in two-dimensional oxide films. Together with the discussion on vibrational properties, those aspects are of fundamental importance in rationalizing the observed structural phenomena. In the subsequent two chapters, specific aspects of catalysis are touched upon. One, by Matolin and collaborators from the angle of a specific system, namely, ceria grown on Cu (111), a system that has provided an interesting playground for evidencing the importance of defects and charge transfer in rare earths oxide films, and, the other one, through a collaboration between Pacific Northwest National Laboratory, Brookhaven National Laboratory, and Weaver at Florida State University, on catalytic chemistry involving oxide nanostructures. Chapter 10 by Risse deals with charge transfer effects in ultrathin oxide films, an interesting and important aspect for metal supported oxide films, a topic the author has studied in detail by a specific experimental technique, i.e., ultrahigh vacuum compatible EPR spectroscopy. The following two chapters extend the discussion towards oxide interfaces. Chapter 11 by Shluger and Bersuker deals with a specific system, namely Si and two-dimensional oxides films grown on top of this substrate. In particular, they stress the importance of understanding the defect structure of those systems. This was a question raised at the outset of the field, when oxide films on Si were recognized as crucial in semiconductor device physics. Chapter 12 by Demkov addresses the question of two-dimensional oxide interfaces from a more general point of view. Widdra and Förster extend the discussion on oxide structures and properties to concepts connecting bulk structures and novel interfaces and they use once again perovskite ultrathin films as an example.

In summary, this book will provide the reader with a marvelous introduction into the fundamentals of ultrathin oxide films, which has been put together by the editors carefully in a well-balanced way. The reader is lead from the fundamentals of ultrathin film physics to the applications, and in this sense the book closes a circle from the outset of the field demanding an understanding of thin oxide films in device production to the creation of new concepts and systems that will provide the scientific community with a wide playground for the years to come. I wish the book success in every aspect.

Berlin, Germany Hajo Freund