PREFACE

Metal oxides are abundant and have a wide application as catalysts, semiconductors, superconductors, varistors and sensors. It has become obvious that many of their properties, being of significant importance for applications, are strongly influenced by their surface properties which differ substantially from those of the crystalline bulk. There has been an accumulation of experimental evidence indicating that surface and grain boundary phenomena such as segregation and chemisorption can affect several processes of industrial significance. Despite of the importance of surface properties of oxide materials our knowledge of this subject is still very limited due to severe difficulties in the experimental approach to surface studies of ionic solids. The application of modern surface sensitive techniques is mainly oriented toward metallic surfaces rather than surfaces of chemical compounds. It is interesting to note that the main progress in surface research of ionic solids has been observed not in the field of surface science but in such engineering related disciplines as materials sciences, ceramics and catalysis. Regrettably the number of works in this field is still very small.

This book aims to collect some of the most interesting recent activity on surface properties of oxide materials and the effect of these properties on reactivity. Under the term of "surface" both external surfaces (free surfaces) and internal surfaces (grain boundaries, dislocations, etc.) are considered. The book involves both theoretical and experimental aspects of the problem in relation to gas-solid, solid-solid and liquid-solid interfaces. Scientists working in this field were invited to contribute to this volume.

From the theoretical study of Kunz it results that many interesting surface properties of oxides are closely related to imperfections such as intrinsic and extrinsic defects. The extensive, overview paper of Blesa et al. deals with surface properties of metal oxides in aqueous solutions as well as chemical and electrochemical processes at the oxide-liquid phase boundary involving dissolutions and phase transitions. Certain aspects of segregation in oxide ceramic materials are discussed by Nowotny. Both theoretical and experimental approaches to evaluate segregation in oxide materials are shortly reviewed. Factors affecting interactions at metal-oxide interfaces as well as practical aspects of this problem are considered by Nicholas. A survey on the effect of grain boundary diffusion on formation of oxide layers on metals is presented by Smeltzer. The paper illustrates the effect of the short-circuit diffusion of metal and oxygen through low resistance diffusion paths along grain boundaries of oxide films and scales. Certain aspects of the oxide-oxide interface involving crystallographic relations in eutectic systems are discussed in the paper of Revcolevschi et al. Experimental approaches to determine the surface layer thickness for several oxide materials and its transport properties (oxygen diffusion) are presented by Ikuma and Komatsu. This work makes an important contribution to the problem of the effect of surface on properties of materials. Here the extent of the surface region is of fundamental importance. The resulting effects of the surface layer on the reactivity of oxide powders are dicussed by Ishii. Available, experimental data on grain boundary and dislocation diffusion in alumina are reviewed by E.G. Moya and F. Moya. The effect of the surface and grain boundaries on the sintering and densification of zinc oxide is discussed by Kobayashi. Van Loo et al. in their studies have shown that even traces of additions may have a significant effect on the reactivity in oxide systems as a result of formation of low or fast diffusion paths. Surface properties are also of significant importance for their practical application as materials for water electrolysis. Certain aspects of the role of surface properties of metal oxides on their practical application for preparation of anodes and separators are the subject of the last chapter by Dufour and Morin.

We hope that the present book will be of interest to materials scientists and engineers concerned with ceramics, catalysis and sensorics.

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