Preface

In the last decade the scaling down of functional structures has been a dominating trend in many fields of science and technology. The size reduction of structures from the micrometer to the nanometer scale leads not only to a miniaturization of functional units but also to the development of new materials and systems with unconventional physical and chemical properties. The electrocrystallization processes, which offer over competing vapor phase deposition some unique advantages such as high selectivity and exact and easy control of the growth conditions by the electrode potential and current density, are very attractive for surface structuring and modification in modern micro- and nanotechnologies.

This book provides a comprehensive overview of recent advances in the nanostructuring and -modification of solid surfaces by electrocrystallization of metals, oxides and semiconductors. After discussing the fundamentals relevant to nanotechnology, the book focuses on the preparation and properties of various nanostructures. With chapters, written by leading experts in these fields, the book is addressed to scientists, researchers and graduate students interested in electrochemical phase formation, electrodeposition, surface science, materials science and nanotechnology.

The first chapter by Staikov and Milchev offers a general introduction to the basic concepts of electrocrystallization and their impact on nanotechnology. Mariscal and Leiva describe, in Chapter 2, different computer simulation techniques and their application to low-dimensional metal phase formation and electrochemical nanostructuring. Chapter 3 by Kautek is devoted to the preparation of low-dimensional metal systems by electrodeposition in templates and STM tip-induced 0D nanocavities. In Chapter 4 Freyland et al. discuss the specific aspects of nanoscale electrocrystallization of metals and semiconductors from ionic liquids. Chapter 5 by Moffat et al. deals with the mechanism of so-called superconformal growth, which is relevant to the nanoscale electrodeposition of on-chip metal interconnections. Schindler and Hugelmann focus, in Chapter 6, on the application of STM for tip-induced localized electrocrystallization of metals. A comprehensive overview of the fabrication of ordered nanoporous anodic alumina layers and their application is given in Chapter 7 by Asoh and Ono. In Chapter 8 Chen and Tao review different approaches for electrochemical fabrication of atomic scale contacts and nanogaps and discuss their properties and applications. An original method

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for the preparation of metallic and compound nanowires by selective electrocrystallization at step edges is described by Penner in Chapter 9. Homma describes, in Chapter 10, a maskless technique for electrochemical fabrication of arrays of metal nanodots on silicon wafers, based on the formation of patterned nanodefects at the wafer surface and subsequent local electroless metal deposition. Chapter 11 by Allongue and Maroun reviews the electrochemical growth of ultrathin epitaxial films of iron group metals on single crystal substrates, correlating the structure and morphology of the films with their specific magnetic properties. Peter and Bakonyi focus, in Chapter 12, on electrodeposition of nanoscale multilayered magnetic/nonmagnetic metallic films, placing an emphasis on their structure and giant magnetoresistance behavior.

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