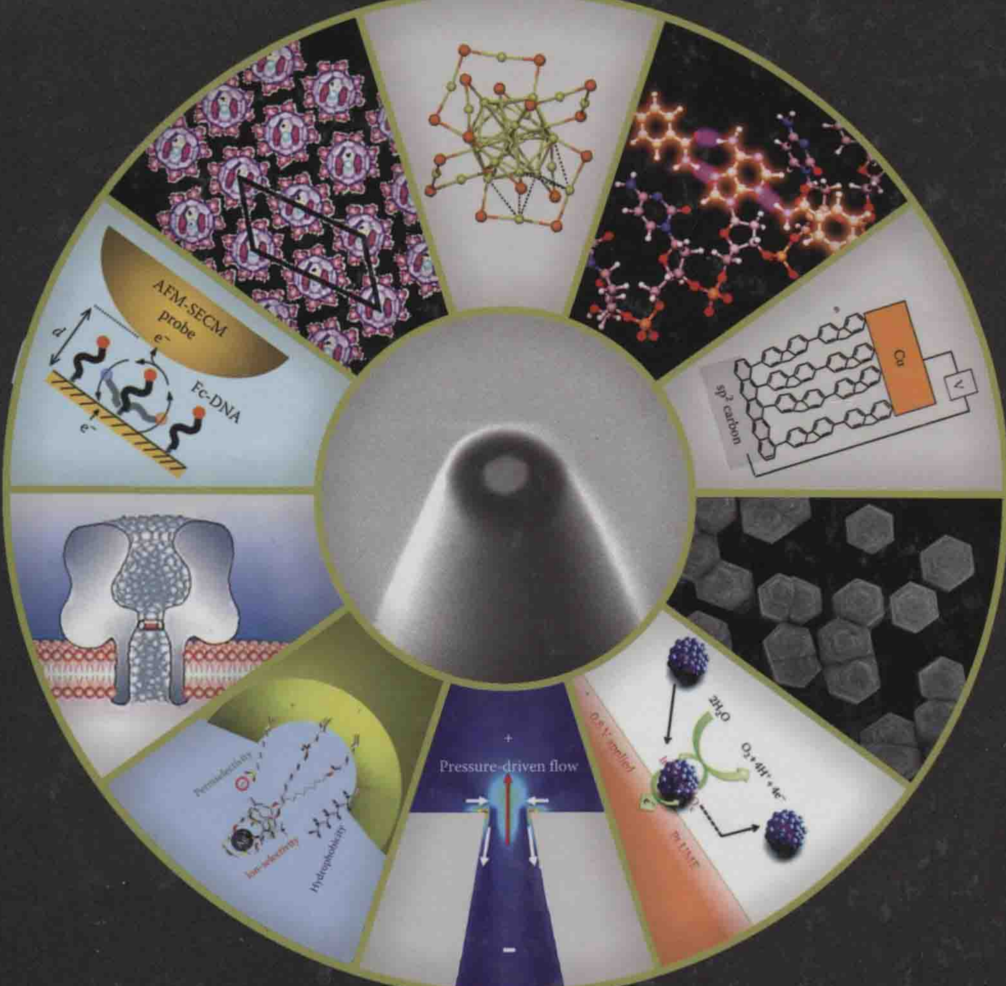
NANOELECTROCHEMISTRY



edited by

Michael V. Mirkin • Shigeru Amemiya

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edited by

Michael V. Mirkin
Queens College, New York, USA

Shigeru Amemiya
University of Pittsburgh, Pennsylvania, USA

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Preface

The number of scientific disciplines whose names begin with the prefix *nano* has grown dramatically since the launch of the National Nanotechnology Initiative in 2000. Some of those specialties were born to be *nano* either because their research subjects are nanometer-sized objects or because of the use of nanometer-scale experimental tools, for example, the scanning tunneling microscope. It took electrochemistry two centuries (counting from Alessandro Volta's creation of the voltaic pile in 1800) to acquire the prefix *nano*. To work on the nanoscale, electrochemists had to produce nanometer-sized probes, learn to accurately measure ultralow currents, and develop a new theory required for data analysis. The evolution of electrochemistry to nanoscience was also accelerated by the development and synthesis of many new nanomaterials and systems. Was the transition to *nano* worth this effort? Our book aims to answer this question with a resounding *Yes!* By the early 1980s, electrochemistry could be seen as a mature and application-driven science. The move to the nanoscale rejuvenated this field and allowed it to generate new electrode systems and begin to gain molecular-level knowledge about heterogeneous processes complementary to that obtained with various spectroscopic and surface science techniques. The nanoscale capabilities also gave electrochemistry a niche in two of the most active areas of current chemical research—biomedical and alternative energy.

This book covers three integral aspects of nanoelectrochemistry. The first two chapters contain theoretical background, which is essential for everyone working in the field, that is, theories of electron transfer (Chapter 1), transport, and double-layer processes (Chapter 2) at nanoscale electrochemical interfaces. The other chapters are dedicated to the electrochemical studies of nanomaterials and nanosystems (Chapters 3 through 14) or the development and applications of nanoelectrochemical techniques (Chapters 15 through 22) and are self-contained. Nanoelectrochemistry has proved useful for a broad range of interdisciplinary research. The applications discussed in this book range from studies of biological systems to nanoparticles and from electrocatalysis to molecular electronics, nanopores, and membranes. Although we did not intend to present even a brief survey of those diverse areas of research, each chapter provides sufficient detail to allow a specialist to evaluate the applicability of nanoelectrochemical approaches to solving a specific problem, and the key ideas are discussed at a level suitable for beginning graduate students.

Our hope is that this book will be useful to all interested in learning about nanoelectrochemical systems. We thank our students, coworkers, and colleagues who have done so much to advance this field.

Editors

Michael V. Mirkin is professor of chemistry at Queens College, City University of New York, New York City, New York. His professional interests are in the application of electrochemical methods to solving problems in physical and analytical chemistry and include charge-transfer reactions at solid–liquid and liquid–liquid interfaces, electrochemical kinetics, and nanoelectrochemistry. He has published more than 110 peer-reviewed papers and book chapters and coedited the first monograph on scanning electrochemical microscopy (second edition, 2012). He earned a PhD in electrochemistry (1987) from Kazakh State University (former USSR) and did postdoctoral research at The University of Texas at Austin from 1990 to 1993.

Shigeru Amemiya is associate professor, Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania. He is the author or coauthor of more than 60 scholarly papers and book chapters in electroanalytical chemistry. His research interests are electrochemical sensing and imaging for biological and material studies, including the development of nanoscale scanning electrochemical microscopy and ultrasensitive ion-selective electrodes. He earned his BS (1993) and PhD (1998) in chemistry from The University of Tokyo, Japan, and received a postdoctoral fellowship from the Japan Society for the Promotion of Science to work at The University of Tokyo and The University of Texas at Austin.

Contributors

Barak D.B. Aaronson
Department of Chemistry
University of Warwick
Coventry, United Kingdom

Radoslav R. Adzic
Department of Chemistry
Brookhaven National Laboratory
Upton, New York

Christian Amatore
Department of Chemistry
Ecole Normale Supérieure
PSL Research University
Paris, France

Shigeru Amemiya
Department of Chemistry
University of Pittsburgh
Pittsburgh, Pennsylvania

Agnès Anne
Laboratory of Molecular Electrochemistry
Paris Diderot University
Paris, France

Lane A. Baker
Department of Chemistry
Indiana University
Bloomington, Indiana

Allen J. Bard
Center for Electrochemistry
The University of Texas at Austin
Austin, Texas

Gregory W. Bishop
Department of Chemistry
University of Connecticut
Storrs, Connecticut

Aliaksei Boika
Center for Electrochemistry
The University of Texas at Austin
Austin, Texas

Philippe Bühlmann
Department of Chemistry
University of Minnesota
Minneapolis, Minnesota

Tessa M. Carducci
Department of Chemistry
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina

Shengli Chen
Department of Chemistry
Wuhan University
Wuhan, Hubei, People's Republic of China

Christophe Demaille
Laboratory of Molecular Electrochemistry
Paris Diderot University
Paris, France

Jonathon Duay
Department of Chemistry and Biochemistry
University of Maryland
College Park, Maryland

Andrew G. Ewing
Department of Chemical and Biological Engineering
Chalmers University of Technology
and
Department of Chemistry and Molecular Biology
University of Gothenburg
Göteborg, Sweden

Alicia K. Friedman
Department of Chemistry
Indiana University
Bloomington, Indiana

Kuanping Gong
San Jose Lab
Corporate Research Institute
Samsung Cheil Industries, Inc.
San Jose, California

Jacob M. Goran
Department of Biochemistry and Chemistry
The University of Texas at Austin
Austin, Texas

Aleix G. Güell
Department of Chemistry
University of Warwick
Coventry, United Kingdom

Manon Guille-Collignon
Department of Chemistry
Ecole Normale Supérieure
PSL Research University
Paris, France

Róbert E. Gyurcsányi
Department of Inorganic and Analytical Chemistry
Budapest University of Technology and Economics
Budapest, Hungary

M.F. Juarez
Institute of Theoretical Chemistry
Ulm University
Ulm, Germany

Shuo Kang
MESA+ Institute for Nanotechnology
University of Twente
Enschede, the Netherlands

Seong Jung Kwon
Center for Electrochemistry
The University of Texas at Austin
Austin, Texas

Wen-Jie Lan
Department of Chemistry
University of Utah
Salt Lake City, Utah

Sang Bok Lee
Department of Chemistry and Biochemistry
University of Maryland
College Park, Maryland

Frédéric Lemaître
Department of Chemistry
Ecole Normale Supérieure
PSL Research University
Paris, France

Serge G. Lemay
MESA+ Institute for Nanotechnology
University of Twente
Enschede, the Netherlands

Stuart Lindsay
Biodesign Institute
Arizona State University
Tempe, Arizona

Stephen Maldonado
Department of Chemistry
University of Michigan
Ann Arbor, Michigan

Richard McCreery
Department of Chemistry
and
National Institute for Nanotechnology
University of Alberta
Edmonton, Alberta, Canada

Kim McKelvey
Department of Chemistry
University of Warwick
Coventry, United Kingdom

Michael V. Mirkin
Department of Chemistry and Biochemistry
Queens College
City University of New York
New York City, New York

Dmitry Momotenko
Department of Chemistry
University of Warwick
Coventry, United Kingdom

Royce W. Murray
Department of Chemistry
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina

Jun Hui Park
Center for Electrochemistry
The University of Texas at Austin
Austin, Texas

Ernö Pretsch
Institute of Biogeochemistry and Pollutant Dynamics
ETH Zürich
Zürich, Switzerland

P. Quaino
Programa de Electroquímica Aplicada e Ingeniería Electroquímica
Universidad Nacional del Litoral
Santa Fé, Argentina

James F. Rusling
Department of Chemistry
and
Institute of Materials Science
University of Connecticut
Storrs, Connecticut

and

Department of Cell Biology
University of Connecticut Health Center
Farmington, Connecticut

and

School of Chemistry
National University of Ireland at Galway
Galway, Ireland

E. Santos
Institute of Theoretical Chemistry
Ulm University
Ulm, Germany

and

Facultad de Matemáticas
Astronomíay Física
Instituto de Física Enrique Gaviola
Consejo Nacional de Investigaciones Científicas y Técnicas
Universidad Nacional de Córdoba
Córdoba, Argentina

W. Schmickler
Institute of Theoretical Chemistry
Ulm University
Ulm, Germany

G.J. Soldano
Institute of Theoretical Chemistry
Ulm University
Ulm, Germany

Keith J. Stevenson
Department of Biochemistry and Chemistry
The University of Texas at Austin
Austin, Texas

Jay A. Switzer
Department of Chemistry and Materials Research Center
Missouri University of Science and Technology
Rolla, Missouri

Scott N. Thorgaard
Department of Chemistry
Grand Valley State University
Allendale, Michigan

Patrick R. Unwin
Department of Chemistry
University of Warwick
Coventry, United Kingdom

Jun Wang
Department of Chemical and Biological Engineering
Chalmers University of Technology
and
Department of Chemistry and Molecular Biology
University of Gothenburg
Göteborg, Sweden

Wen Wen
Department of Chemistry
University of Michigan
Ann Arbor, Michigan

Henry S. White
Department of Chemistry
University of Utah
Salt Lake City, Utah

Contents

Section I

Theory of Nanoelectrochemistry