Edited by Vladislav V. Kharton

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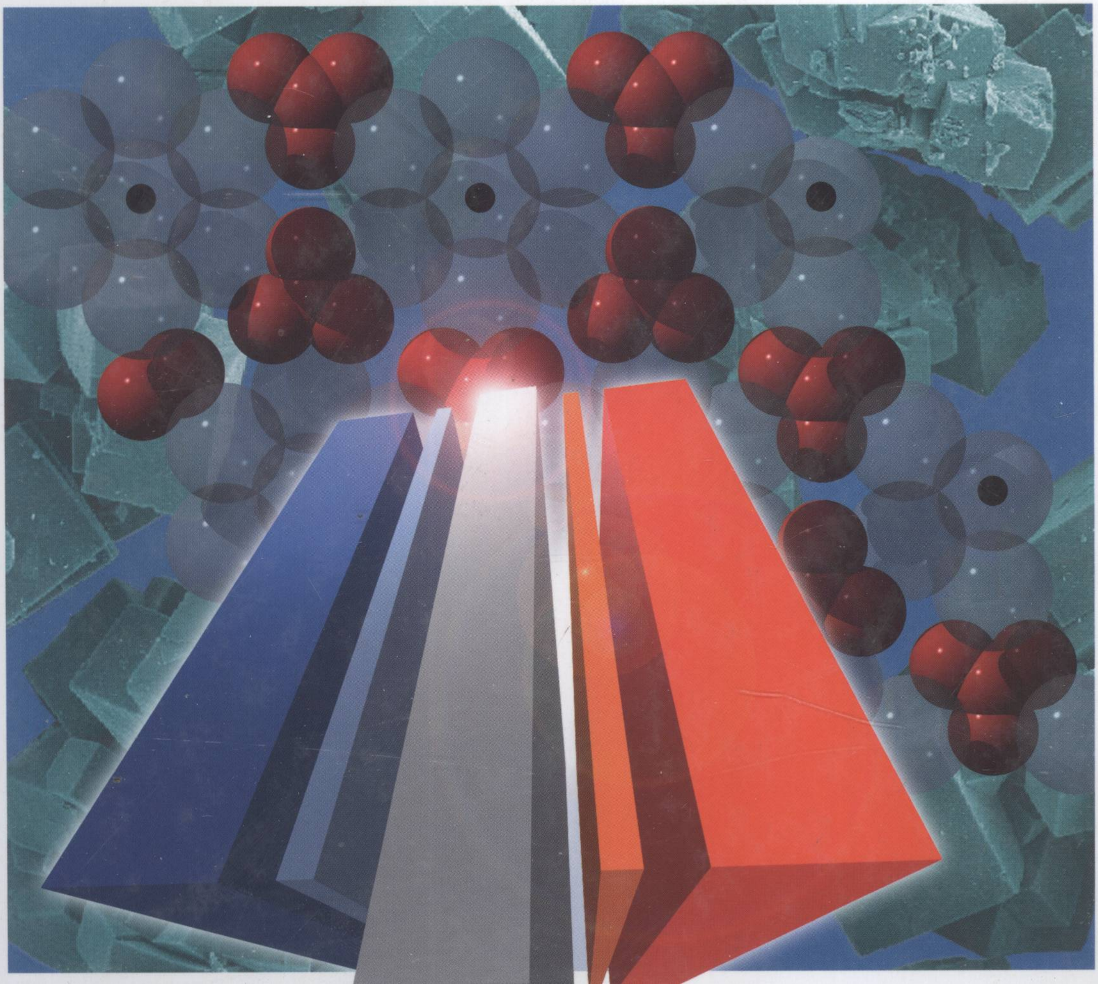
Fundamentals, Materials and their Applications



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The Editor

Vladislav V. Kharton
University of Aveiro
Dept. of Ceramics and Glass Engineering CICECO
3810-193 Aveiro
Portugal

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Further Reading

Kharton, V.V. (ed.)

Solid State Electrochemistry II

Electrodes, Interfaces and Ceramic Membranes

2011
ISBN: 978-3-527-32638-9

Endres, F., MacFarlane, D., Abbott, A. (eds.)

Electrodeposition from Ionic Liquids

2008
ISBN: 978-3-527-31565-9

Bard, A. J., Stratmann, M., Gileadi, E., Urbakh, M., Calvo, E. J., Unwin, P. R., Frankel, G. S., Macdonald, D., Licht, S., Schäfer, H. J., Wilson, G. S., Rubinstein, I., Fujihira, M., Schmuki, P., Scholz, F., Pickett, C. J., Rusling, J. F. (eds.)

Encyclopedia of Electrochemistry

11 Volume Set

2007
ISBN: 978-3-527-30250-5

Hamann, C. H., Hamnett, A., Vielstich, W.

Electrochemistry

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ISBN: 978-3-527-31515-4

Alkire, R. C., Kolb, D. M., Lipkowski, J., Ross, P. N. (eds.)

Diffraction and Spectroscopic Methods in Electrochemistry

2006
ISBN: 978-3-527-31317-4

Preface

Vladislav V. Kharton

Solid-state electrochemistry is an important and rapidly developing scientific field that integrates many aspects of classical electrochemical science and engineering, materials science, solid-state chemistry and physics, heterogeneous catalysis, and other areas of physical chemistry. This field comprises – but is not limited to – the electrochemistry of solid materials, the thermodynamics and kinetics of electrochemical reactions involving at least one solid phase, and also the transport of ions and electrons in solids and interactions between solid, liquid and/or gaseous phases, whenever these processes are essentially determined by the properties of solids and are relevant to the electrochemical reactions. The range of applications includes many types of batteries and fuel cells, a variety of sensors and analytical appliances, electrochemical pumps and compressors, ceramic membranes with ionic or mixed ionic-electronic conductivity, solid-state electrolyzers and electrocatalytic reactors, the synthesis of new materials with improved properties and corrosion protection, supercapacitors, and electrochromic and memory devices.

The first fundamental discoveries, which today are considered the foundation of solid-state electrochemistry, were made during the nineteenth century and the first half of the twentieth century by M. Faraday, E. Warburg, W. Nernst, C. Tubandt, W. Schottky, C. Wagner, and other famous scientists. Such investigations provided the background for the rapid progress achieved both in our understanding of solid-state electrochemical processes, and in the applied developments that were made during the latter part of the twentieth century. As the scope of this volume is limited, and so cannot provide an exhaustive analysis of the historical aspects and classical concepts, those readers interested in such information are referred to a range of well-known books [1–11]. It should be mentioned that, similar to any other scientific area, the continuous progress in solid-state electrochemistry leads both to new horizons and to new challenges. In particular, increasing demands for higher-performance electrochemical cells leads to a need to develop novel experimental and theoretical approaches for the nanoscale optimization of the cell materials and interfaces, for the analysis of highly nonideal systems, and for overcoming the numerous gaps in our knowledge, which became possible only due to recent achievements in the related areas of science and technology. Moreover, the increasing amount and diversity of available scientific information acquired during the past few decades

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has raised the importance of systematization, the unification of terminology, and the standardization of experimental and simulation techniques.

The aim of this Handbook is to combine the fundamental information and to provide a brief overview of recent advances in solid-state electrochemistry, with a primary emphasis on methodological aspects, novel materials, factors governing the performance of electrochemical cells, and their practical applications. The main focus is, therefore, centered on specialists working in this scientific field and in closely related areas, except for a number of chapters which present also the basic formulae and relevant definitions for those readers who are less familiar with theory and research methods in solid-state electrochemistry. Since it has been impossible to cover in total the rich diversity of electrochemical phenomena, techniques and appliances, priority has been given to recent developments and research trends. Those readers seeking more detailed information on specific aspects and applications are addressed to the list of reference material below, which includes both interdisciplinary and specialized books [8–20].

The first volume of this Handbook contains brief reviews dealing with the general methodology of solid-state electrochemistry, with the major groups of solid electrolytes and mixed ionic-electronic conductors, and with selected applications for electrochemical cells. Attention is drawn in particular to the nanostructured solids, superionics, polymer and hybrid materials, insertion electrodes, electroanalysis and sensors. Further applications, and the variety of interfacial processes in solid-state electrochemical cells, will be examined in the second volume.

The chapters of the Handbook are written by leading experts in solid-state electrochemistry from Australia, China, France, Germany, Israel, Japan, Korea, Portugal, Russia, the United Kingdom, and the United States of America. Sadly, one of the authors of Chapter 3, Professor Alexander N. Petrov, died during the finalization stages of the Handbook. His professionalism and love of science will be well remembered by all of his colleagues, and the intellectual contributions made by Professor Petrov will continue to live on in the form of the inspiration that he has provided to his students, coworkers and, hopefully, the readers of this book.

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List of Contributors

Alan Atkinson
Imperial College London
Department of Materials
London SW7 2AZ
United Kingdom

Doron Aurbach
Bar Ilan University
Department of Chemistry
52900
Ramat-Gan
Israel

Maxim Avdeev
Bragg Institute
Australian Nuclear Science and
Technology Organisation
1 PMB, Menai 2234
Australia

Alan V. Chadwick
University of Kent
School of Physical Sciences
Canterbury
Kent CT2 7NH
United Kingdom

Vladimir A. Cherepanov
Ural State University
Department of Chemistry
51 Lenin Av.
Ekaterinburg 620083
Russia

Jeffrey W. Fergus
Auburn University
Material Research and Education Center
275 Wilmore Laboratories
Auburn, AL
USA

Jacques Fouletier
LEPMI
ENSEEG-PHELMA
BP 75
38402 Saint Martin d'Hères Cedex
France

Véronique Ghetta
LPSC
53 Rue des Martyrs
38026 Grenoble Cedex
France

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Michael Hermes
Ernst-Moritz-Arndt-Universität Greifswald
Felix-Hausdorff-Straße 4
17489 Greifswald
Germany

Stephen Hull
The ISIS Facility
STFC Rutherford Appleton Laboratory
Didcot
Oxfordshire, OX11 0QX
United Kingdom

Nobuhito Imanaka
Osaka University
Department of Applied Chemistry
Faculty of Engineering
2-1 Yamadaoka, Suita
Osaka 565-0871
Japan

Vladislav V. Kharton
University of Aveiro
Department of Ceramics and Glass Engineering
CICECO
3810-193 Aveiro
Portugal

John A. Kilner
Imperial College London
Department of Materials
London SW7 2AZ
United Kingdom

Sung-Woo Kim
Korea Atomic Energy Research Institute
1045 Daedeok-Daero
Yuseong-Gu
Daejeon 305-353
Republic of Korea

Seung-Bok Lee
Korea Institute of Energy Research
#71-2 Jang-Dong
Yuseong-Gu
Daejeon 305-600
Republic of Korea

Mikhael Levi
Bar Ilan University
Department of Chemistry
52900
Ramat-Gan
Israel

Joachim Maier
Max-Planck-Institut für Festkörperforschung
Stuttgart
Germany

Fernando M.B. Marques
University of Aveiro
Department of Ceramics and Glass Engineering
CICECO
3810-193 Aveiro
Portugal

Vladimir B. Nalbandyan
Southern Federal University
Department of Chemistry
Zorge 7
344090 Rostov-na-Donu
Russia

Alexander N. Petrov
Formerly Ural State University
Department of Chemistry
51 Lenin Av.
Ekaterinburg 620083
Russia

Su-Il Pyun
Korea Advanced Institute of Science and Technology
Department of Materials Science and Engineering
#373-1 Guseong-Dong
Yuseong-Gu
Daejeon 305-701
Republic of Korea

Shelley L.P. Savin
University of Kent
School of Physical Sciences
Canterbury
Kent CT2 7NH
United Kingdom

Fritz Scholz
Ernst-Moritz-Arndt-Universität Greifswald
Felix-Hausdorff-Straße 4
17489 Greifswald
Germany

Igor L. Shukaev
Southern Federal University
Department of Chemistry
Zorge 7
344090 Rostov-na-Donu
Russia

Shinji Tamura
Osaka University
Department of Applied Chemistry
Faculty of Engineering
2-1 Yamadaoka, Suita
Osaka 565-0871
Japan

Danmin Xing
Sunrise Power Co., LTD
Nation Engineering Research Center of Fuel Cells
No. 907, Huangpu Road
Hi-Tech Zone, Dalian 116025
P.R. China

Baolian Yi
Chinese Academy of Sciences
Dalian Institute of Chemical Physics
No. 457, Zhongshan Road
Dalian 116023
P.R. China

Andrey Yu. Zuev
Ural State University
Department of Chemistry
51 Lenin Av.
Ekaterinburg 620083
Russia

Contents

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