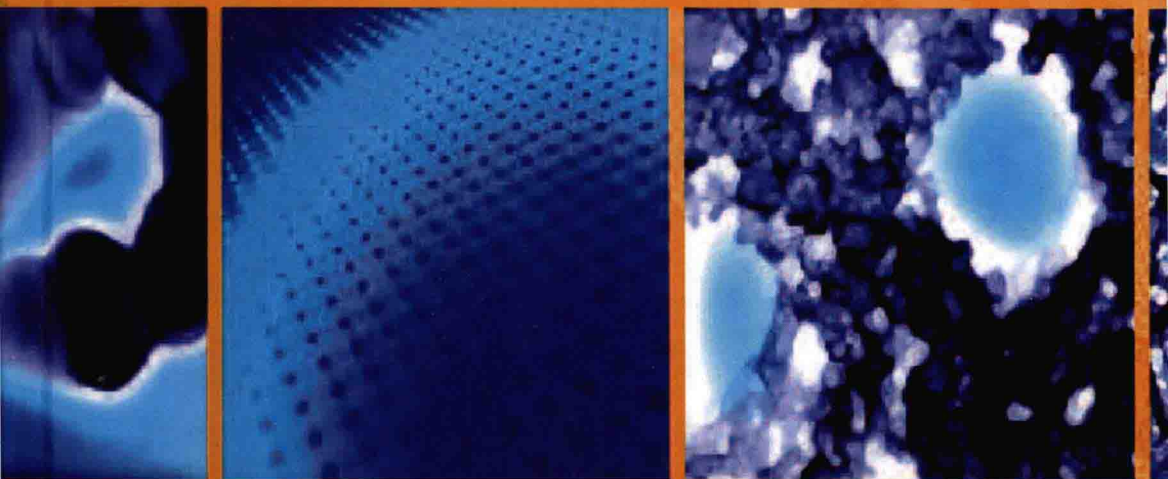


edited by
S. R. S. Prabakaran
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Nanotechnology in Advanced Electrochemical Power Sources



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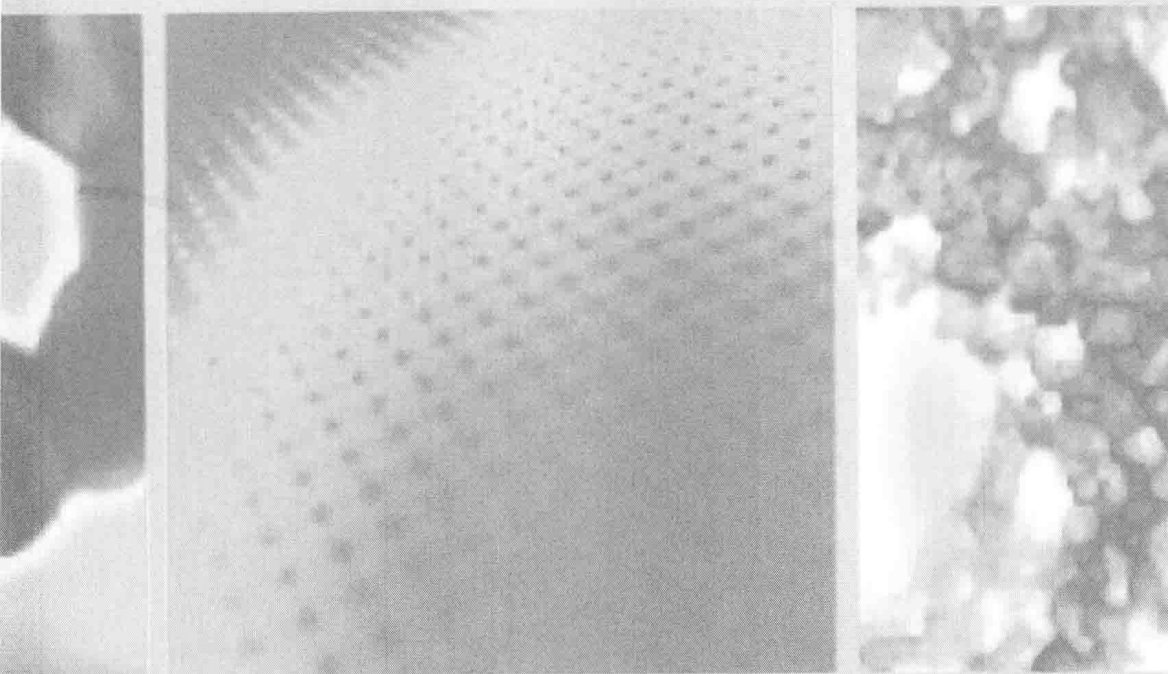
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Foreword

Electrochemical energy storage is regarded as a vital means of providing portable power to the mankind in variety of ways. The current trend in developing advanced power/energy sources has rendered impetus to advancement as anticipated by scientists and engineers around the world. Thus, tremendous research opportunities exist in both government and private funded activities all over the world. To facilitate that nanotechnology has complemented laurels to enhance such opportunities to meet the anticipated demand by improving the existing storage limits of battery system especially lithium-containing batteries of present and the future technologies and supercapacitors.

In this context, the book entitled *Nanotechnology in Advanced Electrochemical Power Sources* is timely which encompasses chapters contributed by various world renowned experts in the field of lithium-containing battery electrodes, electrolytes and supercapacitors. State-of-the-art understanding pertaining to nanoscale aspects of the above mentioned advanced energy storage devices has been the focus of this volume. While the fundamental issues relating to the device performance of various positive and negative electrode materials for instance, olivine and silicate cathodes, high-capacity anodic materials such as Sn alloys, silicon and conversion type electrode, modified electrode with CNTs, graphene-based supercapacitors, hierarchically designed porous air cathodes and their nanoscale advantages in terms of device performances are also covered. There are 12 full length chapters including a dedicated chapter on Li-air secondary batteries, a futuristic endeavor in developing a high energy density battery having theoretical specific capacity closest to gasoline. The intended audience of this book includes students, materials scientists, electrical engineers, new

comers who would like to learn the nuances of the exhilarating branch having enormous societal advantages for the mankind.



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Preface

The challenge to provide adequate power supplies to the human race on an indefinite basis without causing long-term damage to the environment requires versatile means of energy conversion and storage. The advances in large-scale original equipment manufacturer (OEM) gadgets, smart cellular phones, tablet computers (tabs), power-hungry long-range communication devices, and modern-day electric mobility systems (plug-in electric cars, for instance) demand for huge power and energy in the form of rechargeable energy storage systems. Electrical energy storage thus becomes vital today than at any time in the human history. The recent evolution of nanotechnology may provide opportunities to meet the anticipated demand by improving the existing storage limits of battery system, especially Li-ion batteries, supercapacitors, and upcoming novel energy storage system namely Li-air rechargeable batteries. The engineering of new materials, and especially at the nanoscale, has become imperative to achieve enhanced energy and power efficiency to meet these challenges of energy storage systems. This book incorporates state-of-the-art understanding pertaining to nanoscale aspects of advanced energy storage devices such as Li-ion batteries, Li-air batteries, and electrochemical supercapacitors. It focuses on various fundamental issues related to the device performance of various positive and negative electrode materials, with special reference to their nanoscale advantages. It also includes fundamentals and processing techniques with regard to synthesis, characterization, physical and electrochemical properties, and applications of nanoscale materials pertaining to advanced electrochemical power sources. The goal of this book is to render an update of the current advancement in the field of electrochemical power sources with special reference to nanotechnology. A vari-

ety of advanced nanomaterials, such as transition metal oxides, phosphates, silicates, and conversion electrodes, together with carbonaceous materials that include carbon nanotubes, nanorods, and mesoporous carbons, are discussed by notable authorities of this exhilarating field. The book presents a balanced mix of theoretical and experimental approaches adopted over these years in the advancement of lithium-based power sources (Li-ion and Li-Air) and electrochemical capacitors. The book is a compact reference source for students, scientists, engineers, and specialists in various fields, including electron devices, electrochemistry, electrical engineering, nanotechnology, and solid state physics.

S. R. S. Prabakaran

M. S. Michael

Summer 2014

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