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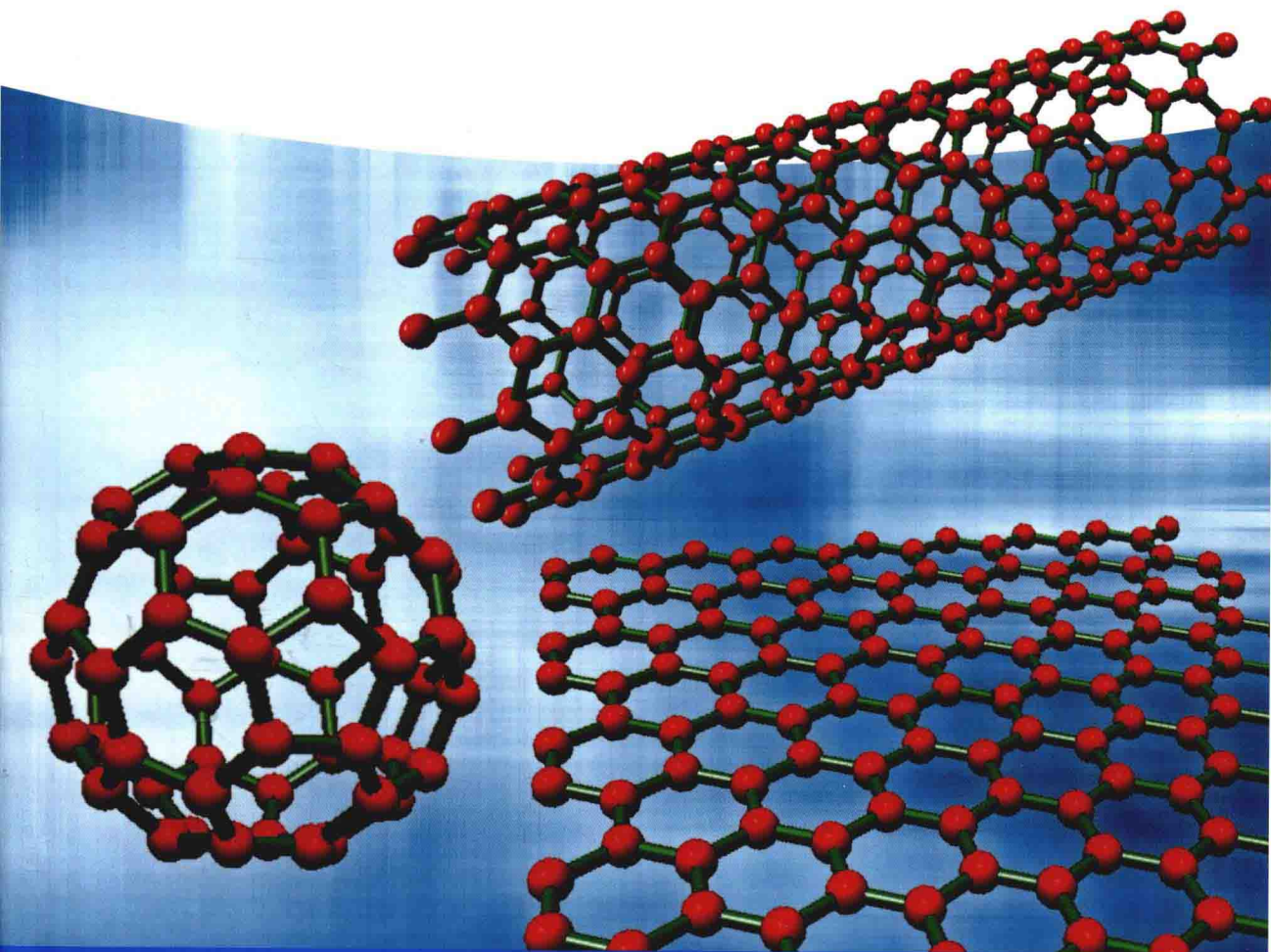
Nanocarbons for Advanced Energy Storage

Volume 1



ADVANCED NANOCARBON MATERIALS

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Volume 1

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Preface

With the rapid change and increasing concerns about the climatic warming and oil consumption, development of new clean energy storage systems (e.g., electricity, hydrogen) with high energy efficiency has become more and more important and urgent in our modern society. One of the major directions to overcome these challenging issues is the production of electricity, for instance, an electric vehicle could be powered by a rechargeable battery or/and supercapacitor instead of oil or coal. Taking this into account, high-performance electrochemical energy storage systems must be developed to meet the growing industrial and societal demands. In this respect, searching for novel materials with exceptional electrochemical properties for energy storage is essential.

Among of all newly developed functional materials, nanocarbons ranging from pristine nanocarbons to carbon-based nanohybrids are playing a key role in high-performance electrochemical energy storage devices. With the rapid growth of nanotechnology, nanocarbon materials such as activated carbon, porous carbons, carbon nanotubes, and graphene have been dramatically developed in the past two decades. Their unique electrical properties and tailored porous structures facilitate fast ion and electron transportation. In order to further improve the power and energy densities of the lithium-ion batteries and electrochemical capacitors, carbon-based hybrids that combine the synergistic properties of carbon and hybrid components (such as metal, metal oxide, polymer) have been extensively explored. These nanocarbon-based materials exhibit not only enhanced specific capacitance, rate capability, but also improved cyclability and energy/power densities. Undoubtedly, advanced nanocarbon materials show great potential in improving current or even further developing high-performance electrochemical energy storage devices. Therefore, the goal of this book is to present the latest advancements associated with the design and synthesis, characterizations, and applications of nanocarbon materials for advanced electrochemical energy storage, in particular, involving nanostructured carbon materials as cathodes and anodes for lithium-ion batteries, and as electrodes for supercapacitors.

In this book, world-leading scientists working in the field of nanocarbons and energy storage applications are joining together to write a book for students

(graduate and undergraduate level), researchers, and possible investors interested in supporting materials research. This book consists of 15 chapters: 11 chapters are devoted to electrochemical capacitors (electrochemical double-layer capacitors, supercapacitors), in which 8 chapters address the general nanocarbon materials, including activated carbons, porous carbon, carbide-derived carbons, aligned carbon nanotubes, carbon nanotube thin films, graphene, and activated graphene, for supercapacitors; 1 chapter describes the theoretical insights into carbon-based supercapacitors; 2 chapters present nanocarbon-based materials and their hybrids for asymmetric supercapacitors and hybrid supercapacitors. And the remaining four chapters discuss the applications of nanocarbons in lithium-ion batteries, of which two are nanocarbon hybrids with metal oxide, silicon, sulfur, or paper/textile, one is related to the precursor-controlled synthesis of nanocarbons and one is graphene for flexible battery devices. Each chapter aims at presenting the most detailed information using familiar terms from the point of view of both research and industrial applications.

Finally, we would like to thank all scientists who have been helpful in the preparation of this book and all colleagues who kindly devoted their time and efforts to contribute chapters.

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