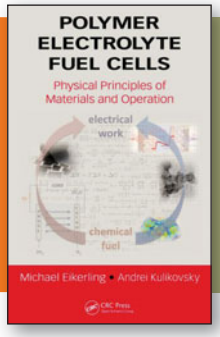


Polymer Electrolyte Fuel Cells: Physical Principles of Materials and Operation

Michael Eikerling and Andrei Kulikovsky

CRC Press, 2014
582 pages, $152.96
ISBN 9781439854051

This is a great book for people who are interested in learning how fuel cells work from electrochemical, polymer physics, and transport perspectives. The authors have organized these areas in an integrated way and with a balance between science and design.

The first chapter presents a general introduction to fuel cells, including design and structures, working principles, and current research focus. This is an excellent chapter for those who do not have a sufficient background in these subjects, or those who are interested in learning some basics.

The second chapter presents a deep discussion of polymer electrolyte membranes, a central part of fuel cells. The functions of the membrane are to separate the reactive gases and keep them in their own compartments, and to allow only hydrogen ions to migrate through the membrane and form an internal electric current. Proton transport is discussed in terms of water—proton interactions, hydrogel physics, and ionic fibrillary structures. A soliton theoretical model, water swelling of hydrogel, and modeling studies are introduced at proper levels.

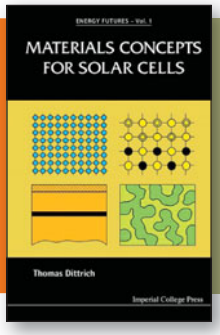
The third chapter describes catalyst layers. It provides a nice treatment of the relationships among microporous structures of the catalyst layers, electrochemical kinetics, and transport processes. This part explains the link between electrochemical reactions and polarization behavior that is key to understanding how chemical energy is converted into electrical energy. The reaction kinetics is related to the voltage of the battery. Discussions are included for a few subjects such as oxygen reduction reactions.

The fourth chapter discusses modeling studies of catalyst layer performance, many of which were performed by the authors and their colleagues. The modeling covers multiple processes, including cathode and anode polarization and various limiting cases imposed by the transport of reactants and hydrogen ions. Theoretical analysis is given for most of the subjects, which provides a comprehensive interpretation of the materials presented in prior chapters.

In the fifth chapter, modeling studies are expanded to cover a few practical aspects of batteries that limit their performance or cause problems. This bridges the theoretical studies with the performance of products.

The references are extensive and up to date. I would have liked to see more real pictures, although the illustrations are good. Overall, this is a nice reference book that I would recommend for students, engineers, and researchers in the field.

Reviewer: SuPing Lyu *is a principal researcher at Medtronic Inc., Mounds View, Minn., USA.*



Materials Concepts for Solar Cells

Thomas Dittrich

Imperial College Press, 2014
552 pages, $118.00 (hardcover)
ISBN 978-1-78326-444-5

Learning about renewable sources of energy is very pertinent in today's context. This textbook is targeted to students interested in the principles and applications of solar cells. It is divided into two parts, with the first part providing the basic principles of solar cells. This section is complemented by a second section where a more practical approach for materials used in the design and architecture of solar cells is presented. The index is comprehensive, and symbols, abbreviations, and acronyms are clearly provided at the beginning of the book. Each chapter contains a summary where the author recapitulates important points. Furthermore, the tasks or problems at the end of each chapter assist in assimilating concepts. The solutions to the tasks are also provided and serve as an auto-evaluation tool. Morever, equations and diagrams are abundant and useful. The bibliography is ample for further reading, and an index with keywords is also provided at the end of the book.

The first of 10 chapters provides an introduction to solar cells by explaining concepts such as I–V characteristics and quantum efficiency. The principles of photogeneration are presented in the second chapter along with practical issues of photon absorption and electron–hole generation. The different types of processes affecting the carrier lifetime, including recombination mechanisms, are discussed in the third chapter. The fourth chapter deals with charge separation of photogenerated carriers created in a *p*–*n* junction by its built-in potential. Connecting the *p*–*n* junction via an ohmic contact to an external load is well explained in the fifth chapter, which deals mainly with the physics of semiconductor-metal contacts. The sixth chapter concludes the first part of the book by discussing the maximum efficiency of a solar cell and its limitations.

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