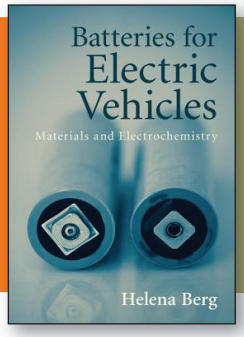


Batteries for Electric Vehicles: Materials and Electrochemistry

Helena Berg

Cambridge University Press, 2015
250 pages, $99.99 (e-book $80.00)
ISBN 9781107085930

This book is a guide to batteries used in electric vehicles. The strength of the book lies in its simplicity and clarity. Its audience is beginning researchers and those in industry seeking practical information and guidance in the design of batteries for electric vehicles. Unburdened by heavy data, the book illustrates many concepts using only schematic diagrams that are relevant to a wide range of batteries and show general trends.

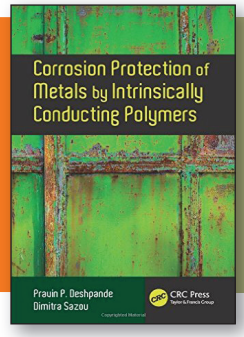
The book is divided into three major parts: basics, lithium-ion batteries, and battery usage in electric vehicles. Part I, consisting of two chapters, benefits from the author's academic background. The first chapter explains cell components and electrochemistry. The explanation of typical discharge profiles as a practical application of Gibbs phase rule is an example of the author's approach. These fundamentals are linked to materials in the second chapter, which briefly describes eight battery types: lead-acid, nickel metal hydride, lithium, high-temperature molten, nickel-zinc, zinc-air, metal-ion, and redox flow. Supercapacitors and fuel cells are also included in this chapter.

Part II has an extended chapter on lithium battery materials and another chapter on cell design. The author makes use of her industrial background in describing how cells are designed for energy or power, the tradeoffs involved, and how performance depends on particle size, porosity and thickness of electrodes, and on the type of cell—cylindrical, prismatic, or pouch. She succinctly describes the manufacturing process of lithium-ion cells.

Part III considers the specific battery requirements at different levels of electrification—all electrics, hybrids, and plug-in hybrids. The battery contains not only cells, but also a thermal system, electronics, and a management system. These are described in chapters 5 and 6 from a design point of view with clear terminology and a glossary in the appendix. The degradation of the battery due to loss of cyclable lithium and of active electrode material, nonoptimal cycling, temperature outside the design range, overcharge, and overdischarge and current rate are discussed in chapter 7. Degradation mechanisms of lithium-ion cells and methods of failure analysis are also discussed.

This book is recommended as supplementary reading in a senior undergraduate or graduate-level course and as a primer on design and for getting practical information on batteries for electric vehicles. There are no homework exercises and only eight references in the entire book; therefore, it may not serve as a textbook in spite of its clarity. However, it achieves its intended purpose of enabling the reader to make informed choices to optimize battery performance.

Reviewer: N. Balasubramanian *works in the area of ultrafine-grain materials, energy storage, and materials innovation in Bangalore, India.*



Corrosion Protection of Metals by Intrinsically Conducting Polymers

Pravin P. Deshpande and Dimitra Sazou

CRC Press, 2015
214 pages, $159.95 (e-book $111.97)
ISBN 9781498706926

Corrosion of metals is an electrochemical process of degradation that occurs in the atmosphere with an annual cost estimate of tens of billions of dollars amounting to about 1–3% of the gross national product in developed countries, such as the United States and the United Kingdom. A variety of methods available for metal protection are dependent on the nature and environment of the metal. This book deals with the use of conducting polymers (CPs) as a novel method for corrosion protection.

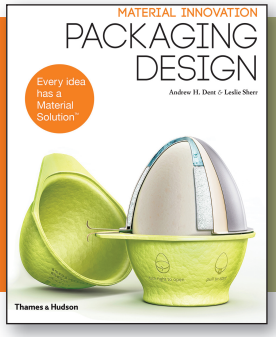
The book is divided into seven chapters, with chapter 1 giving an overview of the developments in anticorrosion technology that has evolved using conducting polymers. In this chapter, there is a historical introduction to the discovery of conducting polymers by H. Shirakawa, Alan J. Heeger, and Alan G. MacDiarmid that resulted in a Nobel prize. The chemical structures and conductivities of CPs such as polyaniline, polypyrrole, polythiophene, poly(para-phenylene vinylene), and polycarbazole are discussed, as well as charge transport in these CPs based on solitons, polarons, and bipolarons. The next few pages contain examples of applications of CPs, a brief introduction to corrosion of metals and the methodology for its prevention, chromate-based anticorrosive coatings, and the occupational health hazards associated with chromates. Subsequent material focuses on smart green, self-repairing coatings explained through diagrams. This chapter concludes with a summary of possible mechanisms by which CPs can protect metals against corrosion. Chapter 2 includes the principles of

https://doi.org/10.1557/mrs.2016.263 Published online by Cambridge University Press

electrochemical corrosion. The material in this section lacks clarity; the references given at the end of this chapter would be more useful for understanding the principles. Chapter 3 includes a survey of the literature on corrosion prevention using conducting polymers based upon recent work. Here, the emphasis is on material synthesis, usefulness of having CPs on the top coat as a protective coating, caution to be applied on the metal substrates, and a consideration of the nature of the corrosive environment. Various protective coatings are covered. Chapter 4 discusses the preparation of those protective coatings. Chapter 5 contains the basics of corrosion-rate measurements through weight loss over time, polarization techniques involving Tafel measurements, potentiodynamic techniques, cyclic polarization, linear polarization resistance, and electrochemical impedance spectroscopy. Chapter 6 deals with strategies adopted for improving the protective efficiency of the CP coatings, followed by a discussion of the problems encountered in CP coatings on corrosion protection. Chapter 7 is a one-page concluding chapter about the future trends in this emerging technology.

This book is well organized with reasonable coverage of the existing literature. It also contains an index and a list of abbreviations used in the book. There are an adequate number of tables and figures. This is a specialized book that would be useful for researchers in the field of CPs who have knowledge of corrosion.

Reviewer: K.S.V. Santhanam *is a professor in the School of Chemistry and Materials Science at the Rochester Institute of Technology, USA.*



Material Innovation: Packaging Design
Andrew H. Dent and Leslie Sherr
Thames & Hudson, 2015
208 pages, $29.95
ISBN 9780500291979

This is a well-designed book filled with two- to four-page case studies of innovations in packaging, a short section on the materials insights used in packaging, and illuminating photographs. Rather than electronic packaging, this book deals more with compression-molded plastic containers for creams and innovative paper packaging for food. It is published in association with the Material ConneXion consulting agency and features how packaging can be used not only to increase sales, but also to add beauty and functionality to a product. This book not only deals with packaging as a marketing tool, but also grapples with how packaging can be used to both improve the human experience and be environmentally friendly.

The book has six chapters. The chapter "Getting to Zero" is focused on making products more environmentally sustainable, for instance, using origami-type folding to create boxes that do not have toxic glues, food containers that are wholly edible, and laser-etched produce whereby lasers are used to write information about the picking date and freshness of the produce. The chapter "Functional Forms" features a shipping box that can be transformed into a workbench, and the life-saving Aid Pod that provides antidiarrheal medications to developing countries by shipping them for free in Coca-Cola cases in the spaces between bottles. The remaining four chapters focus on dispensing systems, advanced protection, interactive packaging, and "mass craft," or the attempt to create personalized items that are mass produced.

Some of the concepts are quite ingenious. For instance, an innovative egg package called the Gogol Mogol has multifunctional capability to store, ship, cook, and serve eggs. Pull a tab on the carton, and the egg can be boiled in minutes directly in the container via the exothermic reaction of calcium oxide and water. There are also several features of packaging to improve human hygiene and safety—the XSTAT syringe can be used to insert anticoagulant-coated materials into a wound in seconds to stop the injured from fatal bleeding. The Drinkable Book provides sheets of silver nanoparticle-embedded paper that can be used to purify and filter 100 liters of water for safe drinking. The PeePoo bag is a low-cost portable toilet for developing countries. The book also describes the packaging of a champagne bottle. On the other end of the technical spectrum, a modular vitrification system is described for the purpose of safely containing nuclear waste in glass. The book concludes with a short section on the recyclability of materials, and then provides a Material ConneXion directory of the materials used in the book's packaging contents.

The reader will come away with many simple lessons, such as pouches are now popular in packaging because they are lightweight and easy to ship. Most of the featured innovations are created around materials such as low-density polyethylene and cardboard—materials that sell for pennies on the dollar. Those interested in using materials for packaging will find this book fascinating. Anyone interested in the beauty of mechanical design will be inspired. However, materials scientists looking for advanced materials ideas should probably look elsewhere.

Reviewer: Karen Swider Lyons *researches fuel-cell and battery materials and their integration into naval systems in Alexandria, Va., USA.*

https://doi.org/10.1557/mrs.2016.263 Published online by Cambridge University Press