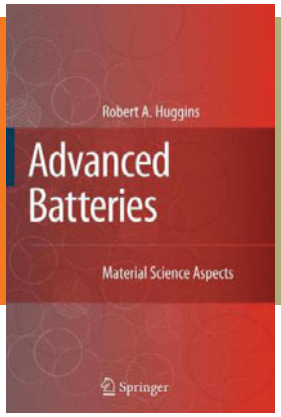


Advanced batteries—Materials science aspects

Robert A. Huggins

Springer, 2009
462 pages, $129.00
ISBN 978-0-387-76423-8

This book is an excellent introduction to the field of advanced batteries for the newcomer to the field. It will not be outdated for a long time, as it is written from the point of view of the basics. It is written from a materials science aspect and comprises 20 chapters and 462 pages.

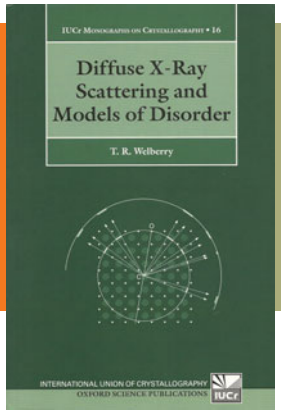
The first four chapters cover the necessary fundamentals of thermodynamics, including phase diagrams, that are essential to an understanding of the reactions of battery materials. The next two chapters introduce the concept of nonequilibrium and the key area of insertion reactions. Chapters 7 and 8 cover the negative electrode, both carbon and metals. Chapter 9 goes into positive electrodes for lithium systems, with an emphasis on those that have been commercialized, such as $LiTiS_2$, $LiCoO_2$, and $LiFePO_4$. The book seems to be pretty much error free, but there is an incorrect attribution to $LiCoO_2$ being the first cell built in the discharged state; many of the disulfide batteries were constructed this way in the 1970s.

Chapters 10 and 11 cover the negative and positive electrode, respectively, in aqueous systems, an understanding of which is essential for flow batteries, which are covered among a hotch-potch of topics in chapter 12. The book then gets back to the fundamentals underpinning of batteries, starting off with a thorough discussion of potentials, reference electrodes, and defect equilibria. This is followed by three chapters on liquid electrolytes, solid electrolytes, and their stability windows. Chapter 17 gives a very useful description of some of the most common electrochemical methods for studying battery materials including potentiostatic, galvanostatic, and alternating current (Wechselstrom) intermittent titration techniques (PITT, GITT, and WITT), and complex impedance. The last two chapters cover very briefly (too briefly) polymers and transient behavior.

In conclusion the author states, "the major emphasis here is upon the fundamental phenomena that determine the properties of the components. . . . The objective is not to describe battery technology." The author has succeeded in doing this, and this approach will allow the book to be useful for many years, and not become dated as many battery books do even before they are published.

As noted already there are few errors in the text, but some researchers are going to be annoyed that the sources of the figures, with a few exceptions, have not been acknowledged. I can recommend without hesitation this book to all interested in batteries, and particularly to those entering the field. It is written at a level appropriate to someone with a chemistry, physics, or materials background.

***Reviewer: Stan Whittingham** of the State University of New York at Binghamton.*



Diffuse x-ray scattering and models of disorder

T.R. Welberry

Oxford University Press, 2010
280 pages, $65.00
ISBN13: 978-0-19-958381-2
ISBN10: 0-19-958381-1

This book is the 16th installment in the series of monographs on crystallography by the International Union of Crystallography (IUCr). Its author, T.R. Welberry of the Australian National University, is well known to the worldwide crystallography community as a co-editor of *Acta Crystallographica B* and a long-time leader in the IUCr. Moreover, Welberry is widely considered as one of the experts in the theory and application of diffuse x-ray scattering to problems in modern chemical crystallography. Given the paucity of treatments of diffuse scattering in the x-ray literature, this volume has the potential for serving as an important addition to the libraries of chemical crystallographers everywhere.

The compact book (266 pages) is divided into three sections: Experiment, Disorder Models, and Examples of Real Disordered Systems. The first of these is only 17 pages, and although the author explicitly states that a discussion of laboratory methods is not a major thrust of the book, the experimentally inclined reader is likely to wish for more information than is presented here. In

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contrast, the main focus of the book is set in the section on Disorder Models, where Welberry establishes the theoretical basis for structures that generate diffuse scattering. Starting with the mathematics of disorder in one dimension, increasingly complex models are considered in turn. Mathematically challenged readers would be well-advised to review books on conditional probabilities, Markov chains, and Ising models prior to reading Welberry's work, since the level of his treatment is likely to be found to be fairly advanced for the average chemical crystallographer.

Throughout this section Welberry presents numerous examples where illustrations of real-space disordered structures are shown side-by-side with their resultant calculated reciprocal-space patterns. Such figures are most welcome, of course—but in the cases such as Figure 3.3 where 10 pairs of patterns (20 examples total!) are presented on the same page, the resultant size reduction makes careful study all but impossible. A preferable editorial choice might have been to expand such figures over a two-page spread to allow the individual panels to be viewed with greater ease. In cases where the real and reciprocal-space representations are presented in an easy-to-view format (such as in Figures 6.8 and 6.9), the reader has the opportunity to fully understand the impact of real-space structure on the reciprocal-space diffraction pattern.

The remaining, and major, portion of the book consists of a series of examples—many from Welberry's own extensive published research—where studies of diffuse scattering have generated new insights into the structure of both organic and inorganic crystals. The breadth of such applications is truly stunning and should convince even the most novice reader of the power of diffuse scattering measurements. The wealth of structural information that is evident from these analyses signals the prize that waits at the end of the rainbow: the crystallographer who is willing to work through the needed probability theory will be rewarded with an appreciation for the information that is to be found in the diffuse scattering.

Welberry's book is not for the faint of heart: junior readers may be scared off by the mathematical rigor that is demanded in the section on Disorder Models. That being said, this book will be a valuable addition to the libraries of all crystallographers as it displays in meticulous detail the information that is available so long as one chooses to look elsewhere in reciprocal space and beyond the standard Bragg reflections.

Reviewer: Richard Matyi *of the College of Nanoscale Science and Engineering, University at Albany–SUNY.*

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