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between Ratner and Schatz's text and such other popular books in the subject as *Quantum Chemistry*, by Ira N. Levine (Prentice Hall, 1999). Levine's book offers a more detailed discussion (some 600 pages) on several topics, but it mostly addresses a different audience: graduate students. The attempt of Ratner and Schatz to offer a concise and easily understandable text to undergraduate students is highly commendable.

HOLGER F. BETTINGER
GUSTAVO E. SCUSERIA
Rice University
Houston, Texas

Methods of X-Ray and Neutron Scattering in Polymer Science

▶ Ryong-Joon Roe
Oxford U. Press, New York, 2000.
\$80.00 (331 pp.).
ISBN 0-19-511321-7

A great deal of similarity exists between x-ray and neutron scattering methods as applied to the study of the structure of matter. Historically, however, the two methods were developed at different times by different groups of scientists; as a result, very different terminologies often evolved to explain the same phenomena. By presenting the two methods together and emphasizing their similarities, Ryong-Joon Roe has written an introductory textbook that enables readers to become equally familiar with both techniques. For this reason, *Methods of X-Ray and Neutron Scattering in Polymer Science* meets a need that has not been adequately addressed by the many earlier textbooks and monographs, which have dealt principally with one method or the other.

Roe succeeds admirably in giving a balanced and unified presentation of the basic theory underlying both x-ray and neutron scattering. He uses a consistent set of symbols and nomenclature throughout the book and carefully explains and justifies any deviations from conventions used in specialized areas of the literature.

The book is aimed at readers with little prior exposure to scattering phenomena; it covers a range of topics at modest length without oversimplifying the subject matter or becoming bogged down in formalism. Expressions and relationships are developed clearly from first principles in most cases; in others, heuristic arguments are used effectively, or the reader is

referred to one or more sources for a more rigorous treatment. Experimental results are used sparingly and only to illustrate how the theoretical concepts or the methods of analysis discussed are used in practice.

The first two chapters, covering the basic theory and experimental methods of x-ray and neutron scattering, are among the book's best and are not at all specific to polymer science. These chapters provide a firm foundation for understanding the applicability of the techniques to any type of material. Building on this basis, the subsequent chapters, on topics such as crystalline and amorphous polymers, blends, and copolymers, are presented as largely self-contained units that can be studied individually. Even among these more specialized chapters, there is much to recommend to a broad audience. For example, chapters 3 and 4, on scattering from crystalline and amorphous polymers, respectively, cover clearly and concisely the basics of crystal structure analysis, including methods of phase determination, diffraction-line broadening, crystal imperfections, short-range order, pair distribution functions, texture, and the like at a level that is both accessible and germane to students in any area of materials science.

Separate chapters address small-angle scattering and reflectivity, techniques that have probably had more impact on polymer science than any other area of materials science. In each case, Roe makes connections with the basic theory covered in the opening chapters to give the reader a unified view of diffraction. The chapter on small-angle scattering is particularly well organized and includes an excellent summary of the manifestations and analyses of lamellar structure so often encountered in polymer systems. The methods of deuterium labeling and contrast variation that give neutron scattering its unique role in characterizing structure in hydrogenous materials are also largely contained in a single chapter, which focuses on their application to polymer blends and block copolymers. The final chapter deals with inelastic neutron scattering and surveys succinctly the types of molecular motions that may be probed and the experimental techniques for doing so. The associated concepts and mathematical expressions are inherently more complex in this case, but here again Roe builds on and extends the foundation laid in the early chapters to present the material in a way that

is more accessible to newcomers than is the case with most books devoted to neutron scattering.

Throughout this book, Roe has made judicious choices as to content and level of presentation. He has included with each chapter suggestions for further reading for more in-depth study. Having read this book, students of polymer science will be well equipped to read selectively from more comprehensive texts, such as Julia Higgins and Henri Benoit's highly regarded *Polymers and Neutron Scattering* (Oxford U. Press, 1994). In its breadth and even-handed treatment of x-ray and neutron methods, Roe's book deserves an audience that extends well beyond the polymer science community.

CHARLES J. GLINKA

*NIST Center for Neutron Research
Gaithersburg, Maryland*

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