

ences to papers from which the thirty-six pages of crystallographic data for about 270 polymers have been derived. Numerous general references are also included.

The introductory chapter discusses first the basic concepts associated with crystallization in polymers and with X-ray scattering in general; then follow more detailed discussions of both wide-angle and small-angle scattering by polymers. Chapter 2 deals with instrumentation and includes treatment of the problems of specimen preparation and mounting, comparative discussions of diffractometer and photographic methods, and a section on optical diffractometer techniques for interpretation. Chapters 3 and 4 discuss the fascinating and controversial subject of degree of crystallinity in polymers and preferred orientation respectively. The remaining chapters deal with the possibilities of obtaining information on macro-structure from low-angle scattering, relationships between micro-structure and wide-angle scattering and finally a shorter treatment of the problems of lattice distortion and of crystallite size. The book is written for research workers in two main categories – those engaged in polymer studies who want to understand the contribution that X-ray diffraction can make and those engaged in X-ray diffraction studies who wish to widen their experience of their application in materials science.

It is difficult to know where to begin in commenting on such a large and comprehensive book but, as an X-ray crystallographer relatively recently entering the field of polymers, I found the chapter on the degree of crystallinity and the two on macro- and micro-structures perhaps the most valuable. The presentation is highly concentrated but extremely clear and will save newcomers to the field enormous amounts of time in hunting through the literature. The author manages to mix purely technical and experimental details with discussions of the background theory and even detailed step-by-step instructions for carrying out analyses of resulting data.

This book would earn its place on the library shelf purely for the factual material which has already been mentioned at the beginning of this review, but its place in the laboratory and on the desk is also fully justified by the clarity and completeness of the exposition and the sense of prospective balance that it brings to its subject.

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Elements of X-ray crystallography. By LEONID V. AZAROFF. Pp. XVI+610. New York: McGraw-Hill, 1968. Price £7.7 s.

Elements of X-ray Crystallography is an attempt to provide a complete introduction to all the important topics which constitute the subject of X-ray crystallography. Any author who attempts such a difficult and complicated task is to be admired. The author of this book, L. V. Azaroff, deserves special praise for he has produced an excellent book which to a very large extent fulfils the above aim.

The book is divided into four main parts. Part I, *Elements of Crystals*, consists of four chapters and gives a clear account of symmetry elements, crystal morphology, crystal projections, lattices and space groups. It is an im-

possible task to deal comprehensively with space group theory in a few pages but the author has given sufficient information to introduce a reader to the subject. Part II, *Elements of X-ray Physics*, contains two chapters. The first chapter, a historical note, briefly summarizes the development of X-ray crystallography since the initial discovery of X-rays by W. C. Röntgen and the contribution to the subject by M. von Laue and W. H. and W. L. Bragg. In the second chapter the physical properties of X-rays, scattering, fluorescence, absorption, emission, refraction and X-ray spectra are discussed more comprehensively than in most introductory books on X-ray crystallography.

Part III, *Elements of Diffraction Theory*, comprises five chapters. The concept of the reciprocal lattice is first discussed and then related to the diffraction spectra of single crystals. This approach provides the basis for the entire book and is one with which the reviewers entirely concur. The next three chapters in this part develop the scattering of X-rays by atoms, groups of atoms, ideal crystals and real crystals. Readers who possess only a knowledge of ancillary mathematics should be able to follow the text without too much difficulty. The author has presented the mathematical derivations in a clear manner with accompanying text, where appropriate, to show the individual steps and an Appendix is provided on vector algebra and complex variables. The last chapter in this part deals with crystal structure analysis and is the most unsatisfactory section of the book. Whilst the reviewers realize that in an introductory book of this type a discussion of crystal structure analysis must necessarily be somewhat superficial, we feel that this topic is sufficiently important to merit a separate part on its own. It is impossible in the space of 43 pages to indicate in even introductory detail the basic steps by which the refined crystal structure is derived from the diffraction spectra. A coherent picture of structure analysis is not presented and most of the material in this chapter is not unlike a precis of parts of *Crystal Structure Analysis* by M. J. Buerger, with little attempt to bring it up to date.

Part IV, *Elements of Experimental Methods*, consists of nine chapters describing the production and detection of X-rays and how their interaction with crystals can be studied experimentally. Photographic and diffractometric methods of intensity data collection are thoroughly surveyed, together with the powder method and its use in the identification of unknown materials. A final chapter deals with studies of texture, crystallite size and residual stress analysis.

Throughout the book the quality and content of the diagrams and photographs are excellent. This is particularly true of part IV. Each chapter is terminated by a short bibliography and exercises for which answers are provided in an Appendix. The exercises have been selected to illustrate and extend the contents of each chapter and are suitable for the student working without supervision.

In conclusion, we feel that the book may be of limited use for undergraduate students but is highly recommended reading for research workers who use crystallographic techniques.

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