Diffraction from Materials

L.H. Schwartz and J.B. Cohen
Second Edition (Springer-Verlag, 1987)

The vougishness of new methods for characterizing the structural features of materials has caused a deemphasis in the teaching of x-ray diffraction (and the related neutron and electron diffraction) even though it remains the most comprehensive means available for the elucidation of the "average" structure of materials and departures from it. The appearance of a new book on diffraction is most welcome, therefore, since many of the texts available even a decade ago are now out of print.

This book is based on the combined teaching experiences of the co-authors spanning 25 years and, in its second edition, "simplifies the introduction to crystallography," adds new information on synchrotron radiation, and updates the analysis of defects in solids. The first half of the book, covering the geometry of crystals, nature and recording of diffraction, and the symmetry of crystals and diffraction patterns, is intended as an introductory text for college undergraduates. The second half includes crystal-structure analysis, temperature-diffuse scattering, electron imaging, stacking faults and clustering in crystals, small-angle scattering, EXAFS, and an entire chapter on dynamical diffraction. It "is suitable for graduate-level courses or for use as a monograph."

The authors provide a fairly broad smorgasbord of topical coverage but make no claim to comprehensiveness. They are especially meticulous in crediting the sources of their illustrations. Unfortunately, an unreferenced depiction of the rotating-crystal geometry (Figure 4.16a) and the tore of reflection (Figure 4.17) place the origin of the diffracted beams at the origin of the reciprocal lattice instead of at the center of the crystal (Ewald sphere). A further perusal of the text did not turn up equally serious errors but it did disclose a puzzling pedagogy. Thus several pages of equations are devoted to discussing resonance and dispersion relations but the subject of lattice extinctions is introduced parenthetically (by example and without any explanation) in a discussion of indexing procedures for cubic powder patterns. Similarly, the authors employ an unusual writing style that ranges from psychohistory in describing the discoveries of von Laue to the selection of unorthodox terms like "one-dimensional space groups." After reading four pages about the symmetry of one- and two-dimensional "crystals," this reviewer was somewhat nonplussed to come across "But *reflection and rotation are no longer equivalent as they were in one dimension.* Furthermore, some combinations of operations are equivalent to others such as two reflections being equivalent to an inversion or a twofold rotation." The italics are the authors' as is the statement that two enantiomorphous operations (reflections) are equivalent to either an enantiomorphous (inversion) or a congruent one (rotation). In two dimensions this may be literally correct, but how does it help the reader comprehend what follows in the rest of the book that deals with a three-dimensional world?

Because of such unevenness in presentation, it is hard to recommend this book as an introduction to diffraction theory or practice. Because of the many problems following each chapter and the partial list of solutions supplied in the appendix, it should be helpful to a more advanced reader who is also more likely to make use of the extensive bibliographic references provided throughout.

Reviewer: Leonid V. Azaroff, director of IMS, University of Connecticut, currently uses x-ray diffraction to study the structures of liquid-crystalline polymers.

The Crack Tip Opening Displacement in Elastic-Plastic Fracture Mechanics

Edited by K.H. Schwalbe
(Springer-Verlag, 1986)

This 360-page volume is the proceedings of a Workshop on CTOD (crack tip opening displacement) Methodology, held April 1985 at Geesthact, West Germany. As Schwalbe, the editor, explains, "Fracture mechanics offers two concepts for the treatment of a cracked body which behaves in an elastic-plastic manner: The J-integral and the CTOD-concept." The contents of the proceedings deal with the various (at least seven) definitions of CTOD, their interrelation and their connection to the J-integral. Editor and authors attempt to clarify the situation and to bring some order into this field where, at least to my knowledge, very little compacted literature exists to date.

The contents of this proceedings are divided into four sections:

- Crack Tip Examination (four papers),
- Experimental Techniques (three papers),
- CTOD and Crack Growth including J-CTOD Relationship (three papers), and
- Applications (seven papers).

The first section deals with the numerical evaluation of CTOD and certain problems in the analyses. In addition, the use of the Dugdale model for strain hardening materials is discussed. The Experimental Techniques section provides detailed descriptions of the use of displacement gauges in R-curve testing and a comparison of the various CTOD definitions. The third section discusses the use of CTOD to determine R-curves of aluminum and steel samples of various geometries and also general relationships between CTOD and J for growing cracks. Several aspects on the application of CTOD to specific materials problems, including weldments, as well as statistical and "fitness-for-purpose" considerations are included in the Applications sections.

Overall, this volume is a valuable contribution to the fracture mechanics literature. It certainly has helped me gain a clearer picture of the state-of-the-art of CTOD methodology.

Reviewer: Otto Buck is a senior scientist, Ames Laboratory, and professor, Iowa State University. His research interests include mechanical metallurgy, fatigue and fracture mechanics, and NDE. □

ERRATA

The review of *La Matiere a l'Etat Solide: des supraconducteurs aux superalliages (May 1988, p. 46)* should have identified A. Guinier and R. Jullien as the authors, not editors, of the book. The last sentence of the fourth paragraph should have read: "Whenever a critical youngster might feel that hands are perhaps being waved a little, his presumption is promptly quenched with a new mathematical 'box', always very *apposite* to the argument in hand."