Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (R. O. Gould, Department of Chemistry, University of Edinburgh, West Mains Road, Edinburgh EH9 3JJ, Scotland). As far as practicable books will be reviewed in a country different from that of publication.

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Etching of crystals. Theory, experiment, and application. By K. SANGWAL. **Defects in Solids,** Vol. 15. Pp. 497. Amsterdam, Oxford, New York, Tokyo: North Holland, 1987. Price Dfl 275.00.

This book is the most comprehensive compilation of data on etching of single crystals to date. Its particular merit is the painstaking diligence the author has shown in collecting information widely scattered throughout the literature. However, in his obvious desire to cover everything the author has frequently become tangled in the dense underbrush of nonrelevant or distracting details. For example, is Chapter 3 on the growth of crystals really neccessary? This reviewer found that all aspects required to understand the kinetic mechanisms of crystal growth as related to crystal dissolution appear later again in the context of Chapter 4. Thus this monograph makes cumbersome reading because of its sheer volume. Moreover, an often peculiar terminology and many repetitions add to the feeling of overwhelming defeat even the informed reader encounters quite frequently.

It is certainly true that it is highly challenging to write a review on a subject as diverse, multifaceted and difficult as the physics and chemistry of etching. To reiterate this point, the first sentence of § 4.6 may be quoted: 'Dissolution rate of a crystal depends, *inter alia*, on the nature of the crystal, the crystallographic orientation of the surface, the presence of defects in it, the nature of the solvent to be used for etching, the composition of the etchant in case it contains two or more components, the nature and concentration of additive impurities as in etchants for alkali halides, the temperature of etching and the transport of the reactant to the surface and of the dissolved material into the bulk solution.' It is obvious that reconciliation of these many aspects requires voluntary restrictions as to what to include, and then mental discipline in adhering to these limitations. Unfortunately, the author has not alway succeded here. This failure is particularly apparent when looking at Chapters 5, 7 and 10. In all these chapters data appear on water-soluble and water-insoluble crystals, metals and semiconductors (here strong overlap with Chapter 11) that are largely interchangeable. For example, §§ 5.6 and 7.3.6 describe the same problem of dissolution of magnesium oxide, using largely the same set of equations but with different nomenclature. This lack of consistency is as annoying as it is confusing. In the sections cited Sangwal describes his own contributions. It is only human that he devotes more space to this particular aspect than is justified from the context.

Repetitions on a smaller scale appear frequently: equations (1.9) to (1.12) appear again as (4.56), (4.63), (4.64) and (4.45); Figures 3.5, 9.29 and 9.31 show the same subject in slightly different style. Chapters 8 and 9 could have been combined to make the arguments presented there more powerful.

Although in general well edited, some errors have crept into the text. On p. 65, 'octagonal' faces should read 'octahedral' faces, on pp. 67 and 69 the equilibrium form of a simple cubic lattice is not 'cubic' but a 'cube'. On pp. 157 and 158 reference is made to §§ 6.4 and 5.4, respectively. The correct references should read §§ 6.5 and 5.5, respectively. More careful proof-reading would have alleviated these problems. The quality of some photomicrographs (Figures 8.25, 8.29, 11.6, 11.7) is not acceptable.

The core of the monograph is clearly Chapter 4 on the theories of dissolution and etch-pit formation. Here the author shows impressively how much he is on top of his subject. Though dense and complex, this chapter provides the framework from which the rest of the book has been suspended. The logical progression of theoretical concepts, from simple phenomenological kinematic theories (Gross, Batterman) to spin-off theories of the immensely fertile BCF theory (Frank, Cabrera, Mullins, Ives and Hirth), molecular-kinetics theories (Lacmann and Heimann), thermodynamic theories (Cabrera, Schaarwaechter, Bennema) and diffusion theories (Vermilyea, Bohm and Kleber), shows nicely how increasing cross-pollination between solid-state physics and crystallography yielded increasing sophistication in the prediction of the morphology of etch features, the dissolution rates, and their activation energies. Here lies the true strength of the book: to provide a consistent powerful framework to explain and predict etching behaviour of single crystals. Chemists, physicists, metallographers, materials scientists, ceramists, mineralogists and, last but not least, semiconductor engineers will profit from this book in spite of its shortcomings. The extensive list of references and the plethora of etch recipes given will make it a reference book you will want to keep at hand in the materials laboratory.

Despite the humility expressed in the quote from the *Bhagavad Gita* on the frontispiece of the book the author deserves to reap the fruits of his action.

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Essentials of crystallography. By D. MCKIE and C. MCKIE. Pp. viii+437. (Vol. 1 in a series on **Crystalline solids**; Vol 2 deals with crystal chemistry and crystal physics.) Oxford: Blackwell Scientific Publications, 1986. Price £25.00 (cloth), £12.95 (limp).

The book covers crystal lattices, stereographic projections, crystal symmetry (60 pages), internal structure, interplanar and interzonal angles (40 pages), diffraction by X-rays, X-ray powder diffraction patterns, single crystals, principles of structure determination (36 pages), electron diffraction and microscopy. This university text has a collection of problems with each chapter, plus answers, and appendices covering stereographic projection, spherical trigonometry, three-dimensional analytical geometry, matrix methods and crystal setting.

Essentially, it is a printed collection of material given to earth- and materials-science students at Cambridge, England, over the past twenty-five years and some of the material is out of date. The text is more for a traditional crystallography course of the fifties than for a modern one covering structural analysis. In the opinion of the reviewer, it is strong in dealing with stereographic projections, physical crystallography, electron diffraction and microscopy. The experimental techniques mentioned in the chapter on single-crystal X-ray diffraction patterns are from another era. Mounting crystals about principal axes, use of plasticine, and even the non-ACA mounting on the goniometer (Fig. 8.1) are items from the past. The Unicam oscillation camera (Fig. 8.2) should be in the Science Museum in South Kensington, London. In fact so should the book. Most of this chapter is not relevant to modern practice. Yes, the precession camera is included, but no mention is made of interpreting protein rotation photographs, or Laue photographs taken with a synchrotron source, or those rotation photographs taken with a Polaroid holder on a four-circle diffractometer. These are the photographic techniques being used today. *Essentials of Crystallography* is very weak on data collection, structure solution and refinement. It does contain up-to-date snippets on Guinier-de Wolff cameras, Gandolfi cameras, four-circle diffractometer geometry, synchrotron radiation and neutron diffraction. There must be only a few crystallographers in the world that determine accurate unit-cell dimensions from Weissenberg photographs as indicated in pp. 298–302. It is very uneven in detail. Sometimes it is a working manual: aligning crystals; sometimes it is a readers digest: data collection. Page 306 deals with the diffraction symbol *mmmPbcn* and *mmP.cn.* These are not listed in Volume A of *International Tables for Crystallography.* Patterson does not even get a mention in the section on crystal structure determination. Direct methods are poorly treated. Intensity data collection discusses collecting Weissenberg photographic data and a computer-controlled microdensitometer to measure the optical density of each reflection on each film of the pack for each reciprocal layer. There are few examples of this technique being published in *Acta Crystallographica.*

There are better up-do-date texts available at both introductory and post-graduate level dealing with determining structure using crystallographic techniques.

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