References

GULL, S. F. & DANIELL, G. J. (1978). *Nature (London)*, **272**, 686–690.
JAUCH, W. & PALMER, A. (1993). *Acta Cryst.* A**49**, 590–591.
JAYNES, E. T. (1957). *Phys. Rev.* **106**, 620–630.
KUMAZAWA, S., KUBOTA, Y., TAKATA, M. & SAKATA, M. (1993). *J. Appl. Cryst.* **26**, 453–457.
LIVESEY, A. K. & SKILLING, J. (1985). *Acta Cryst.* A**41**, 113–122.
NARAYAN, R. & NITYANANDA, R. (1986). *Annu. Rev. Astron. Astrophys.* **24**, 127–170.
NITYANANDA, R. & NARAYAN, R. (1982). *J. Astrophys. Astron.* **3**, 419–450.
REINSCH, C. H. (1967). *Numer. Math.* **10**, 177–183.
SHORE, J. E. & JOHNSON, R. W. (1980). *IEEE Trans. Inf. Theory*, IT-**26**, 26–37.
TITTERINGTON, D. M. (1985). *Astron. Astrophys.* **144**, 381–387.

Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (R. F. Bryan, Department of Chemistry, University of Virginia, McCormick Road, Charlottesville, Virginia 22901, USA). As far as practicable, books will be reviewed in a country different from that of publication.

Acta Cryst. (1994). A**50**, 652

Cristallographie. By D. SCHWARZENBACH. Pp. x + 274. Lausanne: Presses polytechniques et universitaires romandes, 1993. Price SF 77 (soft cover). ISBN 2-88074-246-3.

Ce volume est surtout destiné aux étudiants de physique, de génie ou des sciences des matériaux. Le présent volume vise l'enseignement des notions fondamentales plutôt que les applications de la cristallographie. Ainsi, il ne traite pas des méthodes de détermination des structures. L'auteur, grâce à son expérience d'enseignant, prend un soin particulier à bien définir et à clarifier les termes utilisés.

Dans le premier chapitre sur la *Cristallographie géométrique* (25 pp.), l'auteur traite de la géométrie analytique des repères obliques, des formes polyédriques des cristaux, des pavages périodiques et conclu par une définition de ce que l'on entend par cristal. La plus grande partie du volume concerne la *Symétrie* (70 pp.) au second chapitre et la *Diffraction par les cristaux* (78 pp.) au chapitre trois. Dans le chapitre *Symétrie*, l'auteur passe en revue les opérations de symétrie, les éléments de symétrie, les classes et systèmes cristallins, les résaux, les symétries des systèmes périodiques pour aboutir aux groupes spatiaux. La diffraction des rayons X par la matière est décrite au chapitre suivant où l'on mentionne aussi les méthodes expérimentales de diffraction et où est abordé le problème des phases.

Ce qui fait l'originalité de ce livre est le chapitre quatre où sont décrites les *Propriétés tensorielles des cristaux*. Dans ce chapitre d'une soixantaine de pages l'auteur commence par faire la distinction entre des matériaux isotropes et anisotropes. Il en tire des conclusions sur les propriétés particulières qui en dépendent. La notion de tenseur est introduite et les contraintes et déformations dans un solide cristallin sont examinées. Un certain nombre de propriétés tensorielles sont décrites (polarisation électrique, élasticité, pyroélectricité, piezoélectricité). Le chapitre se termine par des notions d'optiques cristalline (biréfringence et microscope polarisant).

Une vingtaine de pages sont consacrées à des exercices (avec les solutions) sur chacun des chapitres. Les illustrations de ce volume ont été réalisées à l'aide du programme *MacDraw*II, de *SHAPE* et d'*ATOMS*. Je trouve que les traits sont souvent trop épais et il en résulte pour certain illustrations un manque de clarté. Les adaptations d'illustrations tirées de volumes ou de publications antérieures ne sont pas toujours très heureuses. J'ai bien apprécié la citation, tirée de Voigt (1910), où cet auteur compare l'ordre cristallin à l'activité d'un orchestre dirigé par un directeur renommé. 'La musique des lois physiques se manifeste dans la physique des cristaux par les accords les plus beaux et les plus riches.'

Le volume est écrit en français, ce qui est assez rare de nos jours mais très utile. Ainsi les étudiants francophones pourront acquérir le vocabulaire assez specialisé de la cristallographie dans leur langue.

FRANÇOIS BRISSE

Département de chimie
Université de Montréal
Montréal
Québec
H3C 3J7
Canada

Acta Cryst. (1994). A**50**, 652–653

Handbook of crystal growth. Vol. 1: Fundamentals. *a*: thermodynamics and kinetics; *b*: transport and stability. Edited by D. T. J. HURLE. Pp. xiv + 1218. Amsterdam: North Holland Elsevier Science Publishers, 1993. Price $388.50. ISBN 0-444-88908-6.

These are the two parts of the first volume of a three-volume series planned for the growth of bulk crystals and thin films. One might expect from the title a 'how-to-do-it' handbook, but the stated objective of the series is to expose the underlying scientific basis of crystal growth to help keep theory and practice in touch with each other. The two parts of this volume deal principally with the theory of crystal growth and include some results from experiments and computer simulations. Subsequent volumes are scheduled to cover growth techniques.

mechanisms and phenomena. The chapters in this volume consist of largely unconnected reviews at an advanced level. Thus, the series is likely to be useful primarily as a reference work rather than as a textbook, although there is much tutorial material.

Chapter 1 (H. J. Scheel, 42 pp.) is an interesting historical review, beginning with Egyptian bronze casting in 1500 BC and containing 105 references dating from 1698 to 1991. Chapter 2 (R. F. Brebick, 60 pp.) covers the theory of phase equilibria, with applications to equilibria between two condensed phases, equilibria between a condensed phase and a vapor phase, compounds with a narrow homogeneity range and solid solutions. Chapter 3 (H. Wenzel, W. A. Oates and K. Mika, 84 pp.) emphasizes the equilibria between point defects in silicon and in gallium arsenide, particularly in relation to solidification processes. Chapter 4 (B. Mutaftschiev, 61 pp.) deals with the theory of nucleation, including bulk phases and new atomic layers on a growing crystal surface. The emphasis of Chapter 5 (A. S. Myerson and A. F. Ismailov, 56 pp.) is on the structure of supersaturated solutions, including the most recent experimental measurements of the strange behavior and properties of supersaturated aqueous solutions of inorganic salts and organic compounds. For example, the value of the diffusion coefficient drops dramatically with increasing concentration beyond solubility and continues to decline with time after several days. These results are attributed to the formation of clusters of solute molecules. Chapter 6 (J. P. van der Eerden, 169 pp.) is a clear and thorough exposition of crystal growth mechanisms, with emphasis on the atomic processes occurring at the crystal surface. Chapter 7 (P. Bennema, 101 pp.) treats the morphology of growing crystals. Although crystal morphology is determined by kinetics rather than thermodynamics, the predictions of the two frequently coincide because the slowest growing faces are often (but not always) those with the lowest energy. Bennema shows how crystallographic considerations can be used to predict crystal morphology and gives several experimental examples. Chapter 8 (G. H. Gilmer, 53 pp.) presents the results of numerical simulations of atomic processes at crystal surfaces. Molecular-dynamic and Monte Carlo methods successfully reproduce, and help in understanding, experimental observations. The last chapter (J. E. Greene, 41 pp.) in Vol. 1*a* presents experimental results and molecular-dynamics simulations of film growth from low-energy ion sources.

Vol. 1*b* begins with Chapter 10 (A. A. Wheeler, 55 pp.), an introduction to transport processes, including diffusion, heat transfer and fluid motion. Chapter 11 (H. E. Huppert, 41 pp.) deals primarily with heat transfer during solidification of mixtures, including the formation of a mushy zone between the bulk solid and the bulk melt. Chapter 12 (S. R. Coriell and G. B. McFadden, 71 pp.) covers the theory of morphological stability, primarily for solidification from convection-free melts. This theory successfully predicts the breakdown of a planar interface to a cellular one, which is very deleterious for single-crystal growth. Chapter 13 (S. H. Davis, 37 pp.) shows that convection in the melt can lead to complex morphological behavior and can either promote or retard interface breakdown. Chapter 14 (B. Billia and R. Trivedi, 173 pp.) is a thorough treatment of experimental results and theory on the cellular and dendritic patterns that form when an interface breaks down during directional solidification. Chapter 15 (M. E. Glicksman and S. P. Marsh, 46 pp.) deals primarily with the relationship between tip curvature, undercooling, freezing rate and side branching of a single growing dendrite. Chapter 16 (P. Ramasamay, 81 pp.) is largely unconnected with the preceding chapters and deals with the theory and phenomena of electrocrystallization.

Don Hurle is to be congratulated for masterful editing of these volumes. We did not discover a single error in spelling, grammar or equations. On the other hand, with page costs so astronomically high, we regret that he did not provide more detailed instructions on content to the authors. There is too much avoidable duplication of material between the chapters. For example, the subject index reveals that two-dimensional nucleation is covered in three different chapters and is mentioned in several others. The subject index itself does not reveal all of the duplication. Thus, for example, the differential equation for conservation of a component is referred to once as 'Fick's law' in the subject index and once as the 'diffusion equation'. The same equation appears, however, in four other locations, but without being referenced in the index. There is no author index.

This series promises to fulfill the editor's objective in a definitive way. It is recommended as an introduction for the novice and as a reference work for the experienced student of crystal growth. We learned a great deal while reviewing these first two volumes.

WILLIAM R. WILCOX
LIYA L. REGEL

International Center for Gravity Materials Science and Applications
Clarkson University
Potsdam
NY 13699-5700
USA

Acta Cryst. (1994). A**50**, 653–654

Accuracy in powder diffraction II. National Institute of Standards and Technology Special Publication 846. Edited by E. O. PRINCE and J. K. STALICK. Pp. vi + 234. Washington: US Department of Commerce, 1992. Price US $14.00. SN 003.003.03186.1.

Some quiescent areas of science and technology experience a revolutionary rebirth by a sudden serendipitous discovery, as in the case of high-T_c materials, while others initiate such a renaissance through the advancement of new ideas, which may take longer to develop but whose cumulative effect results in revolutionary advances. In the field of X-ray crystallography we can point to many such milestones: the advent of direct methods for phase determination and the discovery of quasicrystals are just two instances. The advances in powder diffraction surely deserve to be ranked as another such milestone.

The first conference on Accuracy in Powder Diffraction organized in 1979 by the National Institute of Standards and Technology (NIST) (formerly the National Bureau of Standards) was a harbinger of this coming development. The sequel, the International Conference on Accuracy in Powder