Book Reviews

Highly Anisotropic Crystals. By E. I. Givargizov (Institute of Crystallography, Academy of Sciences of the USSR, Moscow). D. Reidel Publishing Company: Dordrecht, Holland. 1987 (Materials Science of Minerals and Rocks series; in cooperation with Terra Scientific Publications Co., Tokyo 150; distributed by Kluwer Academic Publishers, 101 Philip Drive, Norwell, MA 02061). xi + 394 pp. $98.00. ISBN 90-277-2172-6.

The title of this book is misleading. To a prospective reader it might convey the impression that the contents deal with the nature and causes of anisotropy of physical properties in crystals like graphite, SiC, cordierite, organic linear conductors and those based on $[Pt(CN)_4]^{2-}$, and possibly even liquid crystals. In fact, the bulk of the book concerns the growth of crystals with highly anisotropic external morphology, such as fibres and platelets. About one-half of the book is devoted to whiskers of a large variety of compositions, and this subject is covered in great detail, both as to the method of preparation and growth mechanisms. While in this respect the coverage must be near exhaustive, no more than 2 pages are accorded to mechanical properties of whiskers, the great interest in the superior strength etc. of metallic whiskers in particular notwithstanding. Epitaxy as such is not discussed.

The translation (edited by Marjorie Senechal, Smith College) reads well and misprints appear to be few. Among the occasional infelicities of transposition from the Russian edition is the use of sh, ch, th for sinh, cosh, tanh (p 82ff). In a book dealing with diffusion in solids and with dendritic and eutectic solidification one would have expected some reference to the work of J. S. Kirkaldy and co-workers. In Chapter 1, mention could have been made of R. Giovanoli's contributions to the study of MOOH hydroxides; although millerite (capillary pyrites, Haarkies) is a natural whisker *par excellence*, it is not mentioned among the mineral sulfides surveyed in that chapter. On p 293, the reader is left with the impression that a pure fcc or bcc metal will not form plate-like crystals on deposition from the vapor. The structure of platinum cannot be regarded as anisotropic, yet very thin platelets ||(111) of hexagonal appearance form by sublimation at 1200–1300 °C in air given sufficient time. The treatment of applications (Chapter 8, 9 pp including references) is only cursory. On p 378 the author notes the use of acicular particles of α-Fe_2O_3 and FeOOH for magnetic recording, but acicular CrO_2 used extensively in high-grade magnetic tapes is not specifically mentioned (cf. the recent work of G. Demazeau et al. in Bordeaux). On the same page, the section on the use of whiskers for field-emission cathodes could have referred to their use as sensor needles in tunnelling microscopy. Almost no organic compounds are included in the book, even though crystals of pronouncedly anisotropic habit are very common among them and the relationship between morphology and structure is mostly well understood.

However, these are minor deficiencies. Anyone seeking enlightenment on the subjects actually covered in the book will not walk away empty-handed. There are a large number of references, the most recent dated 1985, and the illustrations, especially the electron micrographs, are interesting and well chosen.

Osvald Knop, *Dalhousie University*

Archaeometry: An Introduction to Physical Methods in Archaeology and the History of Art. By Ulrich Leute. VCH Publishers: New York and Weinheim. 1987. xi + 176 pp. $25.00. ISBN 0-89573-612-8.

This book is intended to promote communication and cooperation between the sciences and what the author of *Archaeometry* calls the historic disciplines, art history, and archaeology. Leute outlines a wide variety of scientific methods that are applied to historical problems, addresses the underlying physical and chemical principles and types of applications, and identifies the constraints and pitfalls inherent in each method. The book investigates three general issues: surveying techniques to locate and map archaeological sites; the means of dating sites and objects; and the identification of significant physical and chemical attributes of objects.

In the section on surveying, Leute discusses the impact of chemical, electrical, magnetic, and thermal properties of soils and archaeological features such as dwellings, hearths, and palisades on our ability to detect the presence and structure of archaeological sites. Detection methods include aerial, seismic, magnetometer, and resistivity surveying, and the determination of differential patterns of chemical properties such as phosphates and pH. Leute covers dating methods in greater detail, including radiocarbon, potassium–argon, thermoluminescence, and fission track dating, as well as dendrochronology, amino acid racemization, and archaeomagnetism. The discussion on radiocarbon dating, the most frequently used absolute dating method in archaeology, is quite lengthy and up-to-date, encompassing recent developments in accelerator dating and calibration.

The third section on the characterization of materials discusses a wide range of problems and methods. The need to pinpoint the physical characteristics, chemical composition, and sources of artifacts in archaeology, and to determine the authenticity of objects in art history, has led to the application of techniques that include radiography, gas chromatography, optical and electron microscopy, thermal analysis, diffraction methods, as well as optical, mass, X-ray, infrared, γ, and particle spectrometry. Many of these methods can be applied to very small samples of materials and, hence, minimize the damage to artifacts. One significant recent development in the application of organic chemistry to archaeology is the analysis of carbon and nitrogen isotopes in bone collagen to determine the contribution of either maize or marine foods to the diet of prehistoric peoples. Unfortunately, as Leute points out, many dating and characterization methods are based on chemical properties that are subject to environmental contamination or deterioration over time.

Although there are occasional problems in the clarity of the English text, attributable to translation difficulties, the author's meaning is usually understandable, particularly when the author presents the technical aspects of a method.

Archaeometry certainly covers a wide variety of topics and is therefore a good reference text for anyone concerned with the application of science to archaeological and art historical problems. Although particular discussions are overly simplistic, specialists should derive satisfaction in realizing the diverse application of analytical methods originally developed with very different purposes in mind. Leute often suggests that experts skip sections that were written for the lay person. Finally, Leute's excellent use of tables and graphs to illustrate techniques and to summarize the types, limitations, and applications of the methods, and his pragmatic consideration of the costs involved, makes this book a very practical tool for the implementation of archaeometry.

Claire A. McHale, *Universtiy of Michigan*

Computer Software Applications in Chemistry. By Peter C. Jurs (The Pennsylvania State University). John Wiley & Sons: New York. 1986. xiv + 253 pp. $34.95. ISBN 0471-847356.

The author states "The aim of this book is to provide an overview or survey of computer software applications in chemistry. The coverage of each topic will be introductory, with some advanced material added periodically to selected sections." This is a perfect description of the book. A wide range of topics from curve fitting to graph theory are discussed clearly and in sufficient detail to pique the interest of the reader. Further, the book leads the reader to an appreciation for both the usefulness and potential pitfalls of each software application.

The book is divided into four parts: Introduction, Numerical Methods, Nonnumerical Methods, and Graphics. The introduction begins with a brief, concise discussion of the attributes of computers which make them useful in chemistry. Topics including algorithm design, programming, and compilation are discussed with references for each to provide further details. The second part of the introduction focuses on errors, simple statistics, and propagation of error. Examples of errors resulting from the use of floating point numbers and recommendations to circumvent or minimize the errors are provided. These are important but often overlooked topics which are well covered and referenced.

The Numerical Methods are covered in seven chapters: curve fitting, multiple linear regression analysis, numerical integration, numerical solution of differential equations, matrix methods (and systems of linear equations), random numbers (and Monte Carlo simulation), and simplex optimization. The numerical methods part begins, appropriately, with a short description of iterative methods. In general, each chapter begins with a review of the basic principles for the simplest case, moves to more complicated situations, lists potential pitfalls or questions to ask to check the validity of the procedure, and finally includes examples and/or FORTRAN programs. For example, the curve fitting chapter begins with simple linear least squares and continues on to weighted least squares, polynomial equation fitting, and linearizing transformations. Also included is a discussion of analysis of residuals to check the validity of fitted equations. FORTRAN program listings are provided for curve

fitting to exponential and calculation of Michelis-Menton constants.

The Nonnumerical Methods are described in seven chapters: chemical structure-information handling, mathematical graph theory, substructure searching, molecular mechanics, pattern recognition, artificial intelligence and expert systems, and spectroscopic library searching and structure elucidation.

Graphics are covered in two chapters: graphical display of data and graphical display of molecules. Interesting approaches to display multidimensional data are included in the former chapter.

The author has provided an excellent introduction to the use of computer software in chemistry. Importantly, difficulties and applications are discussed with extensive literature references. I highly recommend the book to all chemists.

John Olesik, *University of North Carolina, Chapel Hill*

Polyimides, Thermally Stable Polymers. By M. I. Bessonov, M. M. Koton, V. V. Kudryavtsev, and L. A. Laius (Institute of Macromolecular Compounds). Consultants Bureau: New York. 1987. xiv + 318 pp. $75.00. ISBN 0-306-10993-X.

This book is a revised and up-dated version of a monograph published in Russian in 1968, followed by an English translation in 1969. The original format of four chapters has been retained; however, the text has been completely rewritten and expanded to include a summary of polyimide research up to 1980. The Russian literature has been thoroughly reviewed, making the book a valuable addition to the literature on thermally stable materials.

Chapter one deals with synthesis and structure, classifying polyimides according to their structure and physical properties. Quantitative data on monomer reactivity, modern synthetic approaches, and the effect of reaction conditions on the molecular weight of poly(amic acids) synthesized are summarized. Research in these areas (up to 1980) has been incorporated into this chapter. In addition, numerous equations, tables, and figures have been included to support these topics.

Thermal and chemical stability of polyimides is dealt with in Chapter Two. Topics covered include the following: polyimide stability as a function of structure; thermal aging; thermal and thermooxidative degradation mechanisms; polyimide stabilization and stability toward radiation; and hydrolytic and chemical reagents. Comparison are made to other heteropolyarylenes.

The third chapter is an extension of the information accumulated in the previous book. Primary and secondary molecular structures of polyimides and their macroscopic properties are the subject of this chapter. Optical, electrical, mechanical, and relaxation properties, thermal transitions, and crystalline and oriented states of polyimides are summarized in tables and figures.

The information in Chapter Four deals with the most popular polyimides produced commercially and their applications. Properties of polyimide films, fibers, plastics, resins, molding powders, varnishes, and adhesives are summarized. This chapter was not meant to be comprehensive and deals only with references to reviews and collections of papers dating to 1980.

The book contains a vast amount of information on condensation-type polyimides. It is clearly and concisely written and should be a valuable assest to workers in the field of thermally stable materials.

Jerry M. Adduci, *Rochester Institute of Technology*

Intermediate Physical Chemistry; Stationary Properties of Chemical Systems. By Joseph B. Dence (St. Louis University) and Dennis J. Diestler (Purdue University). John Wiley and Sons: New York. 1987. xi + 344 pp. $37.50. ISBN 0-471-81243-9.

This is an intermediate physical chemistry text designed for a one-semester course that bridges the gap between the customary undergraduate offering and graduate-level courses in quantum mechanics and statistical mechanics. It should appeal not only to readers who wish to specialise in physical chemistry or chemical physics but also to students in related fields of science (e.g., inorganic and biochemistry) with limited time for additional course work but the need to acquire a grasp of the analytical and computational tools employed in modern physical chemistry.

The text is divided into eight chapters, beginning with an introductory treatment of classical mechanics and the Liouville operator, followed by four chapters on quantum mechanics and three on statistical mechanics. The applications deal with approximation methods in quantum chemistry (perturbation and variation theory), the energy states of molecules via Hartree–Fock theory, the calculation of stationary molecular properties such as the dipole moment, dissociation energy, and the polarizability, calculation of the vibrational and rotation partition functions for monatomic and diatomic molecules, the Debye theory of solids, and theories of simple fluids. There are about ten excercises at the end of each chapter with hints and answers at the end of the book. The book also has two sample closed book examinations! One of the "highlights" (the authors words) of the book are several computer programs written in Basic which illustrate the material and its level of difficulty and promote the use of computers. The programs or flow charts deal with (1) numerical solution of the classical equations of motion (not a molecular dynamics program), (2) optimization of the effective nuclear charge Z for H_2^+, (3) calculation of the inverse of the $S^{1/2}$ matrix to convert the Fock matrix into standard eigenvalue form, (4) computation of the polarizibility tensor for LiH, (5) calculation of the vibrational and rotational constants for diatomic molecules from experiment, and (6) evaluation of the Debye function for specific heats. The numerical solution of an integral equation for the radial distribution of a simple fluid is also discussed in the last chapter. The underlying theme of the book is the elucidation of stationary properties of chemical systems at a microscopic level; there is no discussion of kinetics or transport phenomena, but transitions between states due to a time dependent perturbation, the principle of detailed balance or microscopic reversibility, and Fermi's golden rule are covered.

The chapters are well organized, the writing is clear, and the mathematics is not particularly oppressive. The material should be accessible to most undergraduate seniors with a good background in calculus and a nodding aquaintance with matrix algebra, differential equations, and Basic. An undergraduate course in physical chemistry should be a prerequisite. I would have preferred it if the programs had been written in Fortran, which is the language of choice for most scientific routines. Diskettes encoding the programs would also have been very helpful. The addition of a simple molecular-dynamics program for a Lennard-Jones Fluid would have provided a better balance of computer highlights and introduced the reader to an important tool in modern physical chemistry. I would suggest the addition of an elementary discussion of molecular-beam scattering in chapter one in future editions. These are, however, minor criticisms and suggestions for improvement of a useful new text, and the authors are to be congratulated on their efforts. The book is strongly recommended as a text for a one-semester senior-level undergraduate/first-year graduate course. It is not intended as a substitute for the usual graduate-level courses in quantum chemistry or statistical mechanics in the graduate physical chemistry curriculum but would serve as an excellent introduction to these courses.

Jayendran C. Rasaiah, *University of Maine*

Preparative Chromatography Techniques. Applications in Natural Product Isolation. By K. Hostellmann, M. Hostellmann, and A. Marston (University of Lausanne). Springer-Verlag: New York. 1988. 139 pp. $55.00. ISBN 0-387-16165-1.

This is a very concise and complete summary of chromatographic techniques for the isolation and purification of either natural or synthetic organic chemicals.

It should be useful in teaching advanced students (undergraduate or graduate) involved in such purifications as well as for directing their attention to other references. The book has eight chapters: 1. Introduction; 2. Sample Preparation and Purification; 3. Planar Chromatography; 4. Special Column Chromatography; 5. Preparative Pressure Liquid Chromatography; 6. Counter-Current Chromatography; 7. Combination of Methods; and 8. Subject Index. Each of chapters 2–7 is subdivided into subsections.

There are detailed "how to" instructions that will allow a student to use equipment from various manufacturers to perform chromatography with minimal other directions.

I found the sub-chapter 3.2 on Centrifugal Thin-layer Chromatography very complete from my own experience, with the minor quibble that coated rotors *are* commercially available for the Harrison Research Chromatotron from Analtech.

Donald E. Butler, *Warner-Lambert/Parke Davis*