

## Book Reviews

*Works intended for notice in this column should be sent direct to the Book-Review Editor (J. H. Robertson, School of Chemistry, University of Leeds, Leeds LS2 9JT, England). As far as practicable books will be reviewed in a country different from that of publication.*

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**Matrix isolation spectroscopy.** By A. J. BARNES, W. J. ORVILLE-THOMAS, A. MÜLLER and R. GAUFRÉS. Pp. x + 605. Dordrecht, Boston, London: D. Reidel, 1981. Price Dfl 160, US \$69.50.

This voluminous book is an edited collection of lectures and discussions at the NATO Advanced Study Institute held in France in July 1980. Though the matrix isolation spectroscopy (MIS) technique may be unfamiliar to the crystallographer, those who read even half of this publication will become well acquainted with the technique and readily recognize its usefulness. The MIS technique is one way to study the structure and interactions of solute isolated in an appropriate rare-gas matrix or large cage molecules like adamantane by various methods: IR/Raman, electronic, ESR, and Mössbauer spectroscopy.

Although this book is a collection of lectures by various authors, it has detailed references and an adequate index. This book is composed of three sections: *Technique*, *Matrix effect*, and *Applications*. In section 1, the historical progress in MIS and the technical problems in applying each spectroscopic method are stated in detail in a way which is very understandable for those not well acquainted with MIS. Further, the method for time and frequency-resolved vibrational spectroscopy using the latest laser technique is touched on briefly. The methods for studying stable and unstable molecules trapped in a matrix, and precautions which beginners often fail to take, are included in the experimental discussions. Additionally, high-pressure studies and adducts (complexes) are treated briefly. Reading through the first section gives a good overview of MIS.

In section 2, interpretation of the matrix-isolated species and its behavior are treated theoretically. Experimental evidence for spectral changes, in the different spectroscopic methods, which arise because of matrix isolation (matrix effects), are discussed in comparison with theoretical models. This section is a necessity for spectroscopists in each field for the practical analysis of spectra of matrix-isolated species.

In section 3, the structures and properties of matrix-isolated atoms, their aggregates, ternary oxides, and transition-metal compounds are discussed using electronic and IR/Raman spectroscopies. The generation reaction and interconversion of metal compounds by photolysis in the matrix, which are closely related to photochemical and biochemical reactions, are discussed through IR/Raman spectra. Two interesting applications of MIS are to clarify the bonding nature of hydrogen-bonded species and to determine conformations among isomers which have small energy differences between each other by using the inherent property of the sharpness of the matrix-isolated spectrum peak which is free from hot band and rotation.

There are probably more applications for MIS study than we can imagine. In the field of catalytic reactions of metals

and metal oxides, for example, 'it can be argued that if more was known about the structures and bonding of the reaction intermediates by MIS, this would lead to a better understanding of reaction pathways and perhaps to the ability to direct and control the courses of chemical reactions'.

To point out one deficiency in this book, some figure explanations are insufficient, especially in the latter half of the book.

Any scientist interested in matrix isolation spectroscopy should read this book to get a basic understanding of MIS and a knowledge of its up-to-date and wide range of applications.

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**Dynamical properties of solids. Vol. 3. Metals, superconductors, magnetic materials, liquids.** Edited by G. K. HORTON and A. A. MARADUDIN. Pp. vii + 333. Amsterdam: North Holland, 1980. Price US \$58.50, Dfl. 120.00.

In Volume 1 of this series the editors predicted a three-volume series, with non-crystalline solids to be covered in Volume 3. Apparently there are more essentials to be written on dynamical properties of solids than the editors originally envisaged – the present volume deals mainly with crystalline solids and the non-crystalline solids have been deferred to a fourth volume, reviewed below.

Volume 3 contains four contributions: *Phonons in transition metals* by S. K. Sinha; *Phonons and the superconducting transition temperature* by P. B. Allen; *Spectroscopy of collective pair excitations* by P. A. Fleury; *Interaction of magnetic ions with phonons* by B. Lüthi.

With the chapter by Sinha on phonons in transition metals the most common types of crystalline solids have been covered in this series. The paper discusses the 'anomalies' often observed in the phonon dispersion curves of transition metals and their relation to phase transitions, in particular to the occurrence of high superconducting transition temperatures. The latter is also the main topic of Allen's chapter and hence some overlap results – an almost unavoidable consequence of multiple authorship. The chapter reviews briefly the theory of superconducting transition temperature bearing on the relation between phonon properties and superconducting transition temperatures.

The third, relatively short, chapter by Fleury is concerned with interacting pairs of excitations in condensed matter. As it turns out, the best understood examples are not to be found in the world of phonons but are provided by magnetic excitations in magnetic systems and a substantial part of this chapter is therefore devoted to such systems. The author also makes a brief excursion into the liquid state, one of the topics being roton pairs in liquid helium. In the opinion of the reviewer this is, however, no valid excuse for the average reader of *Acta Crystallographica* to refrain from enjoying this series of volumes.

The last contribution in this volume, by Lüthi, deals with manifestations of magnetoelastic interactions in crystalline solids containing localized magnetic ions.

Like the preceding volumes, this one is a mixture of theory and experimental results with some weighting towards theory, especially in the first chapter. Volume 3 covers to a large extent relatively special areas of lattice dynamics but should nevertheless be of great value to anyone interested in these particular areas.

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**Dynamical properties of solids. Vol. 4. Disordered solids, optical properties.** Edited by G. K. HORTON and A. A. MARADUDIN. Pp. viii + 478. Amsterdam: North Holland, 1980. Price US \$78.00, Dfl. 160.00.

This volume, the last one in the series, contains four contributions: *Vibrational properties of amorphous solids* by D. Weaire & P. C. Taylor; *Computer experiments and disordered solids* by W. M. Visscher & J. E. Gubernatis; *Morphic effects in lattice dynamics* by E. M. Anastassakis; *The absorption of infrared radiation by multiphonon processes in solids* by D. L. Mills, C. J. Duthler & M. Sparks. In this volume two of the contributions leave the field familiar to the common crystallographer – the crystalline solid – for a discussion of amorphous and disordered solids. The usual descriptions of dynamical properties in solids abound with concepts and theories that explicitly or implicitly make use of the translational symmetry of perfect crystals. Therefore, the (careless) person who enters the field of amorphous solids is bound to run into confusion when the vibrations no longer are governed by the safe and sound framework of a lattice. The first contribution of this volume, therefore, very appropriately, starts out with a short glossary of dangerous words, *i.e.* dangerous in the context of amorphous solids. Among these words there is also a description of the word *lattice* that might not satisfy the crystallographic purist: 'Strictly speaking, a lattice ought to be periodic but the loose application of this word to any infinite three-dimensional structure associated with condensed matter is a relatively

harmless indulgence.' Anyway, the chapter gives a condensed review of the fundamentals of dynamics in amorphous solids, and should be good as an introduction to the field. The second chapter, by Visscher & Gubernatis, also deals with disordered solids from a more theoretical point of view. The authors discuss the use of large digital computers to simulate disordered solids with the purpose of analysing their dynamical and related properties, as for example various transport properties. In chapter 3, Anastassakis gives a very thorough discussion of morphic effects in lattice dynamics, *i.e.* what happens to lattice dynamical properties when a crystal is subject to external forces. The author starts out with the group theory required for the discussion of morphic effects and proceeds with a very systematic discussion of the effect of various external forces (electric and magnetic fields, mechanical stress, temperature). The final, short chapter of this volume and of this series of volumes is concerned with multiphonon absorption processes and includes a review of recent experimental results and current theories to describe such processes.

The four volumes in this series complement the classical book on dynamical properties of crystals by Born & Huang by providing an insight into more recent developments and special applications, but they definitely do not replace it. There are simply too many authors with too diverse special interests represented in these four volumes to make the presentation of the subject fully coherent. This is not meant to imply that the books are not useful. On the contrary, all the four volumes in this series certainly deserve their place in the library wherever serious work on lattice dynamics is carried out.

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### Books Received

*The following books have been received by the Editor. Brief and generally uncritical notices are given of works of marginal crystallographic interest; occasionally a book of fundamental interest is included under this heading because of difficulty in finding a suitable reviewer without great delay.*

**X-ray diffraction by disordered and ordered systems.** By D. W. L. HUKINS. Pp. ix + 164. Oxford: Pergamon, 1981. Price, US\$28.75. A review of this book, by F. Rousseaux, has been published in the July 1982 issue of *Acta Crystallographica*. Section B, page 2097.