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Review of "Spectroscopy of Polymers" By JACK L. KOENIG, American Chemical Society Professional Reference Book, 1992, 450 pages; ISBN 0-8412-1904-4 (cloth-bound); ISBN 0-8412-1924-9 (paperback); $ 89.95 (cloth); $ 49.95 (paper)

This book was published by the ACS as a Professional Reference Book for graduate students and polymer scientists to serve both as an introduction to spectroscopic techniques currently available and provide practical advice on use of these spectroscopic techniques in determining polymer structure.

The text includes IR, FT-IR, Raman, FT-Raman and NMR solid state spectroscopic methods as the techniques for characterization of the microstructure polymers in their final solid engineering form. Solution NMR, relaxation processes and imaging complete the discussion of the fine array of techniques presented in this book to the polymer scientist for the characterization of polymers.

Chapter 1 contains an excellent introductory discussion of the elements of polymer structure, composition, microstructure, copolymer sequence and theory of polymerization mechanisms to provide a basis for discussion of spectroscopic determination of structure in later chapters.

Chapter 2 contains an introductory discussion of vibrational spectroscopy as it applies to polymer structure including coupled vibrations as a probe. Numerous literature examples of applications of principles add to the value of this chapter.

Chapter 3 contains a discussion of experimental techniques involved in determining FTIR spectra which includes reflectance, photoacoustic, emission and data manipulation techniques. Liberal use of published examples of principles make the material clear and easy to follow.

Chapter 4 contains a variety of applications of IR to structural characterization of materials including several very detailed examples; a step by step copolymer analysis, measurement of conformational changes that occur in the annealing of PET, polyethylene and polypropylene, and measurement of interactions in polymer blends.

Chapter 5 contains a discussion of Raman spectroscopy from theory to experimental techniques. A comparison of conventional and FT-Raman as well as the spectral differences between IR and Raman spectroscopy make this chapter useful for considering which spectroscopic method to use.

Chapter 6 contains an introduction to high resolution NMR spectroscopy in solution. Practical experimental information is presented and principles are nicely illustrated with polymer examples.

Chapter 7 contains a discussion of methods of selectively examining structure using special pulse techniques including decoupling, selective excitation, polarization transfer and 2-dimensional methods. This is an excellent presentation summarized by a table listing the information available from each type of experiment.

Chapter 8 contains an introduction to high resolution NMR spectroscopy of solid polymers. The previous chapter on special pulse techniques nicely sets up the material in this chapter which includes motional and chemical exchange effects.

Chapter 9 contains applications of solid state NMR to polymers. A variety of polymeric materials were chosen as examples and they cover a good range of polymer types from rubbers to composites.

Chapter 10 contains a discussion of relaxation techniques as applied to solid polymers. Again the liberal use of examples from the literature raises the level of interest in this chapter which includes theoretical concepts as well as experimental techniques.

Chapter 11 contains an introduction and examples of the use of NMR imaging in the study of polymers. Although the chapter is short, it provides a sound basis for imaging concepts and a number of interesting examples from the literature.

Summary

Dr. Koenig has clearly achieved the stated goal of providing a book that will be used by graduate students and polymer scientists. This text is well written in a clearly readable style, well-organized in its presentation of material and remarkably free of errors. The liberal use of literature examples is a strength of the book as it brings the introductory aterial on concepts to applied laboratory practice. Each technique receives a theory introduction that provides sufficient information for the novice and plenty of valuable references for further reading. The material is presented in a logical manner and is easy to find, either in the table of contents or the index. Comparisons of techniques are given in selected cases to help the reader decide on the best one for a particular application. This book is suitable as a text for any graduate course having a substantial polymer characterization component, and any scientist that deals with characterization of polymers should have it on the reference bookshelf.

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"Scanning Tunneling Microscopy and Spectroscopy: Theory, Techniques and Applications" Dawn A. Bonnell, Editor, VCH Publishers, New York, 1993; ISBN 0-89573-768-X; 436 pages; 199 DM, 80£

Since the reduction to practice of scanning tunneling microscopy (STM) in 1982, and the subsequent demonstration of atomic force microscopy (AFM) in 1985, thousands of papers have appeared which describe the use of these techniques for characterization of various materials. A substantial portion of these contributions involve the characterization of specific crystal planes of molecular crystals, including organic metals and superconductors. Even more papers have appeared which describe scanning tunneling microscopy of molecular films such as Langmuir-Blodgett mono- and multilayers and liquid crystals immobilized on atomically flat substrates. These scanning probe microscopies have provided insight into the electronic structure and supramolecular organization of crystalline and liquid crystalline systems with

unprecedented resolution, and promise to be an important tool for scientists who are readers of Molecular Crystals and Liquid Crystals. These microscopes are commercially available at costs which are continually declining, and their design is improving substantionally so as to make these techniques more user friendly and appealing to a wider audience. It is not unlikely that they will become routine instruments in every chemistry, physics, biology, materials science and chemical engineering departments in the near future. Of course, the danger in such ready access and ease-of-use is that practitioners will approach experiments and interpretation casually, without a good working knowledge of the principles of the technique, the fundamental physics responsible for images, and the nuances of acquiring and interpreting data. This is compounded by the fact that much of this information is distributed in a rather voluminous literature.

The recently published book, "Scanning Tunneling Microscopy and Spectros copy: Theory, Techniques and Applications," edited by Dawn Bonnell,represents a significant step toward introducing the novice practitioner to the fundamentals of scanning tunneling and force microscopies, while also providing the expert with a consolidated collection of principles and references pertaining to these techniques. The strength of this book is its scope, in that it covers the fundamental principles of tunneling, principles of operation, design of instruments, practical information for the user, and some well-selected applications of STM. The 10 chapters contained in this book are written in a concise manner, are frequently cross-referenced for the convenience of the reader, and are presented in a logical order. The book also provides thorough appendices of acronyms and terms used in the book, which new practitioners will find convenient. The most surprising feature of this book, however, is the consistent clarity throughout, which reflects good editing. Consequently, this reviewer was able to read the entire book thoroughly in approximately eight hours. There is some redundancy in the materials presented in different chapters, but this is a positive attribute as it reinforces key points. Probably the most important feature of this book is the emphasis on artifacts that frequently accompany these techniques. Mention of these artifacts, and how they can be detected and resolved, are sprinkled throughout the text in appropriate places. The value of this cannot be understated.

The first four chapters deal with fundamentals of scanning tunneling microscopy, including microscope design and application (Bonnell), theory (J. Tersoff), and tunneling spectroscopy (R. J. Hamers). Even the novice will find these chapters palatable. The equations describing the dependence of tunneling current on distance and density of states, their relationship to STM data, and examples of STM data, are clearly presented. The chapters are presented such that an understanding of these equations will fortify the conceptual understanding of the technique for the new practitioner. The second section of the book contains a chapter describing the surface structure of crystalline solids (W. Unertl) and the preparation of tip and sample surfaces (G. Rohrer). The former is probably the weakest chapter in the book, as it describes surface structure and properties with only a very small discussion of the use of STM to probe these characteristics. The chapter by Rohrer, however, will be indispensible to new users who need to understand the nuances of tip fabrication. This chapter is especially good in sumarizing the influence of various tip artifacts, such as double tips and blunt tips, on images recorded on surfaces with various different surface topography.

This will aid users in distinguishing between artifactual and real data. The last section contains chapters on force microscopy (N. A. Burnham and R. J. Colton), ballistic emission electron spectroscopy (W. J. Kaiser, *et al.*), electrochemical applications (A. J. Bard and F. F. Fan), and imaging of biological specimens (S. M. Lindsay). The force microscopy chapter is an especially good introduction of the principles in tip-sample forces, which are influential in both STM and AFM. Reference is made to key texts and references which describe forces, and the constitutive equations are well presented. Furthermore, the chapter clearly describes the typical forces which are operative in these microscopies, and the effect they have on operation and data interpretation. Experimenters working with soft samples such as organic crystals and liquid crystals, which can potentially be damaged by STM and AFM tips, will find this chapter especially valuable for guidance in establishing appropriate experimental conditions and acquiring useful data. Likewise, the chapter on biological specimans, provides a good background on the principles relevant to imaging soft samples. This chapter also presents possible explanations for tunneling currents in what are generally considered to be "insulating" samples. This is accomplished in language that will be readily understood by readers of Molecular Crystals and Liquid Crystals, in particular the description that uses tight binding approximations and site hopping to describe the tunneling mechanisms through biological molecules. The chapter on electron spectroscopy will probably be useful to readers interested in fabricating device structures based on molecular systems. The chapter on electrochemical applications is well organized and thorough.

In summary, even though certain references and examples may be dated by the reading of this review, and advances in techniques have been considerable since the text was written, this book is a must for the casual, or expert, practitioner of STMor AFM.

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Progress in Inorganic Chemistry: Vol. 41, K. D. Karlin, editor, Wiley-Interscience, 1994, ISBN 0-471-59699X; $125.00

The editor states in his introduction to this volume that he wishes to have this series go in a direction that will include work that represents interdisciplinary efforts and have an impact on fields outside traditional inorganic chemistry. In volume 41, this has been done very well. This volume should be of interest to those working in materials, organometallics, semiconductors, biochemistry, and biology.

The chapters vary in presentation from a short review-overview to detailed presentations of principles. Each has an adequate bibliography. This volume could be a possible text for an advanced topics course in inorganic materials. More than half of the pages are of interest for material scientists; particularly chapters 1 through 3 and chapter 9.

Each chapter has its own table of contents but no page numbers are given to help with quick location of a subtopic of interest.

The first chapter is a short overview of the use of X-ray crystallography as an analytical tool. Not a lot of details are given but references are of a general nature. Useful hints on techniques in collecting X-ray data are given.

Semiconductor photoelectrochemistry (PEC) is discussed in the second chapter. Both principles and applications are covered. A good review of principles of energy conversion with PEC is presented. This chapter in particular appears to be written for non-chemists and is more than a review of the topic. The chemical control of photoelectrochemical energy was not emphasized enough. A future volume warrants a chapter on the production and synthesis of semiconductors used in photoelectrochemistry.

Chapter 3 deals with chemical deposition of metal-containing thin film materials from organometallic compounds. There are 22 pages of references. This chapter covers electronics, inert containers and magnetic materials. There is a good review of techniques for the preparation and design of these materials. The chemistry of precursor compounds and the identification of new families of organometallics for application to this technology is well covered. Table I with references of known compounds, method of deposition and properties is excellent. This chapter combined with the last chapter provides a good source of information for those interested in semiconductors and photochemistry.

The chapter "Construction of small polynuclear complexes with trifunctional phosphine-base ligands as backbones", presents the basics of this topic but has no discussion of the applications or use of the complexes. The types of complexes with their structure are presented but no information is given on synthesis or characterization.

Coordination Chemistry is one of the main areas of modern inorganic chemistry and the chapter on transitional metal complexes containing catechol and semiquinones ligands will be of considerable interest to inorganic chemists as well as to those working in catalysis and dioxygen activation. Detailed models of various types and structures with various transitional metals are given. Electron transfer reactions are also discussed.

Chapters 6 and 7 which deal with zinc complexes and nickel containing enzymes will be of interest to biochemists as well as coordination chemists.

A somewhat new area of nitrogen chemistry, the chemistry of peroxonitrites, is given in chapter 8, which is relevant and of current interest. This topic forms an important connection between solution inorganic chemistry, photochemistry, environmental, and atmospheric/space science.

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