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Book Reviews

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Book Reviews

"Vibrational Spectroscopy of Molecules and Macromolecules on Surfaces" by Marek W. Urban; Wiley-Interscience, John Wiley & Sons, Inc; New York, 1993; ISBN 0-471-52815-3; xiv + 380 pages; $ 55.00.

In the Preface, the author states that this book is intended to bridge the gap between basic principles and practical aspects of vibrational spectroscopy and focus on the structure-property relations on surfaces and interfaces. The intended audience includes graduate students and more advanced researchers. Chapter One is entitled "Fundamentals of Vibrational Spectroscopy" and includes a discussion of the origin of molecular spectra, symmetry and selection rules, normal coordinate analysis, and force fields. Chapter Two is entitled "Vibrational Features of Molecules Adsorbed on Surfaces" and includes such topics as the theory of surface vibrations, coverage-dependent frequency shifts, band intensities and shapes, and deconvolution methods. Chapter Three is entitled "Experimental Vibrational Surface Techniques". Many techniques used in infrared spectroscopy of surfaces are discussed, including internal reflection, external reflection, diffuse reflection, photoacoustic spectroscopy, surface electromagnetic wave spectroscopy, infrared ellipsometry, and emission spectroscopy. Raman techniques discussed include surface-enhanced Raman spectroscopy. Infrared and Raman microscopy are also discussed.

Chapter Four is entitled "Normal Vibrations of Small Molecules on Surfaces". It includes discussions of factors governing surface vibrational activity, gas atoms and diatomic molecules adsorbed onto metal substrates. Among the examples are carbon dioxide, carbon monoxide, nitrogen, and ammonia. Also included are discussions of adsorbed alkenes, alkynes, saturated hydrocarbons, aromatic hydrocarbons, and heterocyclic compounds such as pyridine. Chapter Five discusses "Adsorption on Metal Oxides" such as alkaline earth oxides, silica, alumina, and the oxides of zinc, iron, and titanium. Also included is a discussion of adsorption onto zeolites and clays.

Chapter Six is entilted "Vibrational Features of Inorganic Macromolecules". Topics such as silicon-containing compounds, phosphates, phthalocyanines, sulfur-containing compounds, and ceramic superconductors are discussed. "Bonding to Polymeric Surfaces" is discussed in Chapter Seven. This chapter is divided into a discussion of thermoplastic and thermosetting polymers. A great deal of information regarding the vibrational spectra of polymers such as polyethylene, polypropylene, polystyrene, fluoropolymers, epoxies, melamines, polysiloxanes, and alkyds is presented. The effects of processes such as oxidation and plasma and corona treatment on the surface composition of polymers are discussed.

Chapter Eight discusses "Surfaces, Interphases, and Interfacial Regions." Among the topics covered are primers, complex formation, acid-base interactions, composite interfaces, and latex films, surfactants, and copolymers. "Surfactants, Colloidal Interfaces, and Thin Films on Surfaces" is the title of Chapter Nine. Surfactants in aqueous media, amphiphilic monolayers, ordered monolayers on solid surfaces, and orientation and packing are discussed. Character tables are presented in an appendix.

In general, the author accomplished his objectives. The first few chapters, where the fundamental of vibrational spectroscopy are discussed, especially as they pertain to the study of surfaces, are interesting and informative. These chapters include a discussion of normal coordinate analysis as applied to small molecules and are accompanied by a wealth of diagrams depicting the normal vibrations of molecules and how they are affected by adsorption, infrared and Raman spectra of selected compounds, infrared and Raman sampling methods, and the principles behind certain sampling methods, such as external reflection. The later chapters in the book are accompanied by a large number of figures in which the infrared and Raman spectra of adsorbed species, polymers, model compounds, and surface-treated polymers are presented and the mechanisms of adsorption and the orientation of adsorbed species are illustrated. Also included are numerous tables summarizing band assignments.

Unfortunately, the book is marred by innumerable typographical and editorial errors and could benefit from a thorough editing. There are errors in some of the equations and in a few instances the tables do not present the information that the text suggests they do. Nevertheless, the book accomplishes the author's objectives and should be a useful addition to the library of any researcher interested in an introduction to the fundamentals of vibrational spectroscopy as applied to small molecules and macromolecules on surfaces.

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Crystal Structure Analysis for Chemists and Biologists by Jenny P. Glusker with Mitchell Lewis and Miriam Rossi, VCH Publishers, Inc. New York; 1994 xviii + 854 pages; ISBN 0-89573-273-4; DM 120.00.

In the preface the authors of this remarkable book state that this volume has been written for those chemists and biochemists who may never themselves do X-ray diffraction analyses of crystals, but who need to understand the results of such studies on structures of immediate interest to them. That may very well have been their intention when writing the book, but I think they have overestimated the present day knowledge of those who actually carry out single crystal diffraction experiments. With modern turnkey automated diffractometers and canned analysis software readily available, crystal structure determinations have become routine even for a novice. It is these new practitioners who will find the book most useful, particularly when they

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encounter their first really difficult problem and find they need a good source that discusses the basics of crystallography and the interpretation of the results.

The book is divided into 18 chapters with the first half of the text discussing the techniques and procedures of a diffraction experiment and the second half the analysis of the results of a crystal structure determination. The material is presented in a colloquial and qualitative manner with just enough mathematics to present the reader with an honest picture. Each chapter contains two notable features, a detailed glossary of terms and an extraordinarily good list of references. The carefully selected references are very thorough and highlight important contributions ranging all the way from the nineteenth century to current times. A sense of history can be found in nearly every chapter, giving the book a very human touch. Some chapters are particularly good.

The opening chapter on crystals gives valuable particle advice concerning the methods of growing crystals. The chapter on crystal properties gives a very useful and remarkably clear discussion of the mechanical, optical and electromagnetic properties of crystals. One of the best chapters discusses the estimation of relative phase angles. This is the primary mystery in a diffraction experiment and a topic that a beginner finds most mysterious.

The latter half of the book is concerned with the interpretation of crystallographic results. This is the portion of the book that will be of most use to someone who is simply reading crystallographic literature. Particularly noteworthy are the sections on thermal motion and disorder, on chirality and on packing in crystals. The chapter on the comparisons of structures includes a useful discussion of the various crystallographic data bases and their uses. The final two chapters discuss recognition, receptors and structure-activity results.

Overall this is a very successful book, one that should be useful to novice crystallographers as well as those who are simply interested in reading the crystallographic literature. It is certainly a must buy for any scientific library and those working in the field who may wish to purchase their own copy.

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