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BOOK REVIEWS

Handbook of Applied Solid State Spectroscopy. Edited by D. R. Vij (Kurukshetra University, India). Springer Science + Business Media, LLC: New York. 2006. xx + 742 pp. $299.00. ISBN 0-387-32497-6.

This book is a comprehensive review of the theory and instrumentation of solid-state spectroscopy and its applications to a broad set of problems in the physical sciences. As such, it is a major contribution to the field and more than fulfills its objectives, covering a broad range of topics including nuclear magnetic resonance, nuclear quadrupole resonance, electron paramagnetic resonance, electron nuclear double resonance, Mössbauer, crystal field, scanning tunneling, resonance acoustic, infrared, Auger, X-ray photoelectron, luminescence, fluorescence, soft X-ray emission and resonant inelastic scattering, Raman, and optical spectroscopies. Every chapter is organized to present the physical basis, quantum mechanical principles, and selection rules for each type of spectroscopy, the practical aspects of the instrumentation, and both traditional and emerging applications. The authors have clearly made efforts to point out the complementary nature of different types of spectroscopies, going beyond the classic infrared, Raman, and neutron scattering comparison to highlight similarities between scanning tunneling microscopy and ultraviolet photoelectron spectroscopy as well as among the many types of magnetic resonance spectroscopies. The challenges and opportunities inherent to each type of spectroscopy are addressed. For instance, emphasis is placed on the use of Auger spectroscopy as a surface-sensitive technique, whereas resonant acoustic spectroscopy is highlighted as a probe of bulk elastic constants. Many other methods are presented as local, microscopic, and site selective probes of matter over various length scales. Discussion of new instrumental developments, such as use of the synchrotron in X-ray absorption spectroscopy and angle-resolved techniques in photoelectron spectroscopy, is an additional plus.

The chemical applications reviewed in the Handbook are very comprehensive, making it an ideal desk reference or text for a course on solid-state spectroscopy. Active researchers will find that the discussions of dynamics, local structure, and bulk properties encompass a variety of physical systems including polymers, glasses, superconducting cuprates and other oxides, biological systems, phthalocyanines and porphyrins, ion conductors, actinides, doped semiconductors, intermetallics, impurities on surfaces, and radicals in matrices, just to name a few. The focus for each chemical system is on problem solving. Educators will also be pleased with the many chemical applications from which they can select classroom examples, e.g., classic experiments on model materials, work on advanced materials, and emerging themes in nanoscience. Variable temperature techniques are covered in most sections, and other physical tuning techniques, such as high magnetic field, high pressure, and photoinduced spectroscopies, can be included depending on student interest. Another positive pedagogical element is that certain topics are covered from more than one point of view. For instance, the chapter on crystal field spectroscopy is complemented by a discussion of crystal field splitting in the Mössbauer (local site symmetry determination) and luminescence spectroscopy (color centers and 4*f* systems) sections. Determination of conformations is another theme that appears in multiple sections on applications.

In conclusion, I highly recommend the *Handbook of Applied Solid State Spectroscopy* as both a reference text and a classroom guide. It will not disappoint.

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Handbook of Reagents for Organic Synthesis: Reagents for Direct Functionalization of C−H Bonds. Edited by Philip L. Fuchs (Purdue University, West Lafayette, IN, USA). J. Wiley & Sons, Ltd.: Chichester. 2007. x + 412 pp. $135.00. ISBN 0-470-01022-3.

This handbook is a compilation of entries from the original *Encyclopedia of Reagents for Organic Synthesis* and from the electronic *e-EROS* that are relevant to the topic at hand. The main reason for the creation of the series *Handbook of Reagents for Organic Synthesis*, of which this book is the eighth, was to create separate handbooks, each on a distinct topic, that would be affordable for use in the laboratory. The book features approximately 80 short articles on different reagents for the direct functionalization of C−H bonds, including information on such transformations as arene and heteroarene functionalizations, the introduction of heteroatoms, and enantiogenesis, to name a few. The book also includes a list of “Recent Review Articles and Monographs”, a list of contributors, a reagent formula index, and a subject index.

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HPLC: A Practical User’s Guide, 2nd ed. By Marvin C. McMaster (University of Missouri-St. Louis, USA). J. Wiley & Sons, Inc.: Hoboken, NJ. 2007. xiv + 238 pp. $74.95. ISBN 0-471-75401-3.

The aim of McMaster in creating this handbook “is to cut through much of the detail and theory to make this [HPLC] a usable technique for you.” To this end, he has described theoretical models and protocols that have worked for him in effecting separations, complete with some of the latest innovations in this area. The book is divided into three main parts: (1) HPLC Primer, which sets the foundation for getting an HPLC system up and running; (2) HPLC Optimization, which shows how “to make the best use of common columns” and offers problem-solving tips on keeping them operational; and (3) HPLC Utiliza-

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tion, which addresses real-world applications of HPLC systems. The book concludes with seven appendices—a separations guide, answers to frequently asked questions, tables of solvents and volatile buffers, a glossary of HPLC terms, a troubleshooting reference, HPLC laboratory experiments, and a reference list—and a brief subject index. A CD-ROM is also included.

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Modelling Molecular Structure and Reactivity in Biological Systems. Edited by Kevin J. Naidoo (University of Cape Town, South Africa), John Brady (Cornell University, USA), Martin J. Field (Institut de Biologie Structurale, Grenoble, France), Jiali Gao (University of Minnesota, USA), and Michael Hann (GlaxoSmithKline Medicines Research Centre, Stevenage, UK). Royal Society of Chemistry: Cambridge. 2006. x + 294 pp. $219.00. ISBN 0-85404-668-2.

This book was developed from the symposium on "Modeling Structure and Reactivity" held at the seventh triennial conference of the World Association of Theoretical and Computational Chemists in Cape Town, South Africa in January 2005. Its 23 chapters are organized under the following three sections: Molecular Conformation and Electronic Structure of Biomolecules; Chemical Reactivity in Biological Surroundings; and Toward Drug Discovery. A brief subject index completes the book.

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Solid State NMR Spectroscopy for Biopolymers: Principles and Applications. By Hazime Saitô (Himeji Institute of Technology and Hiroshima University, Japan), Isao Ando (Tokyo Institute of Technology, Japan), and Akira Naito (Yokohama National University, Japan). Springer: Dordrecht. 2006. xiv + 464 pp. $129.00. ISBN 1-4020-4302-3.

Solid-state NMR spectroscopy has become a very valuable tool to investigate the structure, dynamics, interactions, and assembly of a variety of biopolymers including globular, membrane, and fibrous proteins; polypeptides; nucleic acids; polysaccharides; and lipids. This technique is complementary to X-ray crystallography and solution-state NMR spectroscopy and allows for the study of large and noncrystalline molecules and assemblies. In particular, several new solid-state techniques have been developed in the past two decades for the determination of the structures of biopolymers. These include techniques for the measurement of distances and torsion angles, the use of aligned samples, and the development of ultrahigh-field and ultrahigh-speed magic angle spinning NMR spectroscopy. Several significant advances have also been made in techniques for isotopic enrichment.

The book is divided into two parts: principles and applications. The first eight chapters present the principles of several solid-state NMR spectroscopic techniques, including a general overview of the approach, a brief outline of NMR parameters, multinuclear approaches, experimental strategies, and constraints of the technique for determining secondary structure, as well as the study of hydrogen-bonded systems. Several theoretical descriptions are presented but at a level that does not require an extensive background in quantum mechanics.

The second section of the book, Chapters 9−16, covers several applications of solid-state NMR spectroscopy for the study of various systems, including fibrous proteins, polysaccharides, globular proteins, membrane proteins, biologically active membrane-associated peptides, and amyloid and related biomolecules. The coverage in each chapter is comprehensive and thoroughly documented by an extensive list of references. Examples are well chosen to provide a clear overview of the treated topics. It is also interesting to note that this book presents a good historical and chronological perspective and encourages in several cases the use of simple one-dimensional techniques, such as the DD-MAS (dipolar decoupled magic angle spinning) technique. There is also particular emphasis on the dynamic aspect of biopolymers.

In summary, this book surveys much of the current research in the area of biological solid-state NMR spectroscopy, and as such should be of great interest to the chemical, biochemical, and biophysical communities. The level is appropriate for graduate students, and the book would be an excellent textbook for a graduate level course in biological solid-state NMR spectroscopy. Its publication is timely considering the recent numerous developments in this area and the increasing potential of solid-state NMR spectroscopy for the study of important biological phenomena.

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Single Molecule Chemistry and Physics: An Introduction. By Chen Wang and Chunli Bai (National Center for Nanoscience and Technology, Beijing, China). From the Series: Nanoscience and Technology. Edited by P. Avouris, B. Bhushan, D. Bimberg, K. von Klitzing, H. Sakaki, and R. Wiesendanger. Springer: Berlin, Heidelberg, New York. 2006. xii + 304 pp. $119.00. ISBN 3-540-25369-6.

This book provides a detailed introduction to the literature on scanning probe microscopy (SPM), including a chapter on surface-enhanced Raman scattering of single molecules. There are a total of 10 chapters, although the first is merely a two-page introduction. Each chapter contains its own bibliography of the original papers, as well as occasional references to recent work by the authors themselves.

Chapter 2 begins with a review of the tunneling processes and the underlying quantum mechanics and ends with a discussion of the basics of scanning tunneling microscopy (STM). The next chapter is a description of how STM can provide structural details of complex solids at the atomic levels, mostly compared with simulated structures. The last section of this chapter is entitled "Electron-Spin Resonance Study of Single Molecules", which immediately caught my attention because it is a topic of some familiarity. This section is muddy, however, with references only to some earlier work, considered controversial, on defects on Si. There is more rhetoric than actual details, although I did have a chuckle at the misspelling of spin-resonance as sin-resonance (p. 68).

Chapter 4 presents perhaps the most useful data on what might be considered chemical reactions, such as electron-induced dissociation of pyridine or benzene on a Cu(100) surface at 9 K. It was quite rewarding to read. The succeeding chapter provides details about atomic force and magnetic force microscopy with references to the original work. Of particular interest to me was section 5.4.3 entitled “Imaging Single Molecule Magnets”. Unfortunately, nearly two-thirds of it deals with compounds that are not single-molecule magnets, e.g., polyphenoxyl radicals, or with single-spin centers. In the next chapter, applications of SPM and atomic force microscopy to biomem branes and related materials are discussed. A good introduction is provided for the so-called biomembrane force probe and optical tweezers with their impressive application to determination of forces at the molecular level. Chapter 7 shows how STM can be used for studying transport through single molecules, with direct implication to the development of molecular electronics. Examples of conductance through DNA and carbon nanotubes are discussed in detail, and the chapter ends with some conjectures on single-molecule devices.

Single-molecule fluorescence and fluorescence resonance energy transfer (FRET) are discussed in Chapter 8. Of particular interest is the brief section on magnetic resonance of single fluorescent molecules, which is considered complementary to STM detection of single-spin centers or measurements of magnetic forces. Other sections include a discussion of molecular motors and single-molecule imaging of cells and other biological entities. A discussion of fluorescence imaging continues in Chapter 9, where the focus is on near-field scanning microscopy and the utilization of FRET again. The concluding chapter covers surface-enhanced Raman scattering and its application to single-molecule spectroscopy. As expected, the applications utilize highly colored molecules, such as rhodamine 6G. Here enhancements in the sensitivity of Raman signals by nearly 15 orders of magnitude from dye molecules adsorbed on Ag particles have been noted. The chapter ends with a discussion of Raman scattering on single-carbon nanotubes, a topic that is at the heart of applications of nanoscience and nanotechnology.

In summary, this a valuable book that fills a gap in the reference material for teaching topics in the area of single molecules at a senior undergraduate or beginning graduate level.

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