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BOOK REVIEWS

Organolithiums: Selectivity for Synthesis. By Jonathan Clayden (University of Manchester). Pergamon (An Imprint of Elsevier Science, Ltd.): Oxford. 2002. xvi + 384 pp. $45.00. ISBN 0-08-043261.

Organolithiums, defined as compounds formally possessing a C−Li bond, are indispensable reagents in organic synthesis, and mechanistic investigations of these species represent an important frontier in modern physical organic chemistry. This volume presents an accessible, detailed, and much needed account of work in both areas. Clayden's coverage is timely and comprehensive, and his style is engaging throughout, making the book a pleasure to read.

Chapter 1 provides a clear overview of the structure and reactivity of organolithiums and gives useful information on their stabilities in various solvents. The following three chapters detail regioselective synthetic routes to organolithiums via deprotonation, lithium−X exchange, and reduction of carbon−X bonds. In particular, α-lithiation, ortholithiation, and lateral lithiation methods receive critical and detailed review, a feature that will be greatly useful to both experienced and would-be practitioners of these methods. The discussion of lithium−halogen exchange includes an extended summary of work directed toward elucidating the mechanism of this useful reaction. In Chapter 5, the author describes the stereoselective and stereospecific synthesis of organolithiums, an area of intense synthetic and mechanistic activity over the past 10 years. A vast body of work is summarized, resulting in the most detailed and comprehensive account of configurational stability of organolithiums available today. Chapter 6 offers a discussion of the stereochemistry of the reactions of organolithiums in the absence and presence of chiral ligands (e.g., (−)-sparteine) and provides examples of enantioselective deprotonation and substitution, as well as dynamic resolutions (kinetic and thermodynamic). Many readers may find these two chapters to be the most important and unique contribution of this book. The book closes with chapters on regio- and stereoselective addition reactions of organolithiums to C−C and C−X multiple bonds (including anionic cyclizations), organolithium rearrangements, and the use of selective organolithium reactions in syntheses of nine biologically important targets.

In summary, this volume provides the best reference on synthetic and mechanistic studies of organolithiums available today. Academic and industrial synthetic chemists will find this book an invaluable resource; the pricing will make it a very attractive acquisition, even for use as a companion text in graduate classes on synthesis.

Paul R. Carlier, *Virginia Tech*

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Unsigned book reviews are by the Book Review Editor.

Photoacoustic Infrared Spectroscopy. By Kirk H. Michaelian (National Resources Canada). From the Series: Chemical Analysis, Volume 159. Edited by J. D. Winefordner. John Wiley and Sons, Inc.: Hoboken, NJ. 2003. xii + 336 pp. $125.00. ISBN 0-471-13477-5.

This is an excellent addition to the literature of infrared spectroscopy. From start to finish, it is clear, concise, accessible, and well organized. Anyone wanting to gain a perspective on photoacoustic infrared (PA IR) spectroscopy, find out what its capabilities are, or learn how this technique has been applied should have access to this book.

Michaelian reviews the literature on PA IR spectroscopy, starting with the earliest reports of the use of PA detection in the infrared and including new and exciting developments from as recent as 2002 and 2003. Although the book is limited to the use of photoacoustic/photothermal (PA/PT) spectroscopic methods of detection in the infrared, it is comprehensive within that scope, covering the literature of far- and near-IR, as well as mid-IR, and offering discussions of work in essentially all significant areas of application. The author reviews virtually all infrared PA spectroscopic techniques, places each in historical context, and discusses their applications as well. The text is also enhanced with numerous cross-references between sections, relating developments in PA IR history, techniques, and applications. The early history of the field from 1966 to 1981 is treated relatively briefly, but all of the significant contributions are included. Likewise, all of the distinct methods are succinctly explained and described with careful reference to the significant primary literature. These include the use of dispersive and Fourier transform (rapid-scan and step-scan) spectrometers and lasers, as well as the common sample-gas-microphone technique, photothermal laser beam deflection, reverse mirage, piezoelectric transducer methods, and optothermal window techniques. Special attention is justifiably given to three particular technical aspects: depth profiling, numerical methods, and quantitative analysis. The review of quantitative methods is particularly useful because it is often said (incorrectly) that PA methods are not capable of quantitative application. Perhaps the only significant omissions in terms of PA/PT techniques are photothermal radiometry and thermal lensing, although it might be argued that their application in the IR is limited.

Little discussion of theory accompanies the description of the techniques and the applications, although the reader is directed to the primary literature for details. The areas of application are organized into the following: carbons, coals, hydrocarbons, hydrocarbon fuels, corrosion, clays and minerals, wood and paper, polymers, gases, food products, biology and biochemistry, medical applications, carbonyl compounds, textiles, and catalysts. Special treatment is given to the very recent developments of PA/PT microspectroscopy and to the use of synchrotron radiation in PA IR detection.

The book includes a short glossary of terms of particular significance in the field of PA IR spectroscopy but does not refer to the recently published, comprehensive IUPAC glossary

of PA/PT terms by Terazima et al., which would be useful for the researcher needing an even broader context. However, one especially useful feature of the book is the second appendix, "Literature Guide", which lists 543 references to applications of condensed phase PA IR spectroscopy, with each categorized by its area(s) of application. Gas-phase measurements are not included in this list. In fact, only relatively recent gas-phase PA work published since the earlier Chemical Analysis volume on this subject by Sigrist is covered in the book. This appendix is in addition to the comprehensive author and subject indexes.

This book fulfills very well its intent to review comprehensively and critically the literature of PA/PT IR spectroscopy and its use in chemical analysis. Photoacoustic IR spectroscopy is a technique that, like all others, has specific strengths and limitations, but which is often the only one that will do the job. It should take its place in the armamentarium of all comprehensive analytical laboratories, and this book should be on the shelf in all such labs.

Richard A. Palmer, *Duke University*

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Vacuum Technology: Calculations in Chemistry. By D. J. Hucknall (Leybold Vacuum, London) and A. Morris (University of Southampton, UK). Royal Society of Chemistry: Cambridge. 2003. x + 234 pp. $89.95. ISBN 0-85404-651-8.

In the words of the authors, this book "is intended to be an accessible, applicable guide to how calculations in the subject [vacuum technology] are actually carried out." It is thus targeted to all "who use vacuum technology in chemical applications and who are involved in the design and operation of such equipment." The following seven chapters make up the book: Principles; Gas Flow; Pumps and Pumping Systems; Gas Sources and Attainable Pressure in Vacuum Systems; Total and Partial Vacuum Pressure Measurement; Some Applications of Vacuum Technology; and Summary. A bibliography, an appendix listing the symbols used in vacuum technology, and a subject index complete the book.

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Solvent-Free Organic Synthesis. By Koichi Tanaka (Ehime University, Japan). Wiley-VCH GmbH & Co. KGaA: Weinheim. 2003. x + 434 pp. $135.00. ISBN 3-527-30612-9.

This reference offers graphical summaries of 537 examples of solvent-free organic reactions, with each summary including structure scheme descriptions of the type of reaction and the reaction conditions, and a listing of keywords. A brief outline of the experimental procedures and relevant references are also included with each entry. The reactions are divided into the following chapters: Reduction, Oxidation, Carbon−Carbon Bond Formation, Carbon−Nitrogen Bond Formation, Carbon−Oxygen Bond Formation, Carbon−Sulfur Bond Formation, Carbon−Phosphorus Bond Formation, Carbon−Halogen Bond Formation, Nitrogen−Nitrogen Bond Formation, Rearrangement, Elimination, Hydrolysis, Protection, and Deprotection. A subject index is provided.

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Glow Discharge Plasmas in Analytical Spectroscopy. Edited by R. Kenneth Marcus (Clemson University) and José A. C. Broekaert (Universität Hamburg). John Wiley & Sons, Ltd.: Chichester. 2003. xvi + 482 pp. $165.00. ISBN 0-471-60699-5.

This wide-ranging book covers all aspects of the use of gas discharge plasmas as excitation and ionization sources for emission spectroscopic and mass spectral identification of components of trace and predominant compounds in a variety of media. It covers the use of gas discharges for solid, liquid, and gaseous samples, with the solid samples varying from conducting to nonconducting.

The chapters are written by acknowledged experts in the field, and the references are generally up-to-date, including references to the original papers on which the techniques are based. The presentations are detailed and at a level appropriate for those currently working in the field; the book would not be strongly recommended for beginners. Although there are introductory chapters (Chapters 2 and 3) on optical emission spectroscopy and mass spectrometry (especially the former), there is not sufficient space devoted to these topics to make them understandable for the uninitiated reader. Many of the remaining chapters focus on applications and cover the following topics: rf discharges, depth profile analysis, numerical modeling, applications to the steel industry, analysis of thin films, comparisons with other diagnostic techniques, treatment of radioactive samples, nonconducting samples, reference and calibration standards, liquid samples, coupling to liquid and gas chromatographs, inductively coupled plasmas, and the use of ion sources in tandem to increase the detectability and identification of trace compounds. Many experimental details are given, and numerous established and emerging areas are discussed. Most of the chapters emphasize the atomic component of the plasmas, but in the last two chapters (Chapters 16 and 17) as well as in Chapter 14, emphasis is given to the identification of the molecular fragments, as well as the atomic constituents, in the plasma.

Although the individual chapters are by different authors, there has obviously been an attempt to coordinate the contributions to ensure that there is some, but not excessive, overlap with no significant omissions. This has been largely successful; however, the individual chapters are not all at the same level, and this could pose a problem for some readers. Acronyms for the techniques are used extensively and consistently throughout, which facilitates moving between chapters. Unfortunately, these acronyms are not always defined where the usage is predominant, forcing the reader to search for the meaning. This deficiency is diminished, however, by the inclusion of a comprehensive and useful index. As a final comment, some of the figures have inadequate captions and legends. However, because the original sources are referenced, the additional information is accessible. All in all, this book should be very

valuable for those interested in this rapidly expanding and diagnostically important area.

Lucia M. Babcock, *University of Georgia*

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Adsorbents: Fundamentals and Applications. By Ralph T. Yang (University of Michigan). Wiley-Interscience: Hoboken, NJ. 2003. xii + 410 pp. $89.95. ISBN 0-471-29741-0.

Adsorbents have attracted much interest over the last four decades due in part to their importance in many applications, including catalysis, separations, purification of water and air, solid-state extraction, sensors, and membranes, to mention a few, and to their fascinating porous structures, which range from disordered to highly ordered, often exhibiting a high degree of complexity.

There are several excellent books on the fundamentals of adsorption, especially at the gas/solid interface, as well as on the applications of the adsorption processes. There are also books devoted entirely to such adsorbents as active carbons, carbon blacks, zeolites, and silica. However, there is a strong demand for a book that provides basic information about the most popular commercial and recently developed adsorbents, making Yang's book timely from this perspective. It provides a comprehensive overview on the most popular commercial adsorbents as well as on novel nanoporous materials that are under development.

A brief introduction to commercial and new adsorbents and their current and future applications is provided in the first chapter. Basic information about the synthesis, structure, and adsorption properties of the most popular adsorbents can be found in Chapters 5−9. These include activated carbons (Chapter 5), silica gels, activated alumina, and novel silicas with ordered mesoporosity (Chapter 6), zeolites and molecular sieves (Chapter 7), π-complexation adsorbents (Chapter 8), and carbon nanotubes, pillared clays, and polymeric resins (Chapter 9). An important feature of this book, and lacking in other related texts, is its focus on the industrial and environmental applications of adsorbents. In addition to some information on this subject in Chapters 5−7, Chapter 10 is entirely devoted to such applications as hydrogen storage and purification, methane storage, desulfurization of transportation fuels, removal of aromatics from fuels, air separation, removal of nitrogen oxides and carbon dioxide for environmental cleanup, etc. The reader will also find some information about adsorbent design (Chapter 2) and selection (Chapter 3). The latter chapter contains a very brief discussion of the fundamental equations resulting from Langmuir, adsorption-potential, and ideal-solution theories, as well as their role in the selection of adsorbents. Aspects of pore-size analysis, mostly limited to the Horvath−Kawazoe method, are briefly covered in Chapter 4.

Because Yang's book is focused on commercial and novel adsorbents and their industrial and environmental applications, it provides limited information about models of adsorption and methods for evaluating the surface properties and porosity of adsorbents. The reader wishing to obtain a deeper knowledge about theories of adsorption and characterization of adsorbents should consult other texts.

On the whole, Yang's book fulfills the existing demand for a simple and comprehensive text devoted to commercial and novel adsorbents. It should serve as a valuable guide for advanced undergraduate and graduate students of chemical engineering and chemistry interested in adsorbents and their applications. It should also provide useful information to industrial and academic researchers working in the area as well as to newcomers to the field.

Mietek Jaroniec, *Kent State University*

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Ionic Liquids in Synthesis. Edited by Peter Wasserscheid (Institute for Technical and Macromolecular Chemistry, Aachen) and Thomas Welton (Imperial College of Science, London). Wiley-VCH: Weinheim. 2003. xvi + 364 pp. $175.00. ISBN 3-527-30515-7.

As one of the hot areas of today's chemistry, the synthesis, properties, and applications of ionic liquids are receiving ever-increasing attention in research laboratories worldwide. Ionic liquids are organic salts that are liquid at ambient temperatures. They are polar, yet nonhydroxylic, solvents with negligible vapor pressure, which facilitates their recycling, and the possibility for varying their cationic and anionic partners so as to achieve desired properties imbues them with immense potential.

This monograph provides the first comprehensive treatment of this rapidly expanding field. (Two other volumes on ionic liquids have appeared previously, but both are conference proceedings.) Wasserscheid and Welton, themselves experts in some aspects of ionic liquid chemistry, have assembled an impressive set of contributions by other experts in the field.

The book opens with an introductory chapter that provides some historical perspective to the topic at hand. The reader is then given detailed information on the synthesis of ionic liquids and, equally important, their purification. This is followed by an in-depth discussion of their physicochemical properties. The next chapter provides an account of the effects of the identities of the cations and anions on the liquid range as well as a summary of available information on the viscosity, density, ionic conductivity, and electrochemical behavior of ionic liquids. Metal salt, organic compound, and gas solubilities are also given in this chapter, and applications of ionic liquids in separations are included. The subsequent chapter is devoted to the molecular structure and dynamics of ionic liquids. Both experimental and computational results are presented.

The remainder of the book is devoted to describing applications of ionic liquids in synthesis. Separate chapters containing a wealth of examples are provided for organic, inorganic, and polymer synthesis. A section on synthetic applications concludes with an intriguing chapter on the use of ionic liquids as media for biocatalytic reactions.

This volume provides an excellent summary of available information on ionic liquids as well as ready access to the primary literature on specific topics.

Richard A. Bartsch, *Texas Tech University*

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Quantum Medicinal Chemistry. Edited by Paolo Carloni (International School for Advanced Studies, Trieste) and Frank Alber (Rockefeller University). From the Series: Methods and Principles in Medicinal Chemistry, Volume 17. Edited by Raimund Mannhold, Hugo Kubinyi, and Gerd Folkers. Wiley-VCH Verlag GmbH & Co.: Weinheim. 2003. xviii + 281 pp. ISBN 3-527-30456-8.

This book covers the three major thrusts of quantum chemistry as applied to medicine and biochemistry, density functional theory, quantum-mechanical/molecular-mechanical methods (QM/MM), and computational approaches to molecular properties (structure/activity relationships). The book is current, thorough, and, in general, quite well written.

All of the chapters are written by research groups active in medicinal chemistry. Some of the coverage is redundant, particularly the density functional theory portion, but this does not detract substantially from the quality. Indeed, there are advantages to seeing the basic theory from differing perspectives. Although there is a very brief outline of the book at the beginning, more introductory comments from the editors would have been useful, particularly for graduate students.

The book is exceptionally timely. Graduate students will find a broad survey of today's activity in the areas treated. In particular, the very detailed and complex coverage of time-dependent and excited state density functional methods shows how quantum theory is beginning to explore extremely subtle effects in biological systems.

The QM/MM chapters provide especially nice examples of the application of this approach to catalytic mechanisms, reaction modeling, and quantum effects—all also very current and fairly detailed. Common methods to separate the classical and quantum regions are surveyed, and brief but useful discussions of the impact of the choice of ab initio versus semiempirical versus density functional QM methods are provided. Protein folding, dynamics, protein−protein interaction, and some protein−ligand interactions are also discussed, an example being Thomas' (1999) work on influenza neuraminidase.

In the final sections, approaches to computing molecular properties are discussed. These are necessarily limited to a couple of approaches, but they are interesting and current. Bader et al. provide a detailed review of the status of the Atoms-in-Molecules method applied to problems in medicinal chemistry, and the molecular electrostatic potential method is reviewed by Murray and Politzer. In both approaches, the authors are refreshingly clear as to the advantages and disadvantages of the methods and their ranges of applicability.

The stated purpose of the book, to be a reference for scientists on using quantum chemical techniques, is only partly met because no approach is covered in sufficient detail to be used as such. The references in the book, however, are recent and fairly numerous (but not exhaustive), allowing interested readers to pursue details elsewhere. For active scientists and graduate students in medicinal, biochemical, or theoretical chemistry, this book provides an outstanding context for their work. It should have wide appeal and is well worth the time to read.

William A. Seitz, *Texas A&M University at Galveston*

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