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Book Review

Functional Organic Materials: Syntheses, Strategies and Applications Edited by Thomas J. J. Müller (Heinrich-Heine-Universität Düsseldorf, Germany) and Uwe H. F. Bunz (Georgia Institute of Technology, Atlanta, GA, USA). Wiley-VCH Verlag GmbH & Co. KGaA: Weinheim. 2007. xx + 592 pp. $335. ISBN 978-3-527-31302-0.

Vance E. Williams

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BOOK REVIEWS

Core Concepts in Supramolecular Chemistry and Nanochemistry. By Jonathan W. Steed (Durham University, U.K.), David R. Turner (Monash University, Australia), and Karl J. Wallace (University of Southern Mississippi). John Wiley & Sons, Ltd: Chichester. 2007. xii + 308 pp. $50. ISBN 978-0-470-85867-7.

Supramolecular chemistry/molecular recognition is a powerful tool for making bigger things out of small building blocks. Applying these concepts to the materials world gives chemists the inside track in developing bottom-up strategies for nanotechnology. This book goes right to the heart of the synergy between supramolecular chemistry and nanotechnology, making it a very timely and useful introduction to these topics.

The book begins with a very concise and lucid introduction to supramolecular chemistry, covering core concepts such as the modes of interaction, kinetics and thermodynamics, and cooperativity. The next chapters provide selected examples of solution-based host−guest systems—focusing primarily on ion recognition—and discrete self-assembled structures such as rotaxanes and capsules. Chapter 4 focuses on supramolecular approaches to solids and is particularly useful and interesting. The last chapter provides a nice discussion of nanotechnology from a chemical perspective, a very useful aid in moving chemistry into the nanoworld.

Overall, the authors have done an excellent job in identifying research themes that excite them and conveying that excitement in the book. The addition of key citations to the individual sections and an extensive bibliography for each chapter makes the book useful for both teaching and as a reference. Although there are areas that are not covered in the book, e.g., supramolecular approaches in polymer and nanoparticle assembly, this is to be expected given the authors' mission of creating an accessible textbook. I would say that the book is fully successful in that aim and would be a delightful textbook or an excellent introduction to the field for researchers looking to apply the toolkit of supramolecular chemistry in the nanoworld.

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Thin Layer Chromatography in Chiral Separation and Analysis. Chromatographic Science Series, Volume 98. Edited by Terasa Kowalska (University of Silesia, Katowice, Poland) and Joseph Sherma (Lafayette College, Easton, PA). CRC Press/Taylor and Francis Group: Boca Raton, FL, 2007. xvi + 420 pp. $169.95. ISBN 0-8493-4369-0.

The authors' enthusiasm for thin layer chromatography has succeeded in blinding them to its deficiencies. Chiral separations will never be one of the strengths of thin layer chromatography (TLC). In spite of their negative comments about the deficiencies of column-based methods of separation, these techniques have the primary advantage of higher efficiency, which allows for useful separation of compounds having only small differences in retention factors. In addition, column-based methods are facilitated by superior and more flexible technologies for detecting chiral and nonchiral substances.

As correctly pointed out in this work, there are only a small number of chiral stationary phases available in the form of precoated layers for TLC, and these represent only a very small fraction of those available for column chromatography. It is possible to use mobile-phase additives to overcome some of this deficiency, but these are no different from those used in column-based methods, which are largely free of the nonequilibrium adsorptive and distribution properties that accompany the use of such additives in TLC. Moreover, many chiral selectors used in column chromatography contain UV-absorbing groups that interfere with *in situ* TLC detection. This is one reason why the number of precoated stationary phases is so limited in TLC. A common problem barely addressed anywhere in the book is the quantitative determination of the minor enantiomer (<1% w/w) as an impurity of the major enantiomer. TLC is particularly poor at this type of analysis.

I was struck by the number of procedures described in which visual detection was used to assess the composition of mixtures. This can only result in poor qualitative information for a rough assessment, and I cannot imagine that it would pass the regulatory hurdle, except as a pass/fail test. There are few chromatograms obtained by densitometry in the book, and these are generally for 1:1 mixtures of enantiomers. Also noticeable is the limited diversity of compounds studied so far by TLC in relation to column chromatography; the applications described here are dominated by amino acid separations.

The book is true to its title and provides contemporary coverage of the modern TLC literature; all the applications that should be covered are. There are also some good tutorial chapters on the origin of molecular chirality, its biological importance, and mechanistic details of enantiomer recognition. There is good coverage as well of derivatizing reagents for the separation of enantiomers as diastereomers using, for example, Marfey's reagent. Some authors provide sufficient experimental details to allow a procedure to be performed without resorting to the original literature.

In conclusion, although it is possible to separate enantiomers by TLC, the authors have not convinced me that it would make one of my top three choices as a general approach for this problem.

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Functional Organic Materials: Syntheses, Strategies and Applications. Edited by Thomas J. J. Müller (Heinrich-Heine-Universität Düsseldorf, Germany) and Uwe H. F. Bunz (Georgia Institute of Technology, Atlanta, GA, USA). Wiley-VCH Verlag GmbH & Co. KGaA: Weinheim. 2007. xx + 592 pp. $335. ISBN 978-3-527-31302-0.

10.1021/ja0769853 CCC: $37.00

Functional Organic Materials is a timely survey of a burgeoning field of considerable breadth and diversity. Broad disciplines tend to be difficult to tackle effectively, and the sheer number and variety of topics that fall under the umbrella of "functional organic materials" precludes their comprehensive treatment in a single volume. This point is not lost on the editors, who have chosen instead to highlight selected aspects of the field.

There is considerable variation in the scope of the chapters, which range from extensive reviews of broad topics to much more narrowly focused discussions. Chapters 1 and 2 embody these opposite extremes. The first chapter addresses the functionalization of carbon nanotubes, a topic that could fill an entire book on its own. The authors do a good job of addressing a wide range of methods, although occasionally this all-inclusive approach comes at the expense of pertinent details. In stark contrast, Chapter 2, which ostensibly reviews the preparation of cyclophenacenes, is in fact a précis of a single paper and as such fails to do justice to the rich area it purports to cover.

Fortunately, the other chapters are much more substantial. Chapter 3 is an informative review of cruciform π-conjugated oligomers. Like much of the book, this chapter's main emphasis is synthesis, although the photophysical and glass-forming properties of these materials are also addressed. Many of the chapters similarly focus on synthetic topics, such as organophosphorus π-conjugated systems (Chapter 4), shape-persistent phenylene-ethynylene macrocycles (Chapter 6), thiol end-capped molecules for molecular electronics (Chapter 10), and combinatorial approaches to chromophores (Chapter 5). Chapter 15, which deals with chiral conjugated materials, is largely a review of the synthesis of helicenes that briefly touches on structural and chirooptical properties.

The remaining chapters focus on a variety of less synthetic subjects. Chapter 7 presents select examples of self-assembly via multiple noncovalent interactions, another area that could fill several volumes. It is followed by a highly readable account of work from the Stoddart group on rotaxane-based molecular motors and muscles. Chapter 9 covers the photoswitching of magnetic interactions in diarylethene derivatives; this is the only chapter that deals with the surprisingly under-represented field of photochromic materials. The succeeding chapter is an excellent introduction to the nonlinear optical properties of organic molecules, with particular attention to two-photon absorption. The two most closely related chapters in the book, 12 and 13, give overviews of electron transfer in DNA and π-functional materials, respectively. The final chapter is an interesting and critical discussion of how to induce acenes to π-stack.

In general, the reviews in this volume are well written, up-to-date, and informative, and on the whole they constitute excellent introductions to their subjects. The choice of topics is necessarily idiosyncratic, and there are many important areas within the field that receive little or no attention. For example, readers hoping to learn more about polymers, organic semiconductors, or liquid crystals are likely to be disappointed. However, these kind of editorial decisions are inevitable when dealing with a field of this magnitude, and although some might disagree with which topics were included and which were not, the subjects brought together by the editors do provide a flavor for the field. As such, this book is well suited as a general introduction for nonspecialists.

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Laser Chemistry: Spectroscopy, Dynamics and Applications. Edited by Helmut H. Telle (Swansea University, U.K.), Angel González Ureña (Universidad Complutense de Madrid, Spain), and Robert J. Donovan (Edinburg University, U.K.). John Wiley & Sons, Ltd.: Chichester. 2007. xiv + 502 pp. $90.00. ISBN 978-0-471-48571-1.

This book could serve as a text for either an advanced undergraduate or a graduate course as the authors suggest in their Preface, but it contains information of value to researchers as well. Although I would be comfortable using it for a laser *spectroscopy* course, I am reluctant to teach "laser chemistry" from this text because the coverage is too heavily weighted toward the basic research in gas-phase spectroscopy that began with the advent of the laser and largely ended by about 2000. This is evident by the fact that the vast majority of the references are within that time period. Also the coverage includes an apparently random selection of various laser-based analytical chemistry techniques, e.g., gas-phase atmospheric chemistry, MALDI, LIDAR, etc. Of course, it is impossible to cover all the existing and potential applications of laser spectroscopy or even the subject of laser chemistry in one text; however, because the book does not appear to have an effective unifying conceptual framework, the selection of topics seems random. For example, given the coverage that does appear, one wonders why the pioneering work of Yardley and others at Exxon in the late 1970s is not included in a book about "laser chemistry". Also because the authors have chosen to put in much about spectroscopy, one wonders why there is no mention of the extensive "laser chemical" research on time-resolved resonance Raman, fluorescence, and transient absorption spectroscopy of hemoglobin or the visual pigment-based systems, such as rhodopsin. The lack of coverage of surface-enhanced Raman spectroscopy and the use of excimer lasers in processing and fabrication of semiconductors, including photolithography, is also unfortunate. Still, there is much about molecular beams and the generation and collection of ions. The inclusion of the sections on experimental technology will be helpful for first year graduate students, but serious students and researchers will eventually want to buy *Building Scientific Apparatus: A Practical Guide to Design and Construction* by Moore, Davis, and Coplan, which also covers this material but is much more comprehensive.

I found the index to be of little use in finding specific topics, and it is mentioned in the book that there are worked examples and problems available online, but I was unable to access these for this review. In my opinion, the text fails to define the term "laser chemistry" very well, so despite having some very good schematic diagrams and figures, e.g. illustrating the spatial relationship between laser-induced processes and the laser interaction zone, the overall presentation is not as cohesive as it could be. A textbook should make some mention of existing definitions for words just in case users should some day read another book on the subject. Woodruff and others have suggested reasonable definitions that could easily bring some context to the narrative, thereby making it more logical and rational to me and perhaps other chemists than whatever conceptual framework the authors used in defining the contents of this volume (see Woodruff, W. H. Lasers, Laser Spectroscopy, and Laser Chemistry. In *Inorganic Chemistry: Toward the 21st Century;* Chisholm, M. H., Ed.; ACS Symposium Series 211; American Chemical Society: Washington, D.C., 1983; pp 473−508).

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Atomic and Nuclear Analytical Methods: XRF, Mössbauer, XPS, NAA and Ion-Beam Spectroscopic Techniques. By H. R. Verma (Punjabi University, Patiala, India). Springer: Berlin, Heidelberg, New York. 2007. xiv + 376 pp. $169.00. ISBN 978-3-540-30277-3.

This book looked interesting at first glance because the author, Verma, promised to discuss different analytical methods encountered in the laboratory. Unfortunately, its content does not live up to its title, as the methods described appear to be more randomly chosen than systematically selected. Even the term “Atomic and Nuclear Analytical Methods” is somewhat misleading, as major atomic analytical methods like atomic absorption spectrometry or atomic emission spectrometry are not included.

The book is divided into the following eight chapters of varying length and depth: X-ray Fluorescence (XRF) and Particle-Induced X-ray Emission (PIXE); Rutherford Backscattering Spectroscopy; Elastic Recoil Detection; Mössbauer Spectroscopy (MS); X-ray Photoelectron Spectroscopy; Neutron Activation Analysis; and Particle-Induced Gamma-Ray Emission; and Accelerator Mass Spectrometry (AMS). The largest section, about 90 pages, is taken up by the combined chapter on XRF and PIXE, with the least space devoted to accelerator mass spectrometry.

The chapters are not all uniformly structured. In some chapters, the main emphasis is placed on explaining different detectors in some detail, whereas in other chapters the majority of space is devoted to calculations of beam energies. Applications of the methods are included with most of them, but unfortunately they are very brief, and the advantages and limitations of the methods are often missing from the text. The methods discussed, with the exception of XRF, are not mainstream and may only be interesting and important to a very small user group. In discussing one particular method, the author mentions that there exists only a handful of instruments worldwide. The usefulness of describing such a method here is therefore somewhat questionable.

Considering that the chapter on XRF/PIXE is the longest in the book, one would expect a thorough and reasonably in-depth treatment of these methods. However, this is not the case. The chapter is based on very selective and often outdated references with some major standard works in the field missing. For example, the book *X-ray Fluorescence Spectrometry* by Jenkins has been a standard work for many years with a second edition published in 1999. This reference is neither cited nor recommended for further reading. The same can be said for *Advances in X-ray Analysis*, *Volume 39* edited by Gilfrich et al. (1998) as well as *Handbook of X-ray Spectrometry*, *Second Edition*, *Revised and Expanded* edited by Van Grieken and Markowicz (2002). The chapter itself is not very balanced. Is it really necessary to go into depth about principal quantum numbers and discuss outdated software but devote only a few paragraphs to the applications of the method? Some more time should have been spent on applications, and an overview of recent software available to analyze the spectra should have been presented.

This is also true for the other methods described in the book. The lack of discussion of recent software or analysis methods is noticeable, and the emphasis within each chapter is often odd. For example in the chapter on Rutherford backscattering spectroscopy (RBS), one subchapter entitled “Principle of Rutherford Backscattering Spectroscopy” is several pages long and another called “Fundamentals of the RBS Technique and its Characteristics” is also several pages, whereas the section on applications is only one paragraph long. In the chapter on Mössbauer spectroscopy, the analytical software and data acquisition system described date back to the 1980s. Here one wonders if no new software or data acquisition methods are included because they are so uncommon or because the author does not know about newer versions. There are many more examples throughout the book in which the applications are outdated and the general use of the method is poorly judged, or simply, major complementary methods are omitted, such as Auger electron spectroscopy and X-ray photoelectron spectroscopy.

To summarize, the author describes selective analytical and nuclear methods mostly tailored for a relatively small community. Some of the methods were commonly used in the 1980s and 1990s, but technology has evolved since then, and these methods have been replaced by more powerful ones. This also applies to the references cited in the book, which are also very selective, often outdated, or simply missing. Considering all this, it is questionable whether this book presents a significant contribution to the field.

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Polymers and Light: Fundamentals and Technical Applications. By Wolfram Schnabel (Hahn-Meitner-Institut, Berlin, Germany). Wiley-VCH Verlag GmbH & Co. KGaA: Weinheim. 2007. xiv + 382 pp. $190. ISBN 978-3-527-31866-7.

Schnabel’s stated intent for creating this book was “to comprehend and combine in a single book all important developments related to polymers and light”. This is an ambitious plan and nearly impossible to realize given the breadth of the field and the rapidity of developments. However, while there are some deficiencies and omissions in the book, it is still an admirable work that will be useful to a variety of audiences. It is reasonably up-to-date, with numerous recent references, which is very important since much of the book focuses on the applications and technology of photochemical phenomena in polymeric materials.

The book begins with a simple summary of photophysical and photochemical phenomena and then addresses the physical responses of polymers to light, e.g., photoconductivity, nonlinear optics, photorefractivity, photochromism, and applications (xerography, LEDs, lasers). Photochemical processes in synthetic and biological polymers and the applications of photochemistry, e.g., photoresists, MALDI, stabilizers, are covered next. In the final two sections of the book, Schnabel discusses photopolymerization and its applications in coatings, stereolithography, and holography and other miscellaneous applications, such as optical storage, photosensors, and photocatalysts. As this list of topics shows, the book is very broad in its range; there are few scientists who would be well-versed in all of these fields!

Given the breadth of the coverage, it is not surprising that the depth of coverage is not tremendous. For example, the introductory chapter on photochemistry and photophysics does not go into great detail; selection rules, Franck–Condon factors, molecular orbitals, Jablonski diagrams, and the exciton model are covered in seven pages, with seven figures taking up at least half of the space! Scientists who are already well-versed in photochemistry and photophysics will find most of this chapter a simple review, although the section on circular dichroism may be novel to those who have not worked with chiral substances. For those with less of a photochemical/photophysical background, the chapter will provide a foundation for most of the rest of the book but should not be taken as an exhaustive explanation of photochemistry and photophysics. With regard to the section on microlithography, the author does a good job of covering all of the essentials and of bringing in the most recent developments. Given the enormous volume of publication on microlithography, his 16-page summary does not leave out anything that is truly essential. The traditional bias against negative resists is not explained, some details of the phase-shifting approach are not presented, and a few fairly important types of resists are neglected, etc. Still, the coverage is reasonable for an introduction to the topic. Experts in the other topics will likely respond in the same way to the depth of the presentations: some details are left out, but overall, the treatments are acceptable as introductions to the subjects.

In the end, what does this mean for this book's usefulness and appeal to the broader scientific community? It has a variety of audiences. I would recommend it to polymer chemists or materials scientists who need to learn about photochemistry and photophysics, with particular applications to polymers. This would include new graduates—perhaps beginning employment in one of the applied fields Schnabel covers—and those changing their field of research or employment. I would also recommend it to photochemists who need to learn specifically about the photochemistry and photophysics of polymers and their applications. Finally, it can also be recommended to those who are seeking to broaden their understanding of polymer photochemistry and photophysics, particularly as applied in a variety of technologies. The book might also serve as a useful text or guide for senior or introductory graduate courses in departments of polymer science, chemistry, or materials science, for example, a senior seminar course. Because of the applied nature of the text, it will be interesting to see how it weathers the years: without revision and updating every 2 to 5 years, the text will rapidly become dated. At present, it is a useful, up-to-date resource for a variety of scientists—chemists, physicists, and materials scientists—interested in the interaction of polymers with light.

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Computational Organic Chemistry. By Steven M. Bachrach (Trinity University, San Antonio, TX). John Wiley & Sons, Inc.: Hoboken, NJ. 2007. xviii + 478 pp. $110. ISBN 978-0-471-71342-5.

As the author points out in the introduction, computational chemistry has played an increasingly prominent role in organic chemistry over the past few decades. This book does an admirable job of providing an appreciation of this role with respect to several key problems.

The first chapter is a relatively brief overview of computational methods. Relevant equations are provided, but the section's main strength is its clear description of methods. Although this fairly brief section may not be an effective introduction to these topics for beginners in the field—the author provides references to other texts that are specifically geared for this purpose—it would serve as a good refresher to readers who have had at least a brief exposure to the area. In this section and in the rest of the book, Bachrach discusses *ab initio* and density functional theory with little mention of other techniques, such as semiempirical and molecular mechanics methods. This decision successfully increases the focus of the text, although it does necessarily limit the coverage of some systems, such as larger bioorganic molecules.

In the remaining six chapters, Bachrach describes how computational methods have been used to gain an understanding of a wide variety of organic systems. The first of these focuses on questions related to the fundamentals of organic chemistry, such as acidity and aromaticity, while the following chapters group together studies of pericyclic reactions, diradicals and carbenes, reactions involving anions, the incorporation of solvent effects, and organic reaction dynamics. The author achieved a good balance between breadth and depth by presenting material as a series of "case studies." For example, the chapter on solution-phase organic chemistry provides detailed descriptions of three very different systems: aqueous Diels–Alder reactions, glucose, and nucleic acids. The case studies show how problems have evolved over many years and have been addressed with different computational methods, while stressing the advantages and disadvantages of different approaches. Key results are supported with primary data from calculations, usually in the form of tables or clear grayscale pictures of optimized structures and molecular orbitals. A common theme throughout is the interplay between experiment and computation, and succinct descriptions of related experimental work with relevant references are included. Since many case studies involve work that has developed over a few decades into current studies, the references appropriately range from "classic" papers to articles from the past few years.

One unique feature of the book is that each of the six chapters of case studies includes an interview with a prominent researcher in computational organic chemistry. In these interviews, the scientists discuss the trajectory of their research interests, with a particular focus on important collaborations and controversies that arose related to their studies. The interviews also integrate thematically with the rest of the book, frequently referring to studies discussed elsewhere in the chapters and emphasizing the interaction of computational and experimental results.

Overall, this book provides a good overview of how computation has been used to address important questions in organic chemistry. It should primarily serve as a reference for researchers or as a supplemental text for graduate courses in computational or physical organic chemistry. However, the inclusion of studies involving fundamental questions in organic chemistry may also make it a useful resource for instructors trying to incorporate specific examples of computational results into their undergraduate courses.

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Macromolecules Containing Metal and Metal-Like Elements, Volume 8: Boron-Containing Polymers. Edited by Alaa S. Abd-El-Aziz (University of British Columbia, Okanagan, BC), Charles E. Carraher, Jr. (Florida Atlantic University, Boca Raton, FL) and (Florida Center for Environmental Studies, Palm Beach Gardens, FL), Charles U. Pittman, Jr. (Mississippi State University, Mississippi State, MS), and Martel Zeldin (University of Richmond, Richmond, VA). John Wiley & Sons, Inc.: Hoboken, NJ, 2007. xiv + 206 pp. $150. ISBN 978-0-471-73012-5.

Volume 8 of this comprehensive series on metal-based macromolecules deals specifically with boron-containing polymers. The book is divided into six chapters that, taken together, provide a detailed survey of the entire range of boron-containing macromolecules. The reviews are current and generally cover the literature through 2006 with extensive lists of references in each chapter. There is also a useful 10-page, comprehensive index that makes it easy to locate discussion of a specific topic or compound among multiple chapters. Although the chapters are by several different authors, the book has a very consistent style and format throughout, indicative of a careful and thorough effort by the editors.

Chapter 1 alone, a 76-page review of the state-of-the-art of all types of boron-polymer systems by Keller and Kolel-Veetil of the Naval Research Laboratory, makes the book extremely useful to anyone interested in this broad subfield of materials science. Other chapters, averaging 20–30 pages each, focus on specific topical areas including carborane-containing polymers, boron–nitrogen polymers and materials, and organoboron systems of various types. The emphasis overall is on synthetic chemistry, but the authors also clearly discuss the diverse properties and applications of these polymers in the areas of ceramics, coatings, nanomaterials, catalysts, biomedical agents, and nonlinear optical and fluorescent light-emitting materials.

Overall, this well-written and organized book will allow chemists, materials scientists, and engineers unfamiliar with boron polymers to understand and appreciate the importance of the topics discussed. In addition, workers experienced in one or more of the areas should also find the reviews to be timely and comprehensive and will undoubtedly appreciate the extensive lists of references.

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