J|A|C|S BOOK REVIEWS

Introduction to Fluorescence Sensing. By Alexander P. Demchenko (National Academy of Science of Ukraine, Kiev). Springer Science + Business Media B. V.: www.springer.com. 2009. xxvi + 586 pp. $149.00. ISBN 978-1-4020-9002-8.

Evaluating an individual's enthusiasm or energy level without physically meeting or speaking with them is difficult. This book reveals an individual author who ardently depicts what the future holds for fluorescence-based analytical sensing applications and clearly wants to engender this tremendous enthusiasm to his readers. It is a densely packed monograph that is exhaustively referenced. The majority of the references have been published within the past five years, and the writing style is complete and engaging.

This tutorial textbook is timely and relevant given the continued need for measuring a wide array of solutes rather than single components. Frequently these components reside within either complex sample matrices or sample-limited volumes. As explained by the author, the advances in fluorescence-based sensing methodologies have amplified over the past decade. During this time, we have seen important developments in fluorescence-based applications with microarrays, near field optical microscopy (NSOM), quantum dots, two-photon spectroscopy, and waveguides. The 2008 Nobel Prize in Chemistry to Shinomura, Chalfie, and Tsien for the discovery, understanding, use, and creation of tunable versions of green fluorescent protein and its use to uncover complex molecular interactions within living cells highlights the importance of fluorescence-sensing chemistry and applications.

A unique feature of this book is the final two sections for each chapter. The first section, "Sensing and Thinking" is an overview of the chapter that provides a summary of the highlights as well as points out the future challenges related to the topics discussed. The author does not evade the technical difficulties related to different fluorescence-sensing techniques and clearly points out limitations in various technologies and improvements that must undergo future research. The second section is entitled "Questions and Problems." The majority of these questions are open-ended in nature forcing the reader to properly synthesize the material presented, combined with some creative thinking to effectively provide an answer to these questions.

The book has sections that describe the theoretical principles of fluorescence, different detection techniques, and the design and properties of fluorescence reporters while clearly indicating that other reference texts for fluorescence, such as the volume by Lakowicz, are available. Chapters on recognition units, supramolecular structures, and mechanisms of signal transduction are also included. The later chapters cover the many different types of platforms available, e.g., waveguides, microsphere-based assays, and microfluidic devices, as well as targeted analytes, such as ions, oxygen, glucose, glycolipids, glycoproteins, DNA, proteins, and polysaccharides. An entire chapter is devoted to applications within living cells and mammals. The final chapter is a discussion of the future of fluorescence sensing.

In this excellent and systematic book, there is only one minor problem, in my opinion. It would have been helpful to have the color plates reproduced as black and white figures in the chapters in which they are referenced. Additionally, the color plates are numbered 1 through 16, but there is no specification as to where they belong in the text. This makes it difficult to cross reference between reading the text and the figures printed on the color plates.

Nevertheless, this is a first-rate textbook for introducing readers to the continually growing field of fluorescence sensing. If desired, it is quite suitable for a graduate course on this topic. I am positive that when I teach courses in Instrumental Methods of Analysis as well as Bioanalytical Chemistry that I will frequently refer to this book. As a nonexpert in the area of fluorescence sensing, it was a pleasure to read it.

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Handbook of Asymmetric Heterogeneous Catalysis. Edited by Kuiling Ding (Shanghai Institute of Organic Chemistry, China) and Yasuhiro Uozumi (Institute for Molecular Science, Okazaki, Japan). WILEY-VCH Verlag GmbH & Co. KGaA: Weinheim. 2008. xviii + 448 pp. $200. ISBN 978-3-527-31913-8.

In the field of asymmetric catalysis, very selective and efficient homogeneous metal- and nonmetal-based systems exist that are applicable to a wide variety of synthetic transformations. These catalysts are often difficult to separate and reuse, however, so industrial application of these protocols has been slow to follow. Furthermore, rising environmental concerns regarding accumulation of wastes containing heavy and rare metals that are often used in homogeneous catalysis have also helped to limit their industrial application. Thus it is widely accepted that there is a need for new heterogeneous asymmetric catalysts. The development of heterogeneous chiral catalysts has been attracting significant attention because of their major practical advantages: reduced contamination by catalytic residues in products; safe and simple workup or extraction; and the facile recovery and reuse of costly chiral catalytic resources. *Handbook of Asymmetric Heterogeneous Catalysis* provides 12 review-type chapters that go well beyond an overview of the main research areas of asymmetric heterogeneous catalysis. The opening chapter provides a strong introduction to the general methods used to immobilize homogeneous catalysts. It is basically organized as an in-depth outline of the key concepts of each chapter, which is perfect for those who are not well versed in the field. Chapters 2−11 are grouped by the types of organic transformations. This makes it easy to compare the results of common reactions and discuss their successes and failures within the same context. Furthermore, the authors make it a point to compare the homogeneous catalytic system with

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its heterogeneous counterpart without bias. In addition, each chapter thoroughly covers not only the observed enantioselectivities but also the methods of recovery and reuse of the catalysts. Heterogeneous asymmetric catalysis using inorganic supports, including silica, clays, zeolites, and alumina, is discussed in Chapter 2. The authors of this contribution do a wonderful job discussing examples in the literature and focusing on the key concepts relevant to specific inorganic support systems, such as pore size, confinement effects, site isolation, and supercage effects. Chapter 3 addresses the use of organic polymeric supports for immobilizing the chiral catalyst. I truly appreciated the historical discussion of the limitations of polymer supports in the context of interactions in the microenvironment. The authors play close attention to the nature of polymerization as well as the reaction conditions, type of backbone, and cross-linking. Examples are also given detailing the effects of polymer molecular weight on enantioselectivity. The following chapter provides an excellent discussion on the pros and cons of methods of dendrimer synthesis as well as specific examples in the literature that demonstrate both the positive and negative "dendrimer effect," including blocking effects and site isolation. The authors also discuss dendrimers immobilized on polymer supports. In Chapter 5, the design and implementation of asymmetric fluorous catalysis are outlined. The authors also discuss the effects of the fluorine content of the catalyst and the ease or difficulty of its recovery. Chapter 6 provides a look into the use of immobilized chiral catalysts in aqueous media, and Chapter 7 covers catalysis in ionic liquids and supercritical CO_2, focusing mainly on the ionic liquids and sCO_2 as media, although I was encouraged to see a few examples of chiral organic ionic liquids as chiral catalyst phases. Chapter 8 is a review of heterogenized organocatalysts for asymmetric transformations, covering both ionic and nonionic catalysts systems. The next chapter is a discussion of homochiral metal−organic coordination polymeric frameworks, beginning with a very good historical account and leading into the design and construction of these frameworks. Chapter 10 focuses on enantioselective hydrogenation on chiral molecule-modified metal surfaces, followed by a chapter on recent advances in asymmetric phase-transfer catalysis. The final chapter outlines specific requirements and critical factors for the use of heterogeneous enantioselective catalysts in industry, providing pertinent examples and putting everything in the *Handbook* in the proper context.

As a whole, the chapters are surprisingly consistent in their style and tone, which is very optimistic overall. It is also noteworthy that many of the chapters offer philosophical outlooks on the state of the field and what still remains to be done. All the authors do a tremendous job in conveying the importance and significance of each type of heterogeneous catalyst system. The references are current—most are from within the past 5 to 10 years—and are thoughtfully chosen. The book delivers on its promise to provide an overview of heterogeneous asymmetric catalysis. I highly recommend it.

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High-Field EPR Spectroscopy on Proteins and Their Model Systems: Characterization of Transient Paramagnetic States. By Klaus Möbius and Anton Savitsky (Free University Berlin, Germany). Royal Society of Chemistry: Cambridge. 2009. xvi + 376 pp. $139. ISBN 978-0-85404-368-2.

This book is certainly well timed. During the past two decades, high-field electron paramagnetic resonance (HF EPR) spectroscopy has become an increasingly valuable technique in EPR. Numerous original papers, reviews, and chapters in specialized volumes have been published, but monographs presenting a comprehensive overview of this research are lacking. As a result, it has become increasingly difficult to view "the big picture" of possible applications of HF EPR, as well as the advantages and shortcomings of the various HF EPR techniques, and to follow the development of instrumentation in this area. This book does not cover the entire area of HF EPR but presents a succinct up-to-date summary of its techniques and their application to the study of proteins in which paramagnetic centers are created either by irradiation with light or through site-directed spin labeling. The coherent treatment of the subject and the high quality of coverage reflect the long-time involvement of the authors' laboratory in the development of HF EPR and its applications to biological problems.

The book is well organized and consists of six chapters, which can be read in any order depending upon the interest and expertise of the reader. Chapter 1 provides a short, but rather complete history of the main events of HF EPR development. However, there are some historical inaccuracies. For example, electron spin−echo envelope modulation (ESEEM) was introduced by Mims in 1965, rather than 1972 (see Rowan, L. G.; Hahn, E. L.; Mims, W. B. Electron-Spin-Echo Envelope Modulation. *Phys. Rev.* **1965**, *137*, A61−A71). By 1972 the basis of ESEEM was already quite well understood. Pulsed electron dipolar spectroscopy was introduced in Novosibirsk, as mentioned, but as a single-frequency two-pulse method in the late 1960s and early 1970s. The two-frequency three-pulse method followed in the 1980s. However, these early publications were predated by the famous work of Klauder and Anderson (see Spectral diffusion decay in spin resonance experiments. *Phys. Rev.* **1962**, *125*, 912−930), in which the phenomenon of "instantaneous diffusion"—which is the basis of dipolar spectroscopy in electron-spin echo—was initially introduced. In spite of these and other historical inaccuracies, this chapter is well worth reading.

The next chapter is especially useful for scientists who are starting to use HF EPR in their research. The authors discuss in detail the advantages of HF EPR, including the increase in sensitivity and gain in ENDOR resolution and g-resolution, etc. Examples of the enhanced detection of transients using high-field/high-frequency EPR are discussed. The background information about various ENDOR and ELDOR techniques is essential for understanding the applications of HF EPR spectroscopy to proteins that are reviewed in Chapter 5. However, the description of the capabilities of ESEEM-based techniques is rather superficial. The advantages of 2D ESEEM, for example, HYSCORE, refocused primary echo, and integrated four pulse techniques, to measure hyperfine interactions (hfi) and nuclear quadrupole interactions (nqi) are not discussed, nor are the properties of combination lines which, unlike fundamental lines, allow the anisotropic hfi and nqi to be directly measured. Also, omitted are mixed ESEEM-ENDOR techniques, such as HYEND and 2D Mims ENDOR, which allow correlations among hfi of nuclei to be easily obtained. The limited coverage of ESEEM methods may partly reflect that HF EPR microwave sources did not have enough power to excite nuclear modulation until recently. However, the ELDOR-detected NMR technique, which does not require powerful microwave (mw) sources and which is very efficient for the detection of large anisotropic hfi of nuclei with $I > {}^{1}/_{2}$, is also omitted.

Chapter 3 deals with HF EPR instrumentation, which is still very much "under development". As yet, there are no established standards for HF EPR. The various research groups continue experimenting with probe design, mw sources, detection schemes, and magnets. The authors give the reader "first-hand" experience about the intimate particulars of high-frequency/high-field EPR instrumentation. Spectrometers operating at 95 and 360 GHz that were constructed in Mobius's research group are primarily considered. The description of the 95-GHz design is instructive, but this mw frequency is now less common for "home-built" HF EPR spectrometers because a commercial 95-GHz instrument is manufactured by Bruker. On the other hand, the 360-GHz spectrometer is unique, and the detailed description of this instrument gives a clear idea about the problems to be overcome in constructing this complex and versatile instrument and the advantages it provides. Another extremely interesting part of this chapter is the experience in implementation of the Orotron, a new pulsed mw source that allows the performance of broadband pulsed operations and is highly promising for the implementation of ESEEM spectroscopy (even in this frequency!) for nuclei having small gyromagnetic ratios.

Chapter 5 makes up over 30% of the book and offers a plethora of examples that cover up-to-date results of the applications of HF EPR spectroscopy, e.g., continuous-wave and pulse, to the structure, dynamics, and functions of proteins. Examples are from investigations performed in the research group of the authors as well as in other research groups. The examples include, but are not limited to, multifrequency high-field investigations of function, structure, and conformational changes of bacteriorhodopsin by means of site-directed spin labeling; details of the functioning of photosystems I and II; and investigations of the mechanism of action of molecular toxins. This chapter is supported by nearly 500 references to the current literature and by numerous figures—many in color—that clearly demonstrate the advantages of HF EPR, especially for biological systems with small g-anisotropy.

In several sections of Chapter 5 and elsewhere in the book, the authors emphasize the increased orientational selectivity that HF EPR provides. It must be mentioned, however, that this selectivity takes place in the g-frame rather than in the molecular frame. Translating magnetic resonance information to molecular structure can be difficult. This is not stated explicitly in Chapter 5; however, the authors do discuss this problem and describe ways to solve it in Chapter 4, "Computational Methods for Data Interpretation". Chapter 6 is a short discussion by the authors of the future of HF EPR.

Technically, the book is well prepared. There are relatively few typographical errors. The liberal use of figures, especially color figures, enhances the book and clearly illustrates the advantages of HF EPR for studies of proteins. In summary, we conclude that this book will be useful to a wide circle of readers from academics to graduate students. For those who desire more details, the book provides extensive and current references to the primary literature, reviews, and relevant Web sites.

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Iridium Complexes in Organic Synthesis. Edited by Luis A. Oro (University of Zaragoza, Spain) and Carmen Claver (Universitat Rovira i Virgili, Spain). WILEY-VCH Verlag GmbH & Co. KGaA: Weinheim. 2009. xviii + 396 pp. $215. ISBN 978-3-527-31996-1.

This book on iridium-catalyzed organic transformations is timely and welcome, complementing other books from WILEY-VCH involving ruthenium- and rhodium-catalyzed reactions. It is visually appealing and covers the area fairly comprehensively. Presentation is generally of a high standard, with clear schemes and a well-written text that is easy to follow, although the quality of molecular structures determined by X-ray crystallography varies considerably between chapters.

The individual chapters are self-contained, although there are several examples of topics covered more than once, a consequence of the organization of the book. Some chapters concentrate on particular transformations, such as C=O hydrogenation, hydroamination, allylic substitution, coupling reactions, and cycloadditions. These are balanced by chapters on different classes of iridium complexes, including triisopropylphosphine, *N*-heterocyclic carbene, pentamethylcyclopentadienyl, and pincer complexes. For common reactions, such as hydrogenation or transfer hydrogenation, the same work is cited in two or more chapters.

Some of the chapters give considerable information regarding the coordination chemistry involved in specific catalytic reactions, although it would have been beneficial if an introductory chapter describing the general principles of the inorganic chemistry of iridium complexes had been included. An overview of commonly encountered ligands, oxidation states, and fundamental organometallic steps would have been helpful, especially where the reactivity of iridium is distinct from other late transition metals.

Industrial applications of iridium complexes are discussed in two chapters, making them a good addition to the book. One chapter covers general industrial considerations and the development of the synthesis of the herbicide (*S*)-metolachor, which, with a volume of >10 000 tons per year, is the largest known enantioselective catalytic production process. The other chapter reviews the industrial applications of methanol carbonylation.

The time taken to produce a book will inevitably lead to a lack of coverage of very recently published work; in this case, the book appears to cover material up until late 2007. As a consequence, some of the exciting new C−C forming reactions emerging from the Krische group have received less coverage than they deserve. Overall, this book provides good coverage of an increasingly important area and will be well worth reading by anyone interested in metal-catalyzed organic synthesis.

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Springer Handbook of Enzymes, Supplement, Volume S2: Class 2 Transferases, EC 2.1-2.7.10, 2nd ed. Edited by Dietmar Schomburg and Ida Schomburg (Technical University Braunschweig, Germany). Co-edited by Antje Chang (Technical University Braunschweig). Springer-Verlag: Berlin, Heidelberg: 2009. xx + 566 pp. $379. ISBN 978-3-540-85696-2.

The Springer Handbook of Enzymes offers brief but complete descriptions of some 5000 enzymes and their areas of application, with each enzyme arranged according to its Enzyme Commission (EC) number and each volume organized according to enzyme class. Where appropriate, each entry includes information under the following headings: Nomenclature; Source Organism; Reaction and Specificity; Enzyme Structure; Isolation/Preparation/Mutation/Application; Stability; and References. A short list of abbreviations and an index of recommended enzyme names open the book.

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