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BOOK REVIEWS

Electron Paramagnetic Resonance: A Practitioner's Toolkit. Edited by Marina Brustolon (University of Padova, Italy) and Elio Giamello (University of Torino, Italy). John Wiley & Sons, Inc. Ltd: Hoboken, NJ. 2009. xviii + 540 pp. $125.00. ISBN 978-0-470-25882-8.

When I started learning about EPR spectroscopy during my first year in graduate school, there were many excellent reference books that taught the fundamentals of magnetic resonance from the foundation of a spin Hamiltonian. Although these books were important, I found that the most useful reference in terms of getting started in the field was the manual that came with a 20-year-old Varian E-3 EPR spectrometer housed in my laboratory. This manual featured a brief explanation of the electronic Zeeman effect along with the requisite energy level diagram showing how the energies of the sublevels of an $S = {}^1/_2$ electron spin system varied with an applied magnetic field. The discussion then turned to how the measurements were made through block diagrams of the instrument and explanations of how its various components functioned to yield an EPR spectrum. There were explanations of microwave power saturation—what it meant and how to characterize it with the spectrometer—and of magnetic field modulation—how it could be used to enhance sensitivity and how the modulation amplitude affected the recorded spectrum, etc. While reading *Electron Paramagnetic Resonance: A Practitioner's Toolkit*, I realized that the importance of the old E-3 manual was that it taught the nuts and bolts of cw-EPR spectroscopy without getting bogged down in mathematical formalism. The editors of this current book have used a similar strategy to write a manual for modern EPR spectroscopy that will be invaluable to those trying to learn the methodology and will also serve as an important reference to experienced EPR spectroscopists trying to learn about new areas of applications.

The book consists of 13 chapters, authored by 18 experts in the field, that are split between the development of principles and their application to problems in chemistry, biology, and materials science. The chapters on principles are succinct, and they serve to prepare readers for the second half of the book and its focus on applications. A fine example of how the chapters on principles are pulled together by applications is the chapter "Electron Paramagnetic Resonance Applications to Catalytic and Porous Materials". A case study of Cu(II) sites encapsulated in a zeolite framework is presented wherein multifrequency cw-EPR, ENDOR, and ESEEM are used to determine the structures of the Cu(II) species present under different conditions and to understand the chemical transformations that are likely for these catalytic sites. This study reveals the detailed information on structure and bonding that can be gained from EPR and demonstrates that multiple methods and microwave frequencies are necessary to realize the results. The experiments rely on principles described in Chapter 1 (Zeeman and ENDOR effects), Chapter 2 (continuous wave EPR/ENDOR instrumentation), Chapter 4 (hyperfine coupling), Chapter 5 (pulsed EPR methodology including echo-detected EPR, ESEEM, and ENDOR), and Chapter 6 (EPR in the solid state including g- and hyperfine-anisotropy and orientation selection in EPR).

The chapter on spin trapping is comprehensive and will serve as a good starting point for introducing the technique and guiding the selection of trapping reagents. This chapter is followed later in the book by a second contribution on the detection of radicals in biology and medicine. A chapter on EPR applications in biochemistry and biophysics contains sections on EPR-oximetry, site-directed spin labeling, structure determination using PELDOR or DEER spectroscopy, and an overview of the application of EPR methods to the study of electron-transfer reactions in photosynthesis. The book concludes with a chapter on EPR applications aimed at studying charge carriers in solids. There is a nice historical account of the study of F-centers and the use of EPR to define electronic structures and locales. Finally, there is a presentation of theoretical developments directed toward analyzing EPR data from the foundation of *ab initio* molecular modeling as opposed to the conventional magnetic parameters of a spin Hamiltonian. This is a timely topic that serves to focus readers on the fundamental structural information in an EPR spectrum.

Overall, *Electron Paramagnetic Resonance: A Practitioner's Toolkit* is an excellent reference, especially for newcomers to the field of EPR spectroscopy.

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Microarrays: Preparation, Microfluidics, Detection Methods, and Biological Applications. Edited by Kilian Dill (CombiMatrix Corporation, Inc. Mukilteo, WA), Robin Hui Liu (Osmetech Molecular Diagnostics, Pasadena, CA), and Piotr Grodzinski (National Institutes of Health, Bethesda, MD). From the series, Integrated Analytical Systems. Edited by R. A. Potyrailo (GE Global Research). Springer Science + Business Media, LLC: New York.2009. xvi + 356 pp. $149. ISBN 978-0-387-72716-5.

In the advancement of high throughput methods to study biological systems, microarrays have demonstrated dramatic progress over the past decade. DNA microarrays, in particular, have become a routine tool for studying gene expression and various aspects of genomics. Microarray technology is not without its challenges and limitations, however, and the contents of the 17 chapters of this book highlight novel approaches that may address some of those issues and offer suggestions of new strategies on the horizon. Developments in the field of microarrays occur at a rapid pace, which is one reason why it is difficult to find good books on the subject. To its credit, this book covers some topics at the forefront of the methodology, with quite recent key references.

Although I found many of the topics in the book to be interesting, I also found that the organization was not very cohesive, with chapters that did not have a strong contiguous theme or style. Certainly, the work would have benefited from more thorough editing to correct some obvious oversights, such as a typographical error in the first sentence of the preface,

abstracts in some of the chapters but not in others, and black and white figures whose captions describe color features. In a couple of chapters, the connection to microarrays could be classified as somewhat peripheral. Certainly, this is a book focused on emerging directions, and anyone looking for a comprehensive treatment of microarrays in current practice is likely to be disappointed. If there is a recurring theme, it is electrochemical detection, which figures prominently in at least 10 chapters. Microfluidics is also treated in several chapters. This coverage does not reflect the current usage of these elements in commercial microarray applications, although who knows what the future holds.

The book is organized into five parts. The first, entitled "Overview and New Detection Method", consists of two chapters. The first chapter is a brief discussion of the current status of microarrays, focusing on design and differences in performance of six commercially available systems and some of the challenges facing microarrays, particularly in terms of the quality of measurements. Although this comparison is quite useful, there is little introductory material on instrumentation, methods, data analysis, or applications for someone who is not already familiar with microarrays. To be fair, each chapter contains some additional introductory material, but the first chapter seems disconnected from the remaining ones, which rarely cover the standard DNA platforms. Chapter 2, which briefly reviews electrochemical detection on microarrays in 10 pages, is perhaps better connected to the rest of the book but still does not unify the work.

Part 2 of the book examines microfluidics in the context of microarrays, and the two chapters here address the strategic and mechanical aspects of this union. I found Part 3, ambitiously titled "Statistical Data Evaluation on Microarrays", to be somewhat disappointing, consisting of a single chapter on a very specific application to an electrochemical array. Given the critical issues in data analysis for microarrays, a broader review would have been useful. The largest section of the book is Part 4, with seven chapters under the general umbrella of "Applications". Although the applications presented are quite variable, I found the introduction and reviews in many of the chapters to be quite engaging and particularly enjoyed the chapters on genotyping arrays, peptide arrays, carbohydrate arrays, and living cell arrays. One of the book's strong points is this broad mix of microarray applications that is able to give the reader an expanded perspective on the technology as a whole. The final section of the book, "Future Improvements in Microarray Sensing", presents topics such as magnetic nanotags and barcoding platforms for biomolecules. I found that one chapter in this section, "Biochip Platforms for DNA Diagnostics", contained some nice review material on DNA microarrays that would perhaps have been better served by placing it earlier in the book.

Overall, I would not recommend this book to the novice who is looking to learn the basics of microarrays as they are used in current practice, but it has a considerable amount of useful material for someone who already has a familiarity with the technology and is looking for a broader perspective on applications. It will also be useful to those focused on electrochemical detection and microfluidics in microarrays. Although the specific applications have the potential to become dated quickly, as with any rapidly advancing technology, the thorough reviews, averaging 51 references per chapter, will no doubt be useful for some time to come.

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