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Book Reviews

Methods in Enzymology, Vol. 246: Biochemical Spectroscopy, edited by K. Sauer

Academic Press, San Diego, 1995. 816 pages. $110.00

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Spectroscopic techniques have long been employed as tools for probing the structure and intramolecular interactions of biomolecules. Recent advances in laser technology, x-ray radiation sources, and computationally intensive methodologies have made a wealth of different spectroscopic techniques increasingly accessible. However, this increased accessibility often creates a bewildering array of spectroscopic techniques from which the novice user must choose the best one. Moreover, it is often difficult to determine the efficacy of a given technique for solving a particular biological problem.

This volume attempts to alleviate these dilemmas that face today's biochemist by providing an overview of several different types of spectroscopy as applied to the study of biological macromolecules. Several of the techniques presented are relatively well known and have been reviewed before in previous volumes of the same series. Other techniques, however, are more obscure, and their potential utility is demonstrated in the discussed applications. The scope of the book and the rationale used to decide which spectroscopic techniques to include in this volume are aptly described in the editor's preface and introduction. As stated, a major goal of this volume is to enable an experimentalist who is not a spectroscopist to effectively utilize spectroscopic observables. The volume certainly succeeds on this level. It presents several different spectroscopic methodologies and makes them accessible to an experimentalist who may be considering using a certain technique, but has little to no in depth knowledge of it. Although this volume is primarily geared toward those who are unfamiliar with these spectroscopic techniques, it can be of use to the expert as well. Each chapter contains an extensive reference list, and the volume as a whole, as well as the individual chapters, can serve as a valuable resource for investigating a topic further. Additionally, the volume covers such a broad range of topics that even the most accomplished spectroscopist is unlikely to be an expert in all areas.

The volume consists of four general sections: Ultraviolet/Visible Spectroscopy; Vibrational Spectroscopy; Magnetic Resonance Spectroscopy, X-ray Spectroscopy; and Special Topics. Each of the major sections begins with an introductory chapter that provides an overview of the field, summarizes the benefits and limitations of the different techniques described in the subsequent chapters, and provides the reader with a sense of the state of the field. Whereas these chapters provide an introduction to the topic, they are also useful for directing an experimentalist to the appropriate chapter or chapters for his or her research.

The Vibrational and Magnetic Resonance and X-ray Spectroscopy sections focus on one or two techniques, and each chapter specializes in a particular aspect of this technique. The sections start with the most basic form and work up to more complex applications and experiments, such as time-resolved experiments. These chapters are all quite readable and provide a good orientation to the field and possible biological applications. It should be noted that the Magnetic Resonance Spectroscopy section does not include nuclear magnetic resonance spectroscopy, which is covered in separate volumes of the same series. The magnetic resonance chapters mainly center on electron paramagnetic resonance spectroscopy and double resonance techniques. The chapter on x-ray spectroscopy is limited to x-ray absorption spectroscopy and focuses on the collection and interpretation of near edge and fine structure spectra. Most of the chapters in the vibrational spectroscopy section are devoted to Raman spectroscopy, and the final chapter in the section attempts to summarize the biological applications of infrared (IR) spectroscopy. This is a broad topic to be covered in one chapter and the descriptions of most of the applications are necessarily brief. With the advent of FT-IR and step-scan methodologies, IR spectroscopy is becoming an increasingly powerful tool for investigating biological molecules. An additional chapter on this important area of biochemical spectroscopy would have been appropriate for this volume.

In the case of Ultraviolet/Visible Spectroscopy, a vast and extensive topic, the editor wisely decided to divide this section into three subsections: Absorption and Circular Dichroism; Transient Absorption and Kinetics; and Linear Dichroism and Fluorescence. This section constitutes almost half of the book and each of the subtopics is covered extensively, allowing the inclusion of chapters on magnetic circular dichroism, hole burning spectroscopy, and low temperature spectroscopy. These subsections of the Ultraviolet/Visible Spectroscopy section essentially follow the same format as the Magnetic Resonance and Vibrational Spec-

troscopy sections, and although there is some potential for redundancy, it is kept to a minimum. The Special Topics section, on the other hand, comprises a potpourri of different topics and there is no clear theme tying all of them together. An important chapter in this section is one that discusses using component resolution for spectroscopic analysis. As any spectroscopic experiment that records data as a function of more than one linear variable requires multivariable analysis, this chapter presents an extremely important aspect of spectroscopy. A limitation of this chapter is that it focuses on analysis of fluorescence spectra. Although it is noted that similar analyses could be applied to other techniques, it is unfortunate that other examples are not explicitly given. Additionally, the section on selecting a model and evaluating the number of components required for the analysis could be more detailed; the reader is left with the feeling that empirical judgment is better than any mathematical or statistical tests.

The chapters are written by experts in the field and, in general, they vary in the depth and amount of theory presented. Many of the chapters contain detailed equations, which bring the reader from a more conceptual understanding of the technique to an analytical one. Other chapters, however, focus much more strongly on the application of the technique to demonstrate its potential utility. Of most use to the average reader is that in all of the chapters, the spectroscopic technique is critically evaluated by the authors. Typically, each chapter includes a straightforward discussion of the types of chemical or dynamic processes that can be observed, under what conditions the technique is best used, and the type of information that can be gained from each experiment. Rather than the theoretical approach, this straightforward evaluation of the technique will probably be most appreciated by the audience for whom this volume is primarily intended.

Although it is impossible for a volume of this magnitude to be completely comprehensive, a few new spectroscopic techniques that are already emerging as powerful tools in the study of biological molecules were not included in this volume. These techniques such as vibrational circular dichroism, femtosecond time-resolved infrared spectroscopy, and ultraviolet resonance Raman spectroscopy are alluded to in different chapters. This volume would have benefited from the inclusion of more of these new and emerging methodologies in separate chapters. Although some newer methodologies are covered in the Special Topics section at the end of the volume, a volume of this nature should review more of the new and potentially important techniques for biochemical spectroscopy. Perhaps, an additional section on newer techniques would have fulfilled this need.

Nevertheless, this volume is fairly comprehensive and covers many of the techniques that are commonly used for investigating biological molecules. The chapters are readable and accessible to graduate students and others interested in a particular discipline. It certainly provides an excellent introduction to a variety of topics in spectroscopy with many applications and examples to assist an experimentalist in deciding whether a technique is appropriate or not. Each chapter also includes enough references to make it a good starting point for a more in-depth study. I highly recommend it for all beginning graduate students who plan to use spectroscopy to study biological molecules. This volume is certainly not to be read in a single sitting, rather it will be of most use as a reference book and a valuable resource to be referred to time and again as an experimentalist encounters new and different problems that require solutions involving spectroscopy.

Chaotic Behaviour of Deterministic Dissipative Systems by Miloš Marek and Igor Schreiber

Cambridge University Press, Cambridge, 1995. 367 pages, $39.95

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For scientists and engineers who frequently delve into mathematical descriptions of complex systems, the term chaos has far deeper meaning than its ancient reference to the complete disorder of formless matter and infinite space predating the systematized universe. Careful scientific scrutiny of physical phenomena in more modern times has revealed that there are laws or rules of nature that govern the complicated motions of atoms and molecules and planets and suns. At the end of last century, the famous three-body problem of Poincaré demonstrated that even "simple" astronomical systems trace out trajectories that are unpredictable over time. But it was in the mathematical sciences that the concept of deterministic complexity arising out of structural simplicity matured. By 1975 it was time for a unifying rubric, and Li and Yorke came forth with the term *chaos*. Chaos in this new sense hypothesized that complex dynamical motions that appear random may actually be governed by few and simple deterministic rules.

One goal of Marek and Schreiber in their book (the 1995 paperback reprint of their 1991 edition) is to supply evidence that deterministic chaotic equations of motion provide adequate descriptions of complexities found in physi-