Book Reviews

Comprehensive Cellulose Chemistry. Volume 1. Fundamentals and Analytical Methods. By D. Klemm, B. Philipp, T. Heinze, U. Heinze, and W. Wagenknecht. Wiley: Weinheim, Germany. 1998. 260 pp. $236.25. ISBN 3-527-29413-9.

Cellulose is the most abundant organic material on earth and has been extensively used and studied by mankind. Cellulose chemistry is distinctive and occupies a place of intersection between fields including organic chemistry, polymer chemistry, and physical chemistry. Utilization of cellulose requires manipulation of an existing natural polymer, in contrast to PET and polypropylene, for example, which are formed from synthetic monomers. Thus, the problems of cellulose utilization are distinct and would benefit from a thorough treatment in a modern textbook. The two-volume *Comprehensive Cellulose Chemistry* series is a brave and valuable attempt to cover this broad field. Volume 1 covers the structure and reactivity of cellulose, pertinent analytical methods, and specific procedures (in an appendix) for analysis of cellulose and its derivatives. Volume 2, which is not a subject of this review, contains more comprehensive coverage of cellulose derivatives and their formation. Volume 1 is a valuable and much-needed reference book for both the novice and the practitioner of cellulose chemistry. It falls short of being comprehensive and is, in some areas, overly narrow in its focus. The first language of the authors is not English, and this leads to occasional grammatical awkwardness. Only in a few short passages does this significantly reduce the clarity of the book.

The section on cellulose structure is extensive and is illustrative of the book in that it does a thorough job of covering the key concepts of cellulose structure and the extensive investigations thereof. It is important for the researcher who plans to investigate cellulose utilization or derivatization to have a good understanding of the structure of cellulose, the variation of structure with cellulose source and purity, and the many aspects of cellulose structure which are still uncertain or unknown. This book does an excellent job of illustrating the key issues in cellulose structure and reactivity. There are some disconcerting inconsistencies, such as when the arrangement of cellulose chains in Cellulose II is described correctly as "mostly accepted" to be antiparallel but shown in Figure 2.1.5 as parallel. The subject of the supramolecular structure of cellulose is fascinating, complex, and still very active. This section of Volume 1 does not cover the most recent developments in the field, nor does it cover the older material comprehensively (for example, the work of St. John-Manley is notable by its absence). This section contains introductory chapters on cellulose reactions. These are valuable overviews and cover all of the important classes of derivatives. They do not appear to be intended to be comprehensive, presumably because of the more extensive treatment in Volume 2.

The ensuing chapter on analytical methods and the appendix containing exemplary laboratory analytical procedures are the strength of the book. An excellent overview is presented of methods covering the multiple analytical dimensions of cellulose and its derivatives. These include characterization methods such as molecular weight, IR, and DS, as well as measures of reactivity, pore size, and other properties which are key to cellulose utilization. The presentation of these methods in a single volume rather than scattered over 40 years of literature is a major benefit to the practitioner. The authors clearly understand the principles that underlie the use of each method and the choice of a particular method for a particular purpose. This depth of understanding of analytical methodology is one of the most critical things to learn for both newcomers to the field and veteran practitioners. The coverage in terms of types of analyses is excellent. The shortcomings are similar to those in the rest of the book. Coverage is not comprehensive and seems overly focused on European publications. One excellent example of the strengths and weaknesses of the book is in the area of analysis of cellulose derivatives. The discussion of the types of information needed (distribution of substituents within a monomer unit, along the cellulose chain, and between chains) is insightful and will bring both novice and practitioner up to speed. However, it contains the glaring omission of the extensive work by the group of Gary Gray at the University of Minnesota on determination of substitution pattern around the anhydroglucose ring by his reductive cleavage technique. A similar example can be cited in the area of determination of crystallinity and hemicellulose content of cellulose, particularly from wood pulp. A good description is given of the use of X-ray and solid-state ^{13}C NMR techniques for analysis of these properties. The omission of the fine work of Roger Newman's group in New Zealand on use of ^{13}C NMR to determine cellulose crystallinity, hemicellulose content, and hemicellulose crystallinity is quite surprising and unfortunate.

Despite these shortcomings, this volume and its companion are broad and appropriate in their coverage. For the education of students in the chemistry of cellulose and its derivatives, and for those actively carrying out research in the field, this series should be considered a valuable and much-needed addition to their library.

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Femtosecond Laser Pulses: Principles and Experiments. Edited by C. Rulliere. Springer-Verlag: New York. 1998. $59.95. 305 pp. ISBN 3-540-63663-3.

Not long ago, research groups using the first homemade femtosecond lasers relied on "laser jocks" to advance their research. The training of a laser jock depended on the transfer of information from one laser jock to the next, primarily teaching what works and what does not. In those days, advances published in the literature about these laser sources contained more empirical observations than hard-core principles that one could assimilate and use to improve a laser system. Today, the commercial availability of relatively affordable "turn key" femtosecond lasers and their wide range of application are resulting in increases in the number of users. The extremely wide bandwidth of femtosecond pulses makes it nontrivial to maintain the ultrashort pulse duration from the output of the laser to the point where the experiment occurs. This creates the need for a textbook that serves as a teaching, learning, and reference tool for femtosecond laser research. This book evolved from a series of lectures beginning in 1992 at the Bordeaux University. It was intended as a pedagogical guide to train scientists in the use of femtosecond lasers. Personally, I find it a wonderful resource for any laboratory where femtosecond lasers are used, in that it provides the type of information required for understanding their operation and application.

The book begins with a short chapter on the principles of lasers, followed by four chapters on pulsed laser sources, including one exclusively dedicated to semiconductor lasers. The chapters are well written and relatively short and include a fair amount of useful charts, formulas, and tables. At the end of some of these chapters, the reader can find some practical questions. Answers are provided in most cases so that the reader can understand how to use the information in a practical way. This makes the text ideal for beginning experimenters. More advanced scientists can use the text as a reference that compiles many of the formulas required in the design of new methods and references to their original sources. However, there is some repetition in the three chapters covering the generation of femtosecond laser pulses that could have been avoided.

The chapter dealing with compression, amplification, and tunability introduces these topics but fails to connect them with the formulas given in the previous chapters. Also, this section does not give the user the same level of practical formulas and quantitative information as the other chapters do. Readers will find the chapter on measurement and characterization to be quite useful. It contains tables, formulas, and diagrams that illustrate most of the methods being used to characterize femtosecond laser pulses. Readers may find this chapter to be one of the most useful in the book.

The last three chapters of the book are dedicated to applications. Given the tremendous proliferation of femtosecond lasers in diverse areas of research, it is impossible to review each of the applications individually. Instead, the book covers some of the more conventional methods such as pump−probe and transient grating. The strength of this chapter is that it provides the basic principle of operation and

diagrammatic setup of many of these methods. Additional information is given as useful tricks—valuable experimental parameters that users will want to know when setting up these measurement techniques in their laboratories. The chapter includes four "how to" sections, where the reader is given precise instruction on specific setups.

The chapter on coherent effects in femtosecond spectroscopy gives a very useful introduction based on perturbation theory and Bloch equations. This formulation gives the foundation of many nonlinear optical techniques. Readers should be warned that most femtosecond lasers achieve peak intensities that typically exceed the perturbation limit. This section introduces the excitation of wave packets (coherent superpositions of quantum states). An example is given for an asymmetric semiconductor as well. However, the presentation seems to overlook a very large volume of research on the observation of rotational and vibrational wave packets in molecules in the gas and condensed phases. The final chapter introduces terahertz femtosecond pulses, along with their generation and applications.

In summary, this is a valuable text on the principles and applications of femtosecond laser pulses. In this quickly evolving field, there have been many very useful texts, but progress seems to outpace the rate at which books are published. The book contains few publications after 1996; nevertheless, it is much more readable than a proceedings type of book. Users interested in the very latest technologies will have to rely on scientific literature until the next technical book is written. Readers interested in chemical and biological applications of femtosecond lasers will find the proceedings of the femtochemistry conferences useful. A good source of articles on the latest femtosecond laser techniques is the proceedings of the ultrafast phenomena conferences.

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Drugs: Photochemistry and Photostability. Edited by A. Albini and E. Fasani (Dell' Universita Di Pavia). Royal Society of Chemistry: Cambridge. 1998. viii + 330 pp. ISBN 0-85404-743-3.

This book contains the proceedings of the 2nd International Meeting on Photostability of Drugs, which was held in Pavia, Italy, in September of 1997. The book contains both a preface and review by the editors. In the editor's own words the review is "exemplicative rather than exhaustive", in spite of the summary on the back cover which mistakenly indicates that the review is comprehensive. Appended to the review is the text of the International Conference on Harmonization (ICH) guidelines for drug photostability testing. Following these guidelines are eighteen monographs on various subjects related to photostability. Scientists from universities, industries, and governmental agencies (including the US Food and Drug Administration) author these monographs. The book also includes a 10-page index. The monographs are organized so that photochemistry of various types of drugs (first eleven monographs) precedes photostability of drugs (last seven monographs).

Overall the book covers an important topic that needs to be addressed more thoroughly by academia, industry, and government. The timing for the book is excellent since ICH drug photostability guidelines were implemented in January 1998. In the preface, the editors state that the book "may help to determine...the significance of drug photostability for the pharmaceutical industry and also help serve as a support for phototoxicity studies."

The review article initially outlines different photoreactive functional groups and then gives numerous examples of photoinstability of drugs. The main part of the review is not organized by photoreaction type, but rather by drug function. This organization does not flow well due to the fact that drugs with a certain function don't always have similar structures; therefore, their photoreactivities are often unrelated. A review organized by functional group photoreactivity would be more instructive. If this had been done one could still use the monographs that follow and the index to group drugs by function. There are some structural mistakes in a few of the figures in the review (structures 15, 16, 18, 19, 47—compare to text). The large number of articles published yearly on photoreactivity of organic compounds would make a comprehensive review of this type an enormous task.

The greatest strength of the book lies in the variety and informative nature of the individual monographs, which are presented in a logical manner. The monographs cover photostability of antimalarial, diuretic, and antimycotic drugs; suncreens; leukotriene B4 antagonists; phenothiazines; benzophenones; and coumarins. Not only is the photostability of many compounds discussed, but also their photosensitizing ability. The articles discuss experimental analysis of photoproducts, reproducibility of results, light sources, actinometry, and ideas for photostabilizing drugs. Each of these areas is important to drug regulation and fabrication. However, a few obvious mistakes are present in certain sections which cause one to question the review process for the monographs (i.e.: "coumarin itself does not absorb UV radiation" on page 163—compare to top of page 168 and "the presence of hydroxyl groups enables a secondary metabolite to absorb UV light..." on page 166).

The formatting of the monographs is pleasantly consistent throughout the book. The majority of references are current; however, the few monographs without current references still add to the book by making it more complete.

Overall, I would recommend the book for academicians interested in photophysics and photochemistry and industrial chemists involved in drug development and formulation.

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Handbook of Chlorination and Alternative Disinfectants. Fourth Edition. By George Clifford White. John Wiley & Sons, Inc.: New York, Chichester, Weinheim, Brisbane, Singapore, and Toronto. 1999. xxi + 1569 pp. $195.00. ISBN 0-471-29297-9.

This handbook is a valuable resource for scientists, engineers, managers, and operators working with disinfection processes utilizing chlorination, hypochlorination, chlorine dioxide, ozonation, and ultraviolet irradiation on any size scale: municipal, industrial, or small-scale such as ship-board operations. Extensive detail and generous practical advice is given on nearly all aspects of these disinfectants: their manufacture, their handling and transport, proper emergency response to their spills and accidental releases, their chemistry of production and disinfection, laboratory analysis of residuals, and operating procedures for effective oxidation and sterilization in a variety of applications and for a diversity of source waters. Equipment and design information is also abundant; operating capacities and characteristics of commercially available equipment, as well as design considerations for the manufacture, handling, transport, and use of disinfectants, are provided in great detail. Supplementing this information are numerous national and international case studies, from drinking water and wastewater treatment plants of all capacities to water reuse plants and industrial operations, that demonstrate real-world applications. Moreover, the essential chemistry, microbiology, and physics of disinfection processes are provided at a depth necessary to understand the rationale behind effective design and operating procedures. Finally, each chapter contains an in-depth history detailing the discovery and eventual application of each disinfectant and disinfection procedures, highlighting chemical advances relevant to the disinfectant and the resulting public health impacts.

Reflective of disinfection history, nearly three-fourths of the text discusses disinfection with chlorine and chlorine-based compounds. The first chapter focuses solely on chlorine: the engineering behind its manufacture, its chemical and physical properties, and hazards and precautions for handling chlorine. The next chapter discusses hypochlorination: the chemistry and equipment used in a range of applications. Chapters 3—5 present on-site generation of chlorine, the chemistry of chlorination, and the analytical determination of chlorine residuals, respectively. Chapters 6—9 focus on engineering operation, design aspects, and chlorination concepts such as chlorination of potable water, wastewater, disinfection of wastewater, and the design of chlorine facilities. Chapter 10 presents the rationale, methods, and advantages of dechlorination processes. Operation and maintenance of chlorination and dechlorination equipment is provided in Chapter 11, while numerous aspects of the generation, proper use, and monitoring of chlorine dioxide are provided in Chapter 12. Ozone disinfection is presented in Chapters 13—15. The chemical and physical principles for effective ozone disinfection operating procedures are described, along with a general treatise of advanced oxidation procedures utilizing

ozone. Ozonolysis facility design is presented in Chapter 15. Chapter 16 describes use of the halogens bromine, bromine chloride, and iodine for the disinfection of water, wastewater, cooling water, and swimming pools. As in all previous chapters, the manufacture, equipment, design considerations, operational parameters, and health hazards are presented and supported with case studies. The final chapter covers the use of ultraviolet radiation, alone and in advanced oxidation procedures, discussing the operating aspects and design, as well as presenting commercially available equipment.

As a handbook, this text succeeds in its timeliness, comprehensiveness, and depth. For example, information is presented relating to currently operating water reuse facilities and disinfection issues related to the recent outbreaks of *Giardia* and *Cryptosporidum*, as well as necessary considerations for inactivation of viruses. However, the text is limited in its coverage of disinfection byproducts due to White's opinion, based upon Bruce Ame's studies, that "chlorinated water was not and never could be a carcinogen". Second, the text needs to be reorganized and edited. Its current organization and chapter topics often make it difficult to find all the information related to a topic, because material may be spread out over several chapters. Unfortunately, the material is rarely cross-referenced. This also results in repetition of information; for example, several paragraphs on breakpoint chlorination in the chapter Chemistry of Chlorination are nearly verbatim with a similar section in the chapter Chlorination of Potable Water. Nevertheless, this handbook is a necessary and valuable addition to the bookshelf of any scientist, engineer, or operator working with disinfection processes.

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Natural Products from Plants. By Peter B. Kaufman, Leland J. Cseke, Sara Warber, James A. Duke, and Harry L. Brielmann. CRC Press: Boca Raton, FL, Boston, London, New York, and Washington, D.C. 1999. xi + 343 pp. $129.95. ISBN 0-8493-3134-X.

This volume is an introduction to a broad spectrum of topics related to natural products in plants. Natural products is defined broadly. The range of compounds addressed includes the traditional terpenes, alkaloids, flavonoids, and others, and also proteins, fatty acids, and nucleic acids. The authors state that the book is intended for "biochemists; natural products chemists; molecular biologists; research investigators in industry, federal labs, and universities; physicians, nurses, and nurse practitioners; pre-medical and medical students; ethnobotanists; organic gardeners and farmers; and those interested in herbs and herbal medicine." With such a diverse target audience, it would be expected that the book would cover a wide array of topics from a variety of viewpoints. In this regard, the book delivers.

Each chapter is written by different authors, at least one of whom is also in the list of authors for the book. The chapters each have a clear focus and message. The categorization of natural products, their synthesis, and why the plants make them is the focus of the first three chapters. The use of natural products as drugs and drugs of abuse and the possible mechanisms of action are covered in Chapters 4 and 5. Chapter 6 is a consideration of the different philosophies about whether pure compounds or plant extracts have better action or are more suitable as the preparation administered to the patient. Methods of collection and vouchering of plants and extraction and separation of different classes of natural products are addressed in Chapter 7. Chapter 8 is a collection of case studies which address the applications of different plants and plant natural products to disease, agriculture, fragrances, and dyes, and also includes ethnobotanical information. The final chapter addresses the importance of the conservation of plant resources and the sustained maintenance of diverse populations in natural environments. The book concludes with an appendix which addresses how to begin to ask appropriate questions about plant natural products and how to find information about plant natural products from books, people, databases, and the Internet. The references to each chapter are current, with a large number from the 1990s, although relatively few are post-1996.

One of the more interesting aspects of the book is the use of case studies. In addition to those presented in Chapter 8, several other chapters also contain one or more case studies which address the focus topic. These seem to be written, for the most part, by one or more undergraduate students as essays, term papers, or project reports. These are mostly informative and interesting. However, one describes a self-administration trial of an herbal drug which is uncontrolled and lacks definable outcome criteria. The author does not explain that this is the kind of "trial" which is usually to be avoided and which often does more harm than good to the case for efficacy of a particular herbal preparation. In another case study, on the assay of lavender essential oils, no real results were obtained. This case has more to say about the foibles and vicissitudes of undergraduate research than about the analysis of volatile oils.

The book would have benefitted from more careful editing. In the majority of cases, concepts and terms are explained so they may be understood by all of the intended audiences. However, this is not always the case, particularly in the first chapter. Concepts and terms such as *sp* orbital hybridization, *cis*−*trans* isomerism, tomentose, the Spodoptera, and FID are left undefined. This would be fine for some of the likely readers but would be much more difficult for those who have forgotten, or never took, undergraduate chemistry, plant morphology, and entomology. There are several spelling errors in the book. Some of these are obvious in the intent, while others could lead a reader to a frustrating search for a species which does not exist. The editors could also have tied the chapters more closely together through references to relevant information in other chapters. For example, there is no cross-referencing of the various treatments of *Azadirachta* and no use of some of the abbreviations defined (such as for the sugars), and the terpenes were redefined in Chapter 8 even though they had been thoroughly covered in Chapters 1 and 2.

On the whole, the book is an interesting and wide-ranging introduction to a topic of increasing interest to a large audience. It could be improved by more careful editing and, perhaps, also a glossary of terms. The book fulfills the goal of making the information available to an audience from a wide range of disciplines. Unfortunately, the price of the book will probably prevent purchase by all except institutional libraries and the most committed lay and professional enthusiasts. Except for the price (which makes it prohibitive), the book would make a useful and interesting supplemental or primary text for courses in pharmacognosy, natural products chemistry, or herbal medicine.

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Advances in Molecular Similarity, Vol. 2. Edited by Ramon Carbó-Dorca (University of Girona) and Paul G. Mezey (University of Saskatchewan). JAI Press: Stamford, CT and London. 1998. xii + 297 pp. $112.50. ISBN 0-7623-0258-5.

The chapters in Volume 2 of *Advances in Molecular Similarity* are based on topics presented at the Third Girona Symposium on Molecular Similarity that was held in conjunction with the Seventh International Conference on Mathematical Chemistry. Both meetings were held in May 1997. The 15 chapters present quantum similarity indices, pattern recognition techniques, density functions, molecular shape analysis and topology, and structural invariants. While the emphasis will vary among the chapters, the book covers both theory and applications, the latter ranging from the perennial drug design and toxicological risk assessment topics to the newer molecular engineering for nanotechnology.

Having stated the above, it must be mentioned that many of the chapters are very mathematical, with little carryover to the application of a particular similarity technique to an actual problem. Two application chapters include use of topological fragment spectra to analyze 42 psychotropic agents and a variety of indices that allow "browsing" a data set of artificial sweeteners. A different use of similarity indices composed of structure and reaction descriptors is described in the chapter titled Similarity in Organic Synthesis Design.

Many similarity analyses require some type of statistical evaluation or measurement. Thus, one of the chapters compares principal component analysis with *K*-nearest neighbor estimation using topological indices. Two chapters describe how neural networks can be used in a similarity analysis. One of the latter chapters compares least-squares multiple regression with neural networks.

One can consider Volume 2 a continuation of or sequel to the initial

volume in *Advances in Molecular Similarity*. Anyone interested in this technique should start with Volume 1. The chapters in Volume 2 tend to vary in depth. Some seem to be expanded abstracts of the talk given at the Girona Symposium, and others are very complete. There is a good index, and the chapters generally are well-referenced. With computer power at the desktop increasing as the cost decreases, it has become easier for the chemist to carry out similarity analysis using a variety of computational techniques. Chemists interested in this technique should purchase the *Advances in Molecular Similarity* series including Volume 2.

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Introduction to Bioanalytical Sensors. By Alice J. Cunningham. Techniques in Analytical Chemistry Series. John Wiley & Sons: New York, NY. 1998. 418 pp. $69.95 (hard cover). ISBN 0-471-11861-3.

Dr. Alice J. Cunningham has given us a new book on biosensors. It comes just in time to fill an important niche within the academic dimension of the quite prolific biosensor publications field. Biosensors are based on direct coupling of a biologically active component with a signal transducer and an electronics amplifier. They use biological systems at different levels of integration to specifically recognize the target to be determined. The book provides an introduction to the interdisciplinary field of biosensors as analytical devices and aims to serve as a self-guidance textbook for newcomers to the emerging field of biosensor technology. One should agree with Dr. Cunningham that, in a "cross-disciplinary field such as bioanalytical sensors, it is tempting to produce one more treatise to add to the tomes which already exist". The author consciously avoids slipping into the gap of providing us with the next cumulative volume of self-overweighing chapters written by the prominent leaders in the research and combined together by a preface-writing editor. She is giving us, instead, a monograph-style, self-standing, and quite comprehensive text with a defined instructional value. The past 12 years witnessed the birth of the specialized biosensor books. Most of these books are collective volumes of dedicated chapters. It was onset by *Biosensors: Fundamentals and Applications* (Turner, A. P. F., Karube, I., Wilson, G., Eds.; Oxford University Press: Oxford, 1987) and was carried out later by many of the book series (GBF Monograph Series on Biotechnology and ACS Symposium Series, for example). In addition to these, biosensors have a series of their own (*Advances in Biosensors*; Turner, A. P. F., Ed.; JAI Press: London) and do take a significant part in the some other series devoted to sensor technology or the chemical sensors. A comprehensive new addition to this line of books is *Handbook of Biosensors and Electronic Noses: Medicine, Food and Environment* (Kress-Rogers, E., Ed.; CRC Press: Boca Raton, FL, 1996). There are several monographs, such as *Biosensors*, by F. Scheller and F. Schubert (Elsevier: Amsterdam, 1992) and the book by the same name by E. A. H. Hall (Open University Press: Buckingham, 1990). As one can see, these two monographs are approximately the same age, and regardless of their exceptional qualities, the technical progress in the field has made them look archaic. In the context of providing a single, accumulated, and comprehensive point of view on the field, *Introduction to Bioanalytical Sensors* by A. J. Cunningham comes to stand on this side of the biosensors library shelf. There is a clear indication for this kind of continuity of the effort, expressed by the fact that the original research publications cited individually in Cunningham's book are collected over the 1990s only, while the previous art has been re-cited through those two previous monographs and various review articles. *Introduction to Bioanalytical Sensors*, indeed, makes every effort not to follow the classic examples in its structure. While the older books represent the field being more closely associated with the technological divisions of it, Cunningham makes an attempt to view the biosensors mosaic while trying to cross the lines and cut through the surface of the historically laid sediments of routine.

Alice Cunningham is a recognized chemical educator, who held a long tenure in a liberal arts academic environment, indeed with an evident interest in bioanalytical methodologies. She wrote a very good book on biosensors without being among the major technical contributors to this field. One should think of this and appreciate it as an indication of the fact that the field of biosensors grew old enough to offer itself for overwriting to the viewers and educators. Dr. Cunningham's educational methodological experience is her most precious contribution to our field, and we should be thankful to her for all her effort.

Now we have an instructional text suitable for our courses, which can be successfully used, especially when combined with *Handbook of Biosensors and Electronic Noses*. Combination of these two books comes to compensate some of the weaknesses of *Introduction to Bioanalytical Sensors*. The book provides a quite comprehensive analytical chemistry approach to the field, defining the areas of application and the major techniques, and gives a solid explanation of the analytical figures of merit (low limits of detection, sensitivity, range of operation, etc.) which are still being misused by many. Biotechnology fundamentals of biosensors such as immobilization of the receptor component, including the methods of immobilization, are well presented and illustrated. Immobilization effects in biosensors are discussed in detail, along with the characterization of immobilized enzymes in biosensors. One can expect some more information to be provided on the structure and catalytic action of enzymes, affinity and molecular recognition, and structure of immunoglobulins, but this, indeed, can be found elsewhere.

Technological fundamentals such as structure and function of main types of transducers—electrochemical, thermometric devices, spectrometric and optical sensors, and microgravimetric biosensors—are well addressed. It is surprising, however, to find the thermal transducers combined with the acoustic wave devices in a common chapter. Some of the issues related to biosensor technology, such as interactions between the synthetic and biological interfaces, specific vs nonspecific interactions, protein adsorption, biofilms, and biocompatibility, are addressed in various parts of the text. Engineering approaches for biosensor applications in devices and systems are very generally viewed. Array-based sensors, artificial electronic noses, and signal processing methodologies are practically left behind this book's scope. One of the major under-represented engineering components in this book is that of micro-total analytical systems, micro-fluidics, and other microfabrication avenues for biosensor design and construction. While the application of biosensors has been reviewed well, especially in clinical chemistry, process control, and environmental monitoring, a list of the commercially available (or at least most popular) biosensing devices cannot be found in this book.

The aspects of biosensors fabrication technologies are not covered by the text. The issues of design of the laboratory prototype, miniaturization of biosensors, and engineering concepts for mass production are not separately discussed. The book on biosensors manufacturing technologies, which will address the concepts of conjugation of biotechnology and microelectronics, will describe the currently dominating screen printing technology for thick-film biosensors and ink-jet dispersing of the biological layer, and will elaborate on the microfabrication of thin-film biosensors including the micromashining and microfluidics in biosensors, is not written yet.

One of the serious services which this book does for the scientific community is the collection of biosensor bibliography through the 1990s. Indexing and presentation of some of the major topics of cited papers in special tables is more than useful. While some authors are not necessarily cited with their most contributing articles, the picture presented is broad and, in general, adequate.

In conclusion, this is a good book, and this reviewer has already recommended it to his university's library and included it as required text for the graduate students in the biosensor class to be taught during the 1999 fall semester.

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