Book Review

Bioactive Conformation I Edited by T. Peters (University of Lübeck, Germany). From the series: Topics in Current Chemistry, 272. Springer: Berlin, Heidelberg, New York. 2007. xii + 310 pp. $299.00. ISBN 978-3-540-49077-7.

T. B. Grindley

J. Am. Chem. Soc., **2008**, 130 (2), 776-776 • DOI: 10.1021/ja076948b

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BOOK REVIEWS

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Identifying the shape of a substrate either bound to the active site of an enzyme or other receptor or organized in solution into the best arrangement for binding to that receptor is key to finding compounds that can influence the process initiated by the formation of the receptor−substrate complex. Often these compounds are leads to potential new drugs. This book is the first of two designed to explore methods for identifying these molecular shapes, i.e., the bioactive conformations, and to review progress toward the goal of finding compounds that bind to particular proteins. New methods for identifying and analyzing bioactive conformations by NMR spectroscopy that were initially developed in the 1990s as well as by improvements in NMR instrumentation have led to rapid advances in this area over the past decade. Thus, this is a very opportune time for the appearance of these two books.

Bioactive Conformation I contains eight chapters on quite different topics within the theme of the series. The initial chapter, the longest in the book, is a description of methods for identification of bioactive conformations of integrin ligands—initially peptides—using "spatial screening" that involves different stepwise replacement procedures. Kessler, the senior author of this chapter, played an important role in developing these procedures. The authors then address how knowledge of the bioactive conformations can be used to develop peptidomimetics. In the next chapter, Homans outlines why dynamics and solvation make the prediction of binding affinity of ligands for proteins based on structure difficult and describes the methods currently available to solve this problem. Progress in understanding the signaling process that involves the fibroblast growth factor (FGF) and the FGF receptor and co-receptor heparin is summarized in Chapter 3, and Reif and Narayanan use two examples to illustrate how solution-state NMR spectroscopy can be used to study interactions between misfolding proteins and molecular chaperones at atomic resolution in Chapter 4. This is followed by a chapter by Fischer and Geyer who describe the determination of the conformations and dynamics of the cryoprotective sugars, oligo(1→2)-α-D-glucopyranosyl-(1→2)-β-D-fructopyranosides, by a variety of NMR and other methods and their interactions with phospholipids. Koenig then provides a concise introduction to the use of residual and transferred dipolar couplings from high-resolution liquid-state NMR spectra of compounds undergoing slightly anisotropic tumbling for the determination of protein structure and relative orientation. Their application in determining the active conformation of rhodosin-bound protein fragments is also described. In the next chapter, Schuman et al. give a nice summary of glycosyltransferase structure and function, which is connected to the theme of the series through the close relationship of three-dimensional structure determined by X-ray crystallography to reaction stereoselectivity. The final chapter by Laplante is a discussion of multidisciplinary strategies to improve antiviral inhibitors of the human cytomegalovirus and the hepatitis C virus that focus on the conformations of the inhibitors and their fit to the viral enzymes.

This book provides state-of-the-art descriptions of a number of different topics falling within the theme of the series. It contains very few typographical errors. Along with its companion volume, *Bioactive Conformation II*, it will be essential reading for any researcher working in any area that involves binding of a substrate to a protein. However, the cost will preclude personal ownership for most readers.

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JA076948B

10.1021/ja076948b

Modern Aspects of Electrochemistry, No. 41. Edited by Constantinos Vayenas (University of Patras, Greece), Ralph E. White (University of South Carolina), and Maria E. Gamboa-Adelco (Superior, CO). Springer Science + Business Media, LLC: New York. 2007. xii + 308 pp. $139.00. ISBN 978-0-387-46107-6.

The 41st volume in this series covers a range of topics that touch on issues of potential interest to those working in electrochemistry-related fields. Specialists may also find particular value in several of the chapters. Although each chapter focuses on a rather specialized subject that does not directly relate to others in the book, all feature topics of interest, some of which are covered at significant depth.

Chapter 1 by Maier is the second in a detailed, two-part installment concerning solid-state electrochemistry (Part 1 is in Volume 38). The first part dealt with fundamentals of solid-state electrochemistry, whereas this one focuses on solid-state electrochemical cells and devices. The chapter begins with an overview of electrochemical cells designed for applications as either sensors or as devices for energy conversion/storage. Details of various sensors, including a thorough theoretical analysis of their function, are provided. In addition, a very clear treatment of energy conversion/storage devices is provided, with a focus on solid-oxide fuel cells, lithium-ion batteries, supercapacitors, and photovoltaic cells. The latter portion of the chapter covers methods for measuring and analyzing the properties of solid-state electrochemical devices, with an emphasis on using impedance techniques to evaluate the behavior of complete cells to measure materials properties, such as ionic versus electronic conductivity, to determine rate coefficients, and to analyze inhomogeneities. For those interested in solid-state electrolytes and complete electrochemical cells, this chapter contains a wealth of detailed and useful information.

10.1021/ja076948b CCC: $40.75

Although it is not written broadly enough to serve as a general overview of this area, this chapter would be quite valuable as a reference manual for those doing experimental work in solid-state electrochemistry.

In the second chapter, Lee and Pyun provide a brief review of the synthesis and characterization of nanoporous carbons and their application in supercapacitors or, more precisely, electrochemical double-layer capacitors that rely on double-layer charging rather than redox chemistry to produce large capacitances. Although the treatment has a somewhat limited scope, the subject of this chapter is quite timely and the authors do an adequate job of providing a clear and logical description of the methods of preparation and analysis of nanoporous carbon electrode materials. The chapter ends with a review of the electrochemical analysis of high surface area electrodes via impedance, cyclic voltammetry, and current transient methods.

Chapter 3 by Fehribach provides a very brief description of the use of reaction graphs in the study of electrochemical reaction networks. This subject is similar to reaction pathway analysis used in reaction engineering to help simplify systems involving multiple reactions. Several examples of reaction graphs are provided to illustrate this method for systems ranging from the formation of passive films on iron to reaction mechanism graphs associated with fuel cell reactions. Unfortunately, the chapter is sufficiently brief that it is difficult to assess the importance of this method to the broader electrochemistry community.

In the fourth and final chapter, Scott and Sun provide a detailed overview of methods for mathematical modeling of three-dimensional electrodes, with a focus on the development of approximate analytical solutions. In particular, the authors illustrate how the Adomain Decomposition Method (ADM) can be used to solve a variety of electrochemical problems with an accuracy that rivals that of the complete numerical solution but is quicker and in some ways easier to implement. In this technique, an approximate series solution is generated by decomposition of the original differential equations, and notably, both linear and nonlinear problems can be treated. A variety of example solutions are provided with comparisons to the complete numerical solution. Examples include simple non-electrochemical reactions in trivial geometries as well as electrochemical reaction/diffusion problems in porous electrodes and packed bed electrodes. Each example is treated in sufficient detail that the reader can follow the progression of the model development. A detailed appendix is also included in which the development of the method is thoroughly described, which would be of use to those trying to implement ADM. This chapter should be of value to those interested in modeling of electrochemical phenomena.

Overall, this text contains a diverse collection of topics that would be of varying degrees of interest to the broader electrochemistry community. More likely, the individual chapters would be most valued by specialists working in these areas.

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JA0769752

10.1021/ja0769752

Nanobiotechnology II: More Concepts and Applications. Edited by Chad A. Mirkin (Northwestern University) and Christof M. Niemeyer (University of Dortmund). Wiley-VCH Verlag GmbH & Co. KGaA: Weinheim. 2007. xxvi + 432 pp. $190. ISBN 978-3-527-31673-1.

Over the past 100 years, technological advancements have revolutionized the practice of medicine and drastically improved quality of life. As we proceed in the 21st century, technology is becoming progressively controlled at the molecular level. Molecular understanding is driving the next generation of commercial diagnostic and therapeutic devices. The application of micro-/nanodevices for biological and medical applications is leading to fundamental insights about the behavior and function of tissues, intra- and intercellular communication, forces and flows and the effects on individual cells, and the structure, function, and behavior of proteins, DNA, and other biological molecules. The visualization and manipulation at the molecular level has enormous potential for affecting diagnostic and therapeutic practices leading to enhanced patient prognosis. Therefore, micro- and nanotechnologies are expected to lead to the unparalleled progress of medical science and technology and to countless technological innovations in medicine.

Application of nanoscale science and engineering to create novel materials and devices for diagnostics and therapeutics will profoundly impact the practice of medicine. This volume is the second in a series addressing important aspects of nanobiotechnology. The emerging field of nanomedicine, where nanoscale science and technology are sculpting future innovations in medicine, is reviewed, and the enormous potential of the field is outlined. Nanobiotechnology addresses the value of the microscale technologies and the right size for a feature or device. The scales encountered in biology, medicine, and biotechnology range from the micro- to nanometer, and developments will continue to progress and expand on both levels. Here, the focus is not only on recent developments toward nanoscale technologies but also on exciting and novel technologies that are not strictly nanoscale in dimensionality.

The development of fabrication processes capable of manipulation at the micro- and nanoscale, such as UV, electron-beam, and ion-beam lithography, nanoimprint lithography, microcontact printing, and dip-pen nanolithography, has enabled the creation of novel devices. In addition, self-assembly has been demonstrated to be a powerful method for creating well-defined nanostructures. At the same time, visualization with submicron resolution has been essential in the implementation and utilization of these fabrication techniques. The development of nanoscale visualization techniques, such as scanning tunneling microscopy and atomic force microscopy, has facilitated manipulating and imaging at the atomic level. In recent years, micro- and nanoscale fabrication techniques have been utilized to construct microarrays, microfluidic devices, micro total analysis systems (i.e., lab-on-a-chip), and other micro-/nanodevices. The book reviewed here contains numerous relevant chapters that address important aspects of nanobiotechnology. Written by some of the leading authorities of the field, it includes chapters on biosensors, semiconductor quantum dots, cantilever array sensors, nanowire and nanotube sensors, bionanoarrays, etc.

The emergence of micro- and nanoscale science and engineering has also provided new avenues for engineering materials with macromolecular and even molecular scale precision, leading to diagnostic and therapeutic technologies that will revolutionize the way health care is administered. Biomaterials have evolved from off-the-shelf products to materials that have been designed with molecular precision to exhibit the desired properties for a specific application, often mimicking biological systems. Thus, controlling interactions at the level of natural building blocks, from proteins to cells, facilitates the novel exploration, manipulation, and application of living systems and biological phenomena. The chapters in this book cover a number of applications that require such advanced biomaterials and delivery systems. Nano- and microarrays have been established as the preferred method for carrying out genetic and other biological, e.g., drug discovery, analysis on a massive scale. Natural and synthetic nanopores of tailored dimensions are probing, characterizing, and sequencing biological macromolecules and have demonstrated the possibility to analyze the structure of individual macromolecules faster and cheaper. Self-assembly is being applied to create new biomaterials with well-ordered structures at the nanoscale such as nanofiber peptide and protein scaffolds. All these systems are discussed expertly in this book. Additionally, nanoscale science and engineering have accelerated the development of novel drug delivery systems and led to enhanced control over how a given pharmaceutical is administered, helping transform biological potential into medical reality. The advantages of drug delivery microdevices include simple release mechanisms, very accurate dosing, the ability to have complex release patterns, potential for local delivery, and possible biological drug stability enhancement by storing in a microvolume that can be precisely controlled. These topics are also thoroughly covered here.

The authors have edited this volume extremely well. There is an inherent balance of subjects and a careful selection of important and recent publications in the bibliography. In general, I highly recommend this book for those interested in the principles and applications of nanobiotechnology.

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JA076961W

10.1021/ja076961w