Book Reviews

Chemistry and Physics of Carbon. Volume 27. Edited by Ljubisa R. Radovic (Pennsylvania State University). Marcel Dekker: New York, Basel. 2001. xviii + 416 pp. $225.00. ISBN 0-8247-0246-8.

This volume is the latest addition to the *Chemistry and Physics of Carbon* series, which has become the definitive source for critically reviewed scientific information on carbon materials. Volume 27 presents reviews from separate author teams on four distinct aspects of carbon science and technology while highlighting carbon *surface* phenomena as a strong unifying theme. This most recent volume upholds the standards of the series with respect to clarity, coverage, and appropriate and timely literature citation.

Chapter 1 is a summary of environmental applications of carbon materials in processes ranging from water treatment to methane storage for advanced vehicles. The article catalogues established commercial products as well as ongoing development projects with an abundance of references and attractive graphical material. Chapter 1 differs from most other contributions in the volume set in that it focuses on the technological applications rather than on the basic science, and it emphasizes coverage rather than in-depth description. It is precisely this approach that gives the chapter its fresh appeal—its discussion and references provide entry points into the development literature for each product class. The chapter will be of special value as introductory material for students and others new to the field.

Chapter 2 covers the use of ^{1}H NMR as a powerful tool for understanding the fundamental nature of the adsorbed state. The chapter is not a primer on NMR techniques for carbon scientists, but rather is a compilation of experimental results, arranged by carbon type, that illustrate the unique ability of ^{1}H NMR to probe the physical state, bonding, and orientation of adsorbed molecules. Chapter 3 is focused on the carbon/electrolyte interface, which plays an important role in applications ranging from batteries to capacitors to heavy metal sorbents. The article does not systematically review these relevant applications, but rather, it focuses on the fundamental nature of the interface and includes a special presentation of cyclic voltammetry as a rich characterization tool. This article also includes a well-written concise review of the oxide functionalities on carbon surfaces that allow application-specific tailoring of adsorptive properties.

Chapter 4 is a particularly thorough treatment of aqueous-phase adsorption, a old topic with a new urgency that is driven by ever-stricter environmental regulations. This chapter contains a meticulous review of relevant literature and the many attempts to synthesize critical conclusions regarding the complex adsorption mechanisms. The chapter includes a lengthy citation case study on competing theories of aromatic adsorption that is presented as an exhaustive chronological review, which is interesting both for its insight into mechanism and its use as a window into the scientific process in general.

Overall, the volume is best seen as an essential addition to the celebrated 27-volume set, although it could also be an important stand-alone reference work for chemists, physicists, or materials engineers with particular interests in carbon surface phenomena or environmental applications.

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Templated Organic Synthesis. Edited by F. Diederich (ETH-Zürich) and P. J. Stang (University of Utah). Wiley-VCH: Weinheim. 2000. xx + 410 pp. $170.00. ISBN: 3-527-29666-2.

Biological systems make extensive use of template-directed synthesis. The most obvious examples are nucleic acid and protein synthesis, in which the residue sequence of a template polymer controls the residue sequence of a product polymer. These processes are astonishing. Chemists are very far from being able to synthesize large heteropolymers of irregular but defined sequence in monodisperse form with high efficiency. Other modes of template-directed synthesis are found in biology as well. Biosynthesis of polyketides and nonribosomal peptides, for example, is carried out by large multienzyme complexes in which the spatial order of the synthetic modules controls the covalent structure of the product. Although chemists can synthesize polyketides and short peptides, chemical routes are generally cumbersome relative to biosynthetic processes.

The remarkable power of template-directed synthesis in biology has inspired chemists to explore template-directed synthesis in other contexts. The volume edited by Diederich and Stang can be viewed as a progress report on the chemical community's effort to implement template-directed synthesis in various systems. This book contains quite a bit of fascinating chemistry, but perhaps the most important message is how very much remains unaccomplished in this important area.

The collection of chapters, each from a different author, is eclectic. Chapter 1 (S. and H. L. Anderson) focuses on definitions and analytical approaches. The authors illustrate their points with a range of chemical examples, some of which are discussed in greater detail in subsequent chapters. The introductory chapter summarizes effectively and succinctly the activities of organic chemists in template-directed synthesis, but the reader's perspective would have been enhanced by more extensive discussion of biosynthetic examples, either in this chapter or in an additional chapter.

Chapter 2 (G. Wulff) covers the very important field of molecularly imprinted materials. The author is a pioneer in this area, but unfortunately the chapter is not well-written. This chapter reads more like a catalog of observations and accomplishments than an explanation of fundamental issues; in a volume aimed at a broad readership, the latter approach is preferable. Clarity would have been improved by greater use of chemical structures.

F. M. Raymo and J. F. Stoddart in Chapter 3 discuss templated synthesis of catenanes and rotaxanes. This chapter illustrates the power of well-chosen structural graphics. The authors show how several groups have achieved impressive preparative mastery over catenanes and rotaxanes. It would have been helpful, however, to learn why these molecular assemblies are worth so much synthetic effort.

The focus of Chapter 4 (D. Makeiff and J. C. Sherman) is on container molecules ("careplexes, hemicarceplexes, and capsules"). The authors survey efforts from several of the laboratories most active in this field, including those of Cram, Rebek, and Sherman himself.

In Chapter 5 Y. Gat and D. G. Lynn deal with the challenge of template-directed heteropolymer synthesis. Only one aspect of this challenge, ligation of preformed oligomers, is covered in detail, but the authors provide enough general discussion to give readers a glimpse of a potentially vast and productive area for future research. Much of the material that is summarized involves nucleotides and nucleotide analogues, reflecting the current state of the field, but the authors cover peptidic systems as well. The organization of this chapter is a little idiosyncratic. For example, a very brief summary of pioneering work from Ghadiri et al. on α-helical peptide ligation appears at the end of section 5.5, whereas in the preceding section, the authors offer a detailed discussion of amyloid formation and their hypothesis that such aggregates might be templates for peptide ligation. Toward the end of the chapter, the authors provide intriguing speculations on global structural differences between proteins and RNA and how these differences might affect their roles as templates.

Chapter 6 (R. Breslow) is a summary of several decades of work from the author's laboratory on template-directed functionalization of steroids and other organic structures. This chapter is well worth reading, because Breslow is a pioneer of biomimetic chemistry (a field he named), and because he has devoted so much attention to the chemistry described here. All but 4 of the 124 references are papers from the author's laboratory, which perhaps does a disservice to this work by neglecting to show how Breslow's accomplishments have influenced research in other laboratories.

In Chapter 7, F. Diederich and R. Kessinger describe the very clever strategies that have been developed for regio- and stereoselective multiple functionalization of fullerenes. The drawings are outstanding and allow the reader to apprehend the major points by skimming. The authors explain clearly and convincingly why multiply functionalized fullerenes are worthy targets.

Chapter 8 (K. S. Feldman, N. A. Porter, and J. R. Allen) brings together authors who have pursued creative and complementary

approaches to a difficult common goal: length control of acrylate free radical oligomerization. Porter et al. employed relatively flexible tethers to connect acryloyl units prior to oligomerization. These workers showed that use of a rigid chiral heterocycle as the attachment site for the acryolyl units leads to control of oligomer tacticity as well as oligomer length. Feldman et al., on the other hand, used cleverly designed rigid templates to hold radical initiator and terminator groups apart by a defined distance. The intent in this case is that simple monomers add from solution to the initiated chain until the chain is long enough to reach the intramolecular terminator. This chapter is well written and logically organized.

The final two chapters offer perspectives from the natural product total synthesis community. These two segments are very nicely complementary. Chapter 9 (A. Fürstner) provides a succinct and very cerebral discussion of metal-based templation in macrocyclization reactions. The author lays out principles for determining whether a metal-promoted cyclization is templated and then carefully takes the reader through several well-chosen examples that illustrate the application of these principles. Chapter 10 (L. R. Cox and S. V. Ley) covers temporary tethering in natural product synthesis. This very extensive chapter, which represents one-quarter of the entire volume, is remarkable in that not one of the 169 references comes from the authors' laboratories. The authors provide an extensive and systematic survey of the temporary linker strategy. They do a good job of linking methodological studies with applications in total synthesis. A review of this magnitude could easily subside into a bewildering collection of examples, but the authors maintain control of their subject to the end, taking pains to explain underlying concepts and provide enlightening connections between sections.

Templated Organic Synthesis should find its way into every chemistry/science library. Young researchers looking for large fertile plots among the well-worked fields of organic chemistry (and more-established investigators seeking new directions) will want to peruse this volume to gain a quick sense of the current state-of-the-art in template-controlled reactions. This book would have been even more useful had it included a chapter surveying template-controlled biosynthesis, the gold standard of template-controlled synthesis. Most chemists, however, will know enough about nucleic acid and protein synthesis to recognize that all of the creative research summarized in this volume is rudimentary when held against this standard. Template-directed synthesis is likely to be a growing field. As Gat and Lynn write at the end of their chapter, "we are currently limited only by our structural imagination and synthetic capability."

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Supramolecular Organometallic Chemistry. By Ionel Haiduc (Universitatea Babes-Bolyai, Roumania) and Frank T. Edelmann (Universität Magdeburg, Germany). Wiley-VCH: Weinheim. 1999. xiv + 472. $165.00. ISBN 3-527-29533-X.

Supramolecular chemistry represents one of those areas of chemistry that involve combining many subdisciplines of science. Although many aspects of this field are well-developed (e.g., guest−host chemistry of cryptands and carcerands), others, such as the use of organometallic species in the construction of supramolecular assemblies, are still in their infancy. The authors of this book attempt to provide a broad and somewhat comprehensive perspective on the supramolecular chemistry of organometallic compounds. It works well as an introduction to the role that organometallic species may play in the building of supramolecular architectures.

The book appropriately begins with an introduction to the principles and terminology used in supramolecular chemistry. Within this introductory chapter, the authors discuss the fundamental intermolecular interactions that form the foundation of supramolecular chemistry and serve as a springboard for the later chapters. The second chapter presents a relatively broad overview of guest−host interactions of organometallic species. The chapter provides several elegant examples of organometallic macrocycles that bind cations as well as anions. Metallocene-functionalized macrocycles and calixerenes are discussed here, as well. In this chapter, the incorporation of organometallic guests into zeolites and other mesoporous solids are also briefly addressed. Unfortunately the guest−host chapter omits the relatively recent work of R. H. Fish on the development of rhodium cyclopentadienyl clusters that serve as supramolecular hosts for a variety of biologically relevant substrates. This omission is symptomatic of the emphasis that the authors have placed on main-group organometallic species (vide infra).

The remaining chapters of the book are focused on supramolecular assemblies and extended structures of organometallic subunits and represent the majority of the book. The subject matter is conveniently organized with respect to the predominant intermolecular force (dative bonding, secondary bonds, hydrogen bonds, ionic interactions, and π interactions) that holds the organometallic subunits together. Each chapter is further subdivided into sections according to the type of metal. This arrangement allows the reader to focus quickly on types of intermolecular interactions that may be of particular interest. It is interesting to note that with the exception of the supramolecular assemblies supported by π-interactions, the primary function of the carbon-bonded fragment in many of the systems described is ancillary. The intermolecular interactions holding the metal subunits together are the same as those that link most traditional inorganic supramolecular structures. In this regard, the differentiation of organometallic species from traditional inorganic species is somewhat artificial. Another worthwhile point is that with the exception of the chapters on hydrogen-bonded assemblies, most of the structures presented were not deliberately prepared in the context of supramolecular self-assembly. This speaks directly to the potential for explosive growth in this field as researchers begin to focus on deliberately using organometallic motifs in the construction of supramolecular assemblies.

Although the title of the book suggests a broad and comprehensive discussion of supramolecular organometallic chemistry, the major emphasis of the book is clearly on main-group organometallic species. The sections involving the supramolecular self-assembly of group 12−15 metals are fully developed with a good mixture of new and old references. There are also several sections focusing on self-assembly of organoselenium and organotellurium complexes. Even though they are not normally classified as organometallic species, clusters of alkali and alkaline earth hydrocarbyls, amides, and alkoxides dominate the chapter devoted to ionic interactions. By comparison, there are only limited references to the supramolecular chemistry of classical transition-metal organometallic species. Although the authors admit in the preface that the volume fails to cover many examples from transition-metal chemistry, the title belies this admission. Those readers expecting information regarding transition-metal complexes will surely be disappointed by the lack of coverage devoted to this major component of organometallic chemistry. If the book's objective, as suggested by the title, was to provide a broad overview of supramolecular organometallic chemistry, it has fallen short. While in-depth coverage of every topic of organometallics is unrealistic in a volume this size, an emphasis on recent and deliberate efforts to use organometallic complexes as building blocks in the design of supramolecular assemblies could have brought the authors closer to this goal. Instead, the authors have chosen to give a well-detailed look at the supramolecular behavior of a subsection of organometallic chemistry.

That being said, the book does do a fine job of cataloguing the various types of assemblies that main group organometallic species may form. Figures and drawings are both plentiful and appropriately placed. Although ultimately limited in focus, the book succeeds in introducing the traditional organic-based supramolecular chemist to a wide arsenal of new structural building blocks and interactions that can be used to develop the next generation of supramolecular assemblies.

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Computational Chemistry: A Practical Guide for Applying Techniques to Real World Problems. By David Young (Cytoclonal Pharmaceutics Inc.). Wiley-Interscience: New York. 2001. xxvi + 382 pp. $69.95. ISBN: 0-471-33368-9.

If you are new to the field of computational chemistry or if you are a student interested in learning more about the topic in a very broad sense, this book will be of great use to you. It contains practical, hard-

to-find information on programs and methodologies. The objective here is not to explain theoretical details but to inform the reader about what is feasible in terms of the applicability of computational models. The content grew out of Web pages that offered support for those using molecular modeling programs in chemistry. Annotated bibliographies at the end of each chapter are very complete; these should be extremely useful to someone needing references to the primary literature for more theoretical background on the topics discussed.

The book is not a tutorial, and there are very few specific examples. Instead, the data tables and figures are chosen to offer the reader a generalized view of computational chemistry, which should be useful to all chemists regardless of their field of specialization. Trying to meet the needs of a widely varied audience is always the challenge in writing a book of this type, and I feel that Young has accomplished this objective. By presenting such a broad range of topics, there is bound to be something immediately relevant to one's research, but it is also likely that the reader will be inspired to attempt other types of modeling possibilities beyond the initial interest. Therefore, the book may grow to be more useful as the reader decides to become more and more sophisticated with the types of problems addressed.

Biomolecules (QSAR, molecular mechanics and dynamics) are only briefly discussed; therefore, those solely interested in these topics may be disappointed. Drug design topics, such as docking, database searching, and combinatorial chemistry, are also not well-represented. There is considerably more coverage of electronic structure (quantum mechanical type) calculations.

Software reviews are fairly presented. There is an introduction to assist those unfamiliar or out-of-date with recent vendors and codes. This information should help the reader become sufficiently acquainted with the current products to be able to ask intelligent questions of colleagues or newsgroups in order to obtain more specific details on problems or issues that have arisen after the publication of this guide.

The book is well-organized as a series of short chapters (the average number of pages is 8). These summarize computational chemistry as a series of models that can be applied. One chapter, "How to Conduct a Computational Research Project", organizes the preceding material in terms of what steps one would go through to tackle an actual problem. The book could be read from cover to cover, providing the reader with important insights into how modeling might assist them in their routine work as well as predicting certain difficulties that may arise in attempting a problem that is unrealistic. Alternatively, this book could serve as an excellent reference volume that could be used to jump to a particular topic of interest. In this manner, both researchers and students would find it valuable. Indeed, I would consider it essential to have on the shelf in any standard molecular modeling laboratory.

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Liquid Interfaces in Chemical, Biological, and Pharmaceutical Applications. Surfactant Science Series. Volume 95. Edited by Alexander G. Volkov (Oakwood College). Marcel Dekker, Inc.: New York and Basel. 2001. xiv + 854 pp. $250.00. ISBN 0-8247-0457-6.

Although this book is the 95th volume in a long-running series on surfactant science, it is the first in the series to specifically address issues connected with the liquid interface and focuses primarily on oil−water and water−oil−water interfaces. The 33 chapters can be subdivided into three sections: the chemical and physical structure of the oil−water interface (18 chapters), biological applications (10 chapters), and pharmaceutical applications (5 chapters). The book bridges the gap between texts for advanced course work on these topics and the current literature in this area. Each contribution can be read independently of the others and begins with a general introduction concerning the importance and ubiquity of the liquid−liquid interface. All of the articles are up-to-date, with a total of 2800 references, some as recent as 2000 and a few not yet in print as of the book publication date.

If there is an underlying theme in the contributions, it is connected with the role of ions and electrical field gradients in transport across interfaces. Reflecting the current trend toward greater molecular-level detail in medicinal chemistry, this emphasis on the role of ions in transport is particularly evident in Part III (pharmaceutical applications). Traditionally, it was assumed that passive transport of water-soluble molecules occurs with the molecules in neutral form when they cross the cell membrane, but recent studies have shown this assumption to be in error. The authors present an excellent synopsis of the salient experimental evidence for the role of ions in passive transport and of the experimental techniques for determining partitioning between the cell and extra cellular fluids and transport between them. About one-half of the more general of the first 18 chapters are focused on electrochemical measurements of partitioning and transport between two immiscible fluids and about one-quarter look at theoretical models for ion partitioning. In almost all of the cases, one of the two immiscible fluids is water.

The contributors to this volume generally do an excellent job of pointing out the important issues and exploring the current theoretical and experimental approaches and the unresolved issues. The list of abbreviations and acronyms at the end of most articles was particularly useful, but it would have been even more helpful if this list were included for every article, because unexplained abbreviations and acronyms were confusing and often read like alphabet soup ("w" for water in the text is a prime example). A discussion of the limitations of the experimental techniques would also have been useful. In particular, how do the fields generated by the electrochemical probes perturb the system being probed? On the microscopic and nanoscopic level, these perturbations must be nontrivial, yet they are largely unaddressed. Spectroscopic probes of the interface, including nonlinear optical probes, are provided, although again, the limitations of these techniques are not discussed.

Despite the size and expense, this volume is a valuable resource. It is a good starting point for anyone thinking of entering the area of interfacial phenomena, as well as for those in the field wishing to see the larger picture. If your institution does not have a standing subscription to new volumes in this series, you should recommend this volume for your institution's library.

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Theoretical Methods in Condensed Phase Chemistry. Progress in Theoretical Chemistry and Physics. Volume 5. Edited by Steven D. Schwartz (Albert Einstein College of Medicine). Kluwer Academic: Dordrecht, Boston, London. 2000. xii + 304 pp. $125.00. ISBN: 0-7923-6697-5.

Understanding the underlying microscopic dynamics of condensed phase systems is of primary importance in chemistry. This book reflects the increasing interest in developing and testing methods to describe the chemical physics of condensed phase systems. The potential application of well-tested theoretical methods is vast and covers diverse fields, such as biophysics and materials science. Theoretical condensed phase chemistry necessarily covers a wide variety of physical problems, and consequently, there are many different approaches and techniques. This book provides an excellent overview of a number of recent advances in the development of useful condensed phase methodologies. Insofar as the topics covered are quite diverse, the book will be a useful reference for those working in any one of the particular areas that are covered. That the book also contains direct applications of these methods to environmental and biological problems should make it valuable to experimentalists and theorists who are not necessarily experts in the field. It provides a concise summary of a number of theoretical approaches and illustrates how these methods have been applied to date. Given the number of possible approaches to any one particular problem, for example, reaction dynamics or protein folding, a comprehensive overview of many topics in one volume is not really feasible, and this has not been attempted here.

One of the most important problems in chemistry is reaction dynamics. Over the past one and one-half decades, progress in condensed phase reaction dynamics has been extremely fruitful. Almost all of the chapters deal, at least peripherally, with this common topic. A number of chapters deal with approaches to reaction dynamics and reaction rates in the condensed phase. These include methods based

on classical and quantum generalized Langevin equations, Feynman path centroid dynamics, and quantum Kramers calculations. The underlying theory and algorithms are well-presented. Moreover, an effort is made in these chapters to highlight the differences that may arise in classical, semiclassical, and quantum approaches to condensed phase problems and to show applications to actual chemical systems. Because many chemical reactions involve more complex dynamical processes, inclusion of a chapter that addresses chemical dynamics where nonadiabatic transitions are important is most welcome. An overview of recent algorithmic developments of the semiclassical surface-hopping technique are presented, along with calculations illustrating curve-crossing phenomena in the vibrational relaxation of smaller molecules in solvated systems.

The dynamical processes of larger scale systems are also addressed. Classical approaches to understanding the role of solvation dynamics in reaction kinetics include instantaneous normal-mode and time-domain methods of analyzing solvation response. Numerical simulations show the breakdown of the linear response approximation for several real systems and identify some of the underlying mechanisms of solvation dynamics in chemical systems. The properties of polymeric systems are also studied using classical approaches based on an irreversible generalized Langevin equation. It is shown how solvent friction and temperature can be incorporated into a study of polymer dynamics and how this may be applied to the important problem of protein folding.

This book is not focused exclusively on dynamical processes. A few chapters are also included on the electronic properties of condensed phase systems. Given the recent advances in electronic structure calculations and density functional approaches, these should be included in any representative sampling of condensed phase theory. Density functional theory is covered in some detail in a study that examines a number of methods to represent the kinetic energy operator. The implementation of orbital-free kinetic energy density functionals and their desirable scaling properties illustrates their potential for application to many problems in the condensed phase. Applications of Hartree−Fock (HF) and molecular orbital methods have also become increasingly useful for understanding reaction mechanisms in the condensed phase. Recent applications of HF methods to studies of environmentally relevant reactions on ice clusters and combined quantum/molecular mechanics (QM/MM) methods to the study of a number of simple reactions in solution are nice illustrations of these approaches. Inclusion of a chapter that examines the topology of potential energy surfaces ties in well with the other chapters by making a comparison of current methods to identify saddle points and minimum energy paths on multidimensional potential energy surfaces.

Overall, this volume contains an interesting subset of topics in condensed phase theoretical and computational chemistry that are nicely linked with common themes. Each chapter is composed of an introduction to the essential theoretical ideas, applications to interesting chemical problems, and a list of recent literature references that will be useful to graduate students entering the field. Given the wide variety of topics covered, it may well be that any attempt to group them in this volume would be problematic. The editor elected to organize the volume by starting with the more methodical approaches and progressing to those with more applications. Personally, I felt that a grouping based on the type of approach (generalized Langevin equations, classical dynamics, electronic structure, etc.) might have been preferable, though this is a minor issue, of course.

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Quantitative Chromatographic Analysis. By Thomas E. Beesley (Advanced Separation Technologies, Inc., Whippany, NJ), Benjamin Buglio (Hoffman-La Roche, Nutley, NJ), and Raymond P. W. Scott (Georgetown University, Washington, DC and Birkbeck College, University of London, U.K.). Marcel Dekker: New York, Basel. 2001. xi + 378 pp. $150.00. ISBN: 0-8247-0503-3

There are many books on chromatographic analysis, which is certainly a "mature technique". The authors have contributed many of them over a long period, attesting to their expertise in the field. I aim to place this text in the context of this literature base and to consider what is new and valuable to the student and practicing analytical separation scientist.

I have mixed feelings about this book. It is, in essence, a composite of conventional coverage of chromatographic principles and practice interspersed with instrumental design and operational features with some current applications, which are usually extremely specific. There is, perhaps, understandably minimal mathematical or fundamental theoretical coverage, except in Chapter 5 on data processing. Part 1 (the first five chapters of introduction) have minimal new reference material and could not form a basis for a current review. Part 2, "Quantitative Gas Chromatographic Analysis", comprises chapters on technique and applications. It does not provide much practical guidance to experimental design or optimization, and descriptive sections are much more prominent than sections on quantitation. A critical evaluation of detector expectations would have been valuable. Parts 3, "Quantitative Liquid Chromatography Analysis", and 4, "Thin Layer Chromatography", are both constructed similarly, and parallel strictures apply. In each case, the users can gain a brief background to the technique of interest and may find applications related to their goals, but a coherent plan for experimental design is less readily discerned. Certainly, the goal of this text is not to be an "instructional manual", but nevertheless, pragmatic evaluations of method are important. I would like to have seen an overview chapter correlating the merits and applications of the primary complementary techniques of GC and HPLC. I doubt that the TLC chapters will be widely used.

Some aspects of the field are notably lacking. Bioanalytical applications or chromatography are sadly minimal, since most novice readers may be working in these fields. Likewise, a great deal of the current focus in operational laboratories is on GC−MS and, in particular, on HPLC−MS. These have very scant coverage. This book would not provide a basis for an academic course in analytical chromatography and, at the price of $150, could scarcely be recommended as an ancillary text. The industrial analyst could dip into it for some information but would probably need to progress almost immediately to more specific instrumental information or to the original literature on methodology.

In terms of timeliness of bibliography, application references are quite current, but most fundamental references are to other much older texts. Given the high cost of the book, it is a pity that a higher standard of graphics could not be attained; some figures are obscure and poorly designed and presented.

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Metal Clusters in Chemistry. Volumes 1−3. Edited by Pierre Braunstein (Université Louis Pasteur), Luis A. Oro (I.C.M.A., Zaragoza), and Paul R. Raithby (University of Cambridge, U.K.). Wiley-VCH: Weinheim. 1999. 1846 pp. $1050 (for Set). ISBN: 3-527-29549-6 (Set).

Braunstein, Oro, and Raithby, well-known experts in the field of cluster chemistry, have compiled a monumental three-volume set devoted to an exposition of this increasingly diverse field. This work arises out of scientific exchanges between research laboratories promoted by the Scientific Network of the European Science Foundation. Consequently, the material comes in large part from European research groups, although the editors have chosen to include a few guest contributions from non-European authors. These offer additional interesting perspectives on the development of cluster chemistry but will open the editors to some criticism by those non-European cluster chemists who were not invited to participate. Fortunately for the reader, however, the set of contributors was not larger!

Building upon work presented in various workshops and conferences between 1992 and 1998, the contributions aim to provide a general set of references for the wide spectrum of scientists interested in this field. This work could also serve as an introduction to clusters for newcomers to the area, including beginning graduate students.

The term "cluster" engenders many different connotations and the editors have adopted a pantheistic approach, with a few of the included topics on the fringe of what many chemists would recognize as cluster chemistry. These contributions in large part are interesting and do not necessarily detract from the compilation.

The diversity of the subject matter makes organizing it a tremendous challenge, and the editors have chosen to arrange the topics into three general areas: Molecular Metal Clusters (Volume 1), Catalysis and Dynamics and Physical Properties of Metal Clusters (Volume 2), and Nanomaterials and Solid-State Cluster Chemistry (Volume 3). Although these divisions work reasonably well, they should be considered as a rough guide because several of the contributions might arguably fit better in a different volume. The subject index is found only in Volume 3, and an author index would have been welcome. The project is highly ambitious, and a great variety of subject matter is covered, including synthesis, reactivity, mechanistic studies, redox chemistry, theory of structure and bonding, catalysis, dynamics, surface- and zeolite-supported clusters, nanostructured materials, and colloids, among others. Main group element clusters, transition metal compounds, and hybrids of these two classes are included. This breadth of topics is a strength, highlighting current active research areas as well as describing the historical development of cluster chemistry. It is beneficial to see the broad range of the field presented in one common reference work.

The individual contributions are generally short, easily digested papers with a reasonably well-defined goal. As with all compendia of this type, there is a considerable range in the approach taken by the various authors. Although some articles are treated as miniature research papers presenting new findings, the majority and, in my opinion, more valuable articles are short reviews of a reasonably narrow topic of particular relevance to the research of the authors. Most of these are of the style of an *Accounts of Chemical Research* paper. As such, they focus more on the authors' contributions to the particular field rather than provide an exhaustive and comprehensive review. I found many to be enjoyable reading, because they presented both interesting chemistry and a succinct historical perspective on the development and current status of a specific research problem.

Metal Clusters in Chemistry will be a welcome and important addition to the institutional reference library for all those interested in cluster chemistry and related emerging fields, although most will find it too pricey for a personal collection. The set provides a good entry point to newcomers to the area, as long as it is remembered that the reference list is not exhaustive. The editors may be congratulated for compiling a valuable and timely contribution to the chemical literature.

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Optical Control of Molecular Dynamics. By Stuart A. Rice and Meishan Zhao (University of Chicago). John Wiley & Sons: New York. 2000. xvi + 438 pp. $89.95. ISBN 0-471-35423-6.

About 15 years ago, the first theoretical articles started to appear suggesting controlled evolution of a molecular reaction by using laser excitation. Theory suggested that one could not only control the molecular dynamics of the molecule, but also influence the choice of product in a branching unimolecular chemical reaction. The concept was not only very exciting but also controversial. It was met with considerable skepticism, in part because the entrenched use of classical mechanics to describe unimolecular dynamics was incapable of describing field-induced selectivity. Added to this classical constraint was the logical and widely held belief that energy redistribution would invariably be many times faster than unimolecular fragmentation. Resolution of the controversy was not possible at the time, because laser equipment was not sufficiently advanced to generate optical fields with the necessary temporal and spectral characteristics. Much has changed during the intervening period, and both theory and experiment have now collaboratively converged on the successful active control of product selection in a number of unimolecular branching reactions. The goal of the authors of this book is to provide both experimentalists and theoreticians with the necessary background not only to understand the key theoretical and experimental components of this field but also to understand the important issues that remain to be resolved. Both goals are met with clarity and creativity. The book can be read and enjoyed by any researcher interested in studying the optical control of molecular dynamics from either a theoretical or experimental perspective.

This book was developed after Dr. Rice presented a series of lectures at Cornell University as part of the George Fisher Baker series. This lectureship has yielded a number of excellent treatises during the past few years, and the present volume is an excellent example of the global value of the Baker Lectureships. The book is presented in a sequence that is based in part on historical considerations but primarily on the desire to provide a systematic introduction to the material. Fortunately for most readers, the topics are presented in progressively more difficult stages so that those who are not experts in this field (such as this reviewer) can follow the material and the concepts easily. In the first chapter, an overview of the field that explains why it is simultaneously important and controversial is provided. In the second chapter, the question of how much control can be actually achieved in practice is presented and partially answered, and the global features of an optimal control field are given. In the ensuing chapter the rationale and formulation of the Tannor-Rice method are introduced, and the theoretical and experimental aspects of pulse-timing control of molecular dynamics is examined. By interlacing theory and experiment in a very well designed presentation in this chapter, the authors provide an excellent introduction to the principal issues. In Chapters 4 and 5, there is discussion of a number of other methods of controlling dynamics, including multiphoton interference, poled incoherent interference, and stimulated Raman scattering involving adiabatic passage (STIRAP). In the next two chapters, the authors discuss the optimal field control of molecular dynamics and the use of adaptive learning and feedback to optimize the process. In Chapter 8 they provide a very brief examination of multi-state systems.This chapter also serves as a valuable introduction to Chapter 9, in which reduced space analysis methods are described. In Chapter 10, a brief discussion of the many other methods that have been explored to use optical fields to control both atomic and electronic motion in molecules is provided. This chapter is not as thorough as the others, and in many cases, it only whets the appetite of the reader to explore the referenced articles in more detail. The two appendices on wave packet dynamics and numerical methods are valuable additions to the book and will be of particular help to those seeking to implement some of the theoretical methods outlined in the main text.

In summary, this is an outstanding contribution that will be of value to both experimentalists and theoreticians who are interested in exploring optical control of molecular dynamics and unimolecular reactions. Considerable care was taken to include both theory and experiment in examining the key issues and to compare and contrast the results of both approaches. This is one of many books written by Prof. Rice, who has earned a reputation as a theoretician who can communicate his ideas with clarity and enthusiasm to experimentalists. Although this is the first book coauthored by Meishan Zhao, a research scientist and senior lecturer at the University of Chicago, there is no evidence that the authors divided up the chapters; rather, it reads like a shared effort that reflects the mutual creativity and perspectives of the two authors.

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Mechanisms of Protein Folding, 2nd ed. Edited by R. H. Pain (Jozef Stefan Institute, Liubljana, Slovenia). Part of the Frontiers in Molecular Biology Series. Oxford University Press: Oxford. 2001. xxvi + 434 pp. $120.00. ISBN: 0-19-963788-1.

The protein folding field experienced tremendous changes during the latter half of the 1990s. One significant development has been the progress toward establishing a universal model, the energy landscape model, for describing the folding process. Other major advances have been in understanding the functions of molecular chaperones, making links between protein folding and disease, developing rapid-mixing techniques, and combining computational and experimental methods. The second edition of *Mechanisms of Protein Folding* thus makes a timely appearance. It is thoroughly revised and updated from the first (1994) edition, incorporating discussions of these and other advances in the field.

An introduction to the folding problem is presented in the first chapter, which describes the energy landscape model and how it applies to the range of topics in the monograph. An overview of kinetic models in protein folding is presented in the next chapter. These chapters are

an excellent introduction to the topic, providing the background needed to make the topic accessible to well-informed readers outside the field of folding. A number of the following chapters on the early stages of folding, the molten globule model, proline isomerization, the role of disulfide bonds, assembly of multisubunit structures, and molecular chaperones (folding in the cell) also appeared in the first edition. In every case, however, the material has been thoroughly updated. For example, the chapter on the early stages of folding reflects the advances in mixing techniques that allow the observation of events that occur within the first millisecond of folding. A chapter on the study of folding by protein engineering has been recast as a chapter on the analysis of transition states in protein folding using a combination of mutation analysis and molecular dynamics simulations. The text thus maintains its emphasis on experimental techniques but includes a description of some of the contributions made by computational studies. In addition to updates of chapters from the first edition, new chapters on the use of mass spectrometry to study folding and on the relationship between folding and disease have been added. These are fitting additions, reflecting areas of rapid advance in recent years. Finally, three case studies on the folding of apomyoglobin, collagen, and influenza haemagglutinin (in vivo), have been added. These are valuable chapters that together do a fine job of illustrating approaches to the problems discussed throughout the book and also provide more detailed information on specific systems as well as on the particular techniques used to study them. For example, in the chapter on folding of apomyoglobin, the reader is provided with a demonstration on the use of NMR spectroscopy to characterize non-native states of proteins.

In summary, *Mechanisms of Protein Folding* is an important text describing the current state of knowledge of protein folding from the experimental perspective. It provides essential information on techniques as well as perspectives on future work that will serve its readers well for many years, even as the field continues to develop.

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Semiconductor Electrochemistry. By Rüdiger Memming (Rellingen, Germany). Wiley-VCH: Weinheim. 2001. x + 400 pp. $99.95. ISBN 3-527-30147-X.

This book is focused on photochemical and electrochemical processes at semiconductor electrodes and particles. It begins with a tutorial of elementary concepts in solid state (semiconductor) and device physics in Chapters 1 and 2 and continues in Chapter 3 with a summary of electrochemical systems. In Chapter 4, experimental methods for the study of semiconductor-liquid junctions are introduced and there is a very brief description of ultrahigh-vacuum surface science. I found spectroscopic methods (e.g., luminescence) to be conspicuous by their absence, especially spectroelectrochemical techniques that have proven to be exceedingly useful for the study of nanocrystalline and quantum-dot semiconductor films. Another notable omission in this chapter is a discussion of the electrochemical quartz-crystal microbalance methodology.

The next three chapters constitute the meat of this book and are focused on the solid−liquid interface (Chapter 5), electron transfer theories (Chapter 6), and charge-transfer processes at the semiconductor−liquid interface (Chapter 7). In Chapter 8, there is a description of electrochemical decomposition of semiconductors; the subject of Chapter 9 is photoreactions on semiconductor particles; and Chapter 10 contains a description of charge-transfer processes involving excited molecules (e.g., dyes) and semiconductor electrodes. The book concludes with a summary of various applications that are underpinned by semiconductor electrochemistry principles.

As the author himself points out in his preface, this book addresses an enormously broad topic that cuts across many diverse disciplines. Consequently, bringing together all the concepts in a cogent yet concise fashion constitutes a thankless and unenviable task, at best. There are only a couple of monographs on this subject since the late 1980s, in contrast to the much greater number that appeared prior to this period. On the other hand, a fundamental understanding of many important topics, such as dye sensitization of semiconductors, nanostructured/mesoporous films, and quantum dot assemblages, is only slowly evolving. It is this reviewer's opinion that this base of knowledge has not yet reached a sufficient state of maturity for an authoritative account to be written. Thus, it is questionable whether the time is ripe for another treatise on semiconductor electrochemistry/photoelectrochemistry.

In conclusion, I found this monograph to suffer from numerous mechanical problems in the form of wrong equation and figure numbers, repetitious (or even missing) equations, and spelling mistakes, etc., which suggest that a much better degree of quality control could have been exercised in its production. Further, the author's repeated use of the terms: "anodic" and "cathodic" (instead of positive and negative) for potentials or potential shifts may prove to be irksome to some purists of electrochemistry who peruse this book. Nonetheless, practitioners in the related fields of semiconductor electrochemistry, photoelectrochemistry, photocatalysis, and photovoltaic solar energy conversion will find this book to be a generally useful addition to their bookshelf.

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