Book Reviews

Advances in Electrochemical Science and Engineering. Volume 6. Edited by Richard C. Alkire (University of Illinois) and Dieter M. Kolb (University of Ulm). Wiley-VCH: New York. 1999. xii + 344 pp. $198.00. ISBN 3-527-29515-1.

The specified objective of this series is "to provide high quality advanced reviews of topics of both fundamental and practical importance to the experienced reader". This volume satisfies these objectives admirably. The book is divided into four, roughly equal length chapters, each chapter covering one topic. Except for a common electrochemical focus, the chapters are unrelated: Chapter 1, Computer Simulations of Electrochemical Interfaces; Chapter 2, Time and Frequency Resolved Studies of Photoelectrochemical Kinetics; Chapter 3, Chemical Deposition of Chalcogenide Thin Films from Solution; and Chapter 4, Plasma Engineering. The chapters, authored by recognized experts in their respective fields, are well written and well referenced and of uniformly high quality. The text assumes a background in electrochemistry, electrochemical engineering, or some related field and provides a solid, clear discourse leading the reader to a fairly sophisticated appreciation of the important ideas in the field. The authors also do a very good job of explaining the current limitations in understanding for each field. The chapters are useful to the novice looking for well-laid-out and encompassing background material as well as to the established practitioner seeking a synopsis of recent developments.

Chapter 1 (by E. Spohr) provides a good survey of Monte Carlos (stochastic) and molecular dynamics (deterministic) methods for modeling the electrode-solution interface. The limitations of these methods and the evolving trends are very clearly discussed and should appeal to the theoretically inclined; Spohr also discusses how such simulations have augmented the understanding of electrochemical interfaces and their associated reactions, which should be of interest to the less theoretically focused. The chapter is divided into sections that include a discussion of Monte Carlos and molecular dynamics simulations and the associated interaction potentials, water/metal interfaces, electrolyte solution/metal interfaces, and interfacial reactions. Throughout, bulleted lists highlight the successes and current limitations of each model.

Chapter 2 (by L. M. Peters and D. Vanmaekelbergh) begins with a very good review of photoelectrochemical processes at semiconductors and the different time scales appropriate to these processes. The authors describe both photoelectrochemical impedance spectroscopy (PEIS) and intensity-modulated photocurrent spectroscopy (IMPS) as methods appropriate to mapping events on different time scales, but the discussion largely focuses on IMPS. The authors show where each method is appropriate and how the methods complement each other. The remaining two sections of the chapter focus on single-crystal photoelectrodes and porous and nanocrystalline semiconductors. Dye-sensitized nanocrystalline semiconductors are described. The different properties are compared for bulk semiconductors and nanocrystalline semiconductors where particle size and the length of the depletion region are comparable.

Chapter 3 (by D. Lincot, M. Froment, and H. Cachet) describes the different classes of chalcogenide thin films and their applications. The thermodynamics of complexing agents and chalcogenide solubility are reviewed in detail. Different deposition mechanisms and their deconvolution by combined quartz crystal microbalance and impedance studies are presented. Various morphologies are categorized for chalcogenide deposits, and epitaxial growth mechanisms are described. Optimization of the films is well detailed through control of different deposition parameters, including complexing agents, concentrations, pH, mismatch with substrate lattice, and substrate orientation. Finally, applications of the various chalcogenides are described. The chapter is thorough and well presented.

Chapter 4 (by D. J. Economou) describes isotropic and anisotropic etching, as well as the rudiments of plasma physics and plasma chemistry, including surface chemistry. Reactor design is briefly outlined. A more detailed section on plasma modeling and simulation clearly defines the difficulties of modeling systems with disparate length and time scales and provides an excellent discourse on the tricks of the trade used to overcome these difficulties. This section is not mathematically ponderous and is accessible to the nonspecialist. Plasma etching and deposition systems are described, including etching of silicon, silicon dioxide, and aluminum, as well as loading, sputter deposition, plasma-etched chemical vapor deposition, and step coverage. The final sections outline plasma and surface diagnostic methods, compare the similarities and differences of plasma and electrochemical engineering, and suggest future research directions.

Overall, the chapters in this book evolve from basics to state-of-the-art science and engineering and are written in a manner accessible to the novice and useful to the practitioner.

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Green Chemistry: Frontiers in Benign Chemical Syntheses and Processes. Edited by Paul T. Anastas and Tracy C. Williamson (U. S. Environmental Protection Agency). Oxford University Press: New York, NY. 1999. 360 pp. $115.00. ISBN 0-19-850170-6.

Green Chemistry: Frontiers in Benign Chemical Syntheses and Processes consists of an introductory chapter by Anastas and Williamson on the development and current status of the field of green chemistry followed by a series of contributed chapters by researchers in the field. The introductory chapter briefly describes the principle tenets of green chemistry and then highlights the six focus areas that comprise the remainder of the book: Alternative Feedstocks and Reagents; Catalysis, Biocatalysis and Bioprocessing; Alternative Solvents; Uses of Carbon Dioxide; and Alternative Synthesis and Processing. For each of the focus areas, the individual chapters collectively describe the impetus for the research in each of the areas and the issues that must be addressed in order to change existing practices. As a result, this book is useful to both the student of green chemistry and experienced chemists. The emphasis of the book is on innovative research in green chemistry, and as such, less detail on application to industrial problems is available. Individual chapters do describe a broad range of exciting research in this area, and thus the book, as a whole, is an excellent source of information.

Each of the chapters varies significantly in both descriptions of the research and the level at which they are written. For example, the chapter "The Design of Green Oxidants" by Collins et al. is a detailed summary for the more sophisticated reader of their elegant work on the development of transition metal oxidants utilizing H_2O_2, while Nelson's "Art in Science: Utility of Solvents in Green Chemistry" provides an overview of solvent substitution with selected examples designed to illustrate general concepts. A number of additional chapters are noteworthy because of the insight they provide into the principles of green chemistry as well as the innovative research that they describe. The chapter by Hudlicky, "Green Chemistry Alternatives for the Processing of Aromatic Compounds. Tandem Strategies in Biocatalysis and Synthesis", is an excellent description of the concept of atom-efficient chemical synthesis, with examples that illustrate the specific strategies. The use of alternative feedstocks for the chemical industry are described in several sections: for example, the work of Andrews examines the feasibility of using biomass as raw materials. This chapter describes a series of studies that use traditional homogeneous catalysts to accomplish a variety of conversions (hydrogenation, decarbonylation, etc.) on carbohydrate substrates. Buelow and co-workers have explored a number of catalytic transformations in dense phase carbon dioxide, including selective oxidation, asymmetric hydrogenations, and metal-catalyzed polymerizations. Their work has demonstrated that dense phase CO_2 is an attractive and, in some instances, a superior solvent system for catalytic transformations.

In summary, *Green Chemistry: Frontiers in Benign Chemical Syntheses and Processes* is a good contribution to this rapidly expanding and important field, successfully using current research to illustrate

how green chemical principles can be applied to design or redesign syntheses or processes to render them environmentally benign.

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Process Chemistry in the Pharmaceutical Industry. Edited by Kumar G. Gadamasetti (The Bristol-Myers Squibb Company). Marcel Dekker: New York. 1999. 504 pp. $195.00. ISBN 0-8247-1981-6.

There has been a significant increase in the scientific coverage of the application of synthetic and physical organic chemistry in process research groups of the pharmaceutical industry. The volume *Process Chemistry in the Pharmaceutical Industry* is a recent addition to this body of work. It is divided into six sections: Overview and Strategy, Case Studies, Enzymatic Intervention and Phase Transfer Catalysis, Asymmetric Synthesis and Enantioselectivity, Drug Substance Final Form and Process Safety, and Design of Experiments and Automation.

The Case Studies section comprises about half of the book with 12 chapters. Each covers the development of a chemical process for the preparation of a drug candidate. The chapters range from purely technical discussions of the chemistry to narrations of the scientific, engineering, regulatory, and commercial aspects of the project. Those of the latter kind are interesting since they provide reading that is atypical of what one normally finds in the chemical literature. While more than half of these chapters are excellent reading, even for those with many years of process research experience, several chapters contain little detail and thus fail to entice the reader. Each chapter is authored by a different organization, and the reader is struck by the apparent differences in scientific approach. It is clear that increased exchange of information among process chemists, as this book seeks to do, can be expected to enhance the industry as a whole as best practices are adopted more universally.

A group of five chapters covers the use of enzymes, phase-transfer catalysis, and asymmetric synthesis. The chapter on the use of enzymes could have been placed in the Case History section since it describes an elegant example of the successful use of enzymes to solve a difficult synthetic problem. A compendium-style presentation for phase-transfer catalysis and asymmetric reactions describes a variety of published examples on these topics from numerous industrial organizations. The last two chapters in the asymmetric synthesis section focus on contributions from two academic laboratories and serve to highlight the tacit collaboration that occurs when a reaction first discovered in academia is further optimized for application to a specific example in industry.

The final two sections consist of four chapters covering applied topics important to all process research chemists: thermodynamic and kinetic factors governing the isolation of crystal polymorphs, an overview of thermal process safety, the use of factorial experiments to optimize reactions, and finally a chapter devoted to the growing importance of automation. Readers intrigued by any of these chapters will need to do further reading to gain a more complete understanding of the material.

As with any contributed volume, the chapters are of varying quality with the best ones being very informative. Unfortunately, a few are disappointing and detract from the volume as a whole. Nevertheless, the book provides a good overview for those wanting an introduction to the science conducted in a process research group. For experienced process chemists, frequent descriptions of creative solutions to difficult problems makes the book worth reading.

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Advances in Antiviral Drug Design. Volume 3. Edited by E. De Clercq (Katholieke Universiteit Leuven, Belgium). JAI Press: Stamford, CT. 1999. xii + 237 pp. $109.50. ISBN 0-7623-0201-1.

The latest volume of *Advances in Antiviral Drug Design* represents the third installment of this series devoted to reporting case studies of the medicinal chemistry of antiviral agents. Topics include discussions of the chemistry of L-nucleoside analogues, the design of nucleoside phosphonate prodrugs for improved oral bioavailability, the structure−activity relationships (SAR) of the HEPT class of human immunodeficiency virus (HIV) nonnucleoside reverse transcriptase inhibitors, inhibitors of influenza virus sialidase, and the potential use of bicyclam derivatives as inhibitors of HIV. The chapters are individually well written and are likely to be of interest to those working in the field, particularly those with a specific interest in the chemistry of nucleoside-based approaches.

In many ways, this is a transitional volume in the series and reflects the situation of a discipline undergoing a period of rapid change. Volumes 1 and 2 heavily emphasized nucleosides as a starting point for rational design and HIV as a target, two sources of success in the 1990s. However, the number of therapeutic indications being pursued has expanded considerably in recent years, following the identification of novel targets through genetic analysis of pathogenic viruses. Furthermore, leads are now increasingly based not on nucleosides but on peptides or on heterocyclic molecules discovered through screening efforts. The current volume starts to address some of these changes, but still retains a very strong focus on HIV and nucleosides.

Four of the five chapters deal either directly or indirectly with approaches to anti-HIV compounds. A chapter on L-nucleoside analogues gives a very thorough overview of the approach that led to the discovery that these derivatives often show greater potency and selectivity than their enantiomers. This chapter reviews the literature with an emphasis on the syntheses involved in producing these derivatives. The next chapter discusses the design of prodrugs of acyclic nucleoside phosphonates, especially those of the drug adefovir. By masking the phosphonate with a metabolically labile group, one can obtain compounds with increased oral bioavailability. HIV is also the subject of a chapter that tells the story of the discovery and SAR of the HEPT compounds. This chapter includes nice overviews of both the medicinal chemistry and the structural aspects of how the compounds bind to reverse transcriptase.

Two chapters in this volume begin to bring newer concepts into the series. Although the discovery of the bicyclam AMD3100 is an anti-HIV story, it involves a new target: chemokine receptors. These cell surface proteins act as a co-receptor for HIV and their antagonism could have relevance to several indications in immunology and inflammation. Several aspects of the work leading to the first clinical candidate, including the identification of the target protein, are covered in this chapter. Finally there is also a chapter that does not deal with HIV as a target. This chapter discusses the design of sialidase inhibitors for the treatment of influenza. The primary focus here is on the rational design of inhibitors from carbohydrate leads, but non-carbohydrate leads are also mentioned.

As a whole, this volume has value as a reference material and for those specifically working in the field of HIV. For the series to broaden its appeal, however, it will probably need to address more aggressively the other viral indications and molecular targets that are now being reported in the literature.

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