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BOOK REVIEWS

Supramolecular Polymers, 2nd Edition. Edited by Alberto Ciferri (Duke University and University of Genoa). CRC Press (an imprint of Taylor and Francis Group): Boca Raton, FL. 2005. xiv + 762 pp. $125.96. ISBN 0-8247-2331-7.

Molecular chemistry is based on the covalent bond, whereas weaker, noncovalent forces define supramolecular chemistry. Supramolecular chemistry is thus a study of intermolecular interactions and reversible assemblies of molecules. Supramolecular polymers emerged some time in the early 1990s as a direct and logical extension of supramolecular chemistry, self-assembly, materials chemistry, and nanotechnology. Six years ago, the first edition of this book appeared, but the field has become so popular and intellectually intense and has expanded so significantly that publication of this second edition is highly appropriate.

Supramolecular polymers represent a novel class of macromolecules in which reversible bonds and forces hold monomeric units together. The uniqueness of supramolecular polymers is that they combine features of conventional polymers with properties resulting from the reversibility of bonding. Structural parameters of supramolecular polymeric materials and therefore their properties and functions can be switched "on−off" through delicate processes of association−dissociation. And their strength, degree of polymerization, and functions can be programmed at the level of their monomeric units.

The book is organized into two sections with each containing 11 chapters. The first section, "Theory and Structure", starts with exceptionally well-written contributions by Lehn and Ciferri, which essentially define the fields of supramolecular polymers. This section also covers the theory of supramolecular polymerization (Chapter 3) and gives a thorough description of theoretical models of the processes of supramolecular growth (Chapter 2). In the following chapters, the synthesis and structure of supramolecular polymers are further described in great detail. A wide variety of forces can be used to construct main-chain polymeric structures, such as hydrogen bonding, extensively covered in Chapters 5 and 6, metal−ligand coordination, electrostatic and donor−acceptor interactions, van der Waals forces, and others. Noncovalent interactions between covalent polymeric chains have also been identified and used, particularly in side-chain supramolecular polymers. Mechanically interlocked superstructures, such as polyrotaxanes and polycatenanes, are discussed in Chapter 8, and dendritic supramolecular and supramacromolecular assemblies are described in a spectacular contribution by Tomalia in Chapter 7. This section also covers an impressive diversity of supramolecular polymers. Reversibly formed structures include linear, two-dimensional, and three-dimensional assemblies. Relatively simple linear aggregates are complemented by helical, columnar, and tubular supramolecular polymers and even more complex micelles, self-assembling monolayers, and unique assemblies of block copolymers.

The second section is dedicated to the unique properties, functions, and potential applications of supramolecular polymers. The section starts with the excellently presented Chapter 12 by Craig and co-workers on applications of self-assembling DNA structures in nanotechnology, nanofabrication, electronic devices, and molecular computing. Further, in Chapter 13, readers will learn about supramolecular membranes in aqueous media and how to use supramolecular amphiphiles to form functional hydrogels and organic−inorganic hybrid nanocomposites. In Chapters 14 and 16, respectively, the application of self-assembling polymers in optoelectronic devices is described, and columnar, helical, and tubular materials are discussed. How the dynamics and reversibility of polymeric structures are expressed in their rheological features are the topics of Chapter 15. Unique applications in the design of "self-healing" supramolecular networks, in polymer-induced phase separations, and in printing technologies are also discussed. Chapters 17−19 cover complex structures and properties of two-dimensional arrays of proteins, forming bacterial cell surface layers (S-layers), cellular polymers, self-assembling monolayers, and their modification into unique planar micro- and nanostructures, as well as multilayered polyelectrolites. Finally, Chapter 20 is a good overview on how to employ noncovalent forces in the preparation of imprinting polymeric materials for molecular recognition and catalysis.

The book is written by well-recognized experts in the field, and it is also thoroughly edited. All chapters nicely complement each other, despite some unavoidable overlaps. Chapters from the first edition have been updated, and many new chapters have been added. Finally, the references are timely.

Overall, the book is a success. It is very timely and useful, and the price is affordable. There is a broad community of potentially interested readers. These are researchers and, of course, graduate students working in self-assembly and nanotechnology, materials chemistry, hydrogen bonding, molecular recognition, and supramolecular chemistry in general. Not only science and engineering libraries but also many individuals may benefit by having a copy of this excellent book on their bookshelf.

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New Aspects of Zirconium Containing Organic Compounds. Topics in Organometallic Chemistry, 10. Edited by Ilan Marek (Technion-Israel Institute of Technology, Haifa). Springer: Berlin, Heidelberg, New York. 2005. x + 176 pp. $149.00. ISBN 3-540-22221-9.

This small volume is packed with valuable information. Its five chapters address areas of organozirconium chemistry that, together, show how much this field has expanded and matured since the organic chemistry of this metal was first described about 30 years ago.

"Stereoselective Synthesis of Dienyl Zirconocene Complexes" is a survey of a range of targets that can be prepared using what

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one might call outgrowths of broadly known hydride-based procedures or those involving zirconocycles, where the zirconium reagent acts alone or in conjunction with a second metal to yield the desired organic target. "Zirconocene Complexes as New Reagents for the Synthesis of Cyclopropanes" covers the utility of these organometallics for reaction with, for example, carbonyl-containing compounds, to give cyclopropanes; routes involving hydrozirconation of allylic materials are also described, among others. "Octahedral Zirconium Complexes as Polymerization Catalysts" is a presentation of structural, mechanistic, and synthetic studies of zirconium complexes that suggest that these nonmetallocene complexes can have a utility paralleling that of their zirconocene cousins. Finally, "Synthesis and Reactivity of Zirconium−Silene Complexes" and "Synthesis and Reactivity of Zirconaaziridines" are descriptions of the chemistry of new classes of compounds that are now in the novel synthetic reagent pipeline.

The virtue of this book lies in its voluminous data and complete referencing of the various topics presented. As such, it will be a useful source for researchers focused on particular targeted areas. The encyclopedic approach, however, and the density of presentation suggest that this book will be of less appeal to interested, but not expert, readers.

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Nanocrystals Forming Mesoscopic Structures. Edited by Marie-Paule Pileni (Université Pierre et Marie Curie, Paris, France). Wiley-VCH Verlag GmbH & Co. KGaA: Weinheim. 2005. xvi + 330 pp. $175.00. ISBN 3-527-31170-X.

Pileni has compiled a nice summary of review chapters focused on the assembly of inorganic nanocrystals in the sub-10-nm size range into superlattices and other various structures with spatial order. There are 13 chapters, covering topics as diverse as dissipative structures, ordering in mesoporous templates and phase-segregated polymers, magnetic nanocrystal assembly, and self-organization under the influence of external forces, as in solvent convection and applied electric and magnetic fields. Although many books on nanocrystals and superlattices exist, there are very few that cover all these various aspects. Understanding the influence of external fields and self-organization on scales of multiple length is in particular at the forefront of research in the area, which by itself makes this book an important resource. Although the bulk of the book focuses on the assembly process and order, there are also three chapters that cover the properties of these assemblies, with respect to the magnetic properties of magnetic nanocrystal superlattices, scanning tunneling luminescence from metal nanocrystals, and optical properties in the context of biosensing. There is also a brief chapter on using nanocrystal superlattices as nanolithography templates.

The introductory chapter by Pileni and co-workers is a nice fundamental description of the interparticle and particle-substrate forces, such as van der Waals, magnetic dipole, and capillary, involved in the self-assembly process and the basic influence of external forces on order. Chapters on magnetic assembly and the properties of magnetic nanocrystal superlattices, dissipative structures (or spatiotemporal self-organization in nanocrystal systems), directed assembly in mesoporous templates and phase-segregated polymers, and mineral liquid crystals, in particular, represent future challenges facing the field. Davidson and Gabriel's chapter on the influence of shape, e.g., nanorods, wires, and disks, on self-organization is particularly timely, given that many new synthetic methods are being developed for nanocrystals with controlled shapes. The chapter by Shimomura on the self-organizing influence of the evaporating solvent, as in Marangoni flow or convective instabilities such as solvent fingering, or of an additional condensing phase during solvent evaporation, as in the formation of water droplets or "breath figures", is particularly interesting. The coverage of magnetic nanocrystal superlattices throughout the book is outstanding and in my opinion one of its strongest aspects. I found the discussion about the labyrinthine superlattice "phases" of magnetic nanocrystals ordered under applied magnetic fields fascinating.

The only real omission from the book is a chapter on the electronic properties of superlattices, which has been a central topic in the field of nanocrystal self-assembly for the last 10 years. Many of the details about superlattice assembly, including long-range order, defects, superlattice symmetry, particle size, interparticle spacing, capping ligand chemistry, and doping, have been of significant interest in the field largely because they control the electronic properties of superlattices. Perhaps the book would have also benefited from more discussion about potential applications of these materials. However, there are other resources focused on the applications and electronic properties of nanomaterials, which could supplement the material in this book. The only other thing I should mention, somewhat as a warning to those new to the field, is that the chapters tend to focus primarily on the authors' own work, as opposed to providing a more general perspective of work in the field. In several of the chapters, I felt that the authors failed to cite and appropriately recognize important and pioneering work by others. Apart from this criticism, I think the book is a very good resource for beginning graduate students and researchers new to the field and complements the many other reviews on nanocrystals with its excellent coverage of magnetic nanocrystals and their assemblies and the influence of external forces on nanocrystal organization.

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Protecting Groups, 3rd Edition. By Philip J. Kocienski (University of Leeds). Georg Thieme Verlag: Stuttgart, New York. 2005. xvi + 679 pp. $89.95. ISBN 3-13-135603-0.

There are two major classes of books in a professional library. First, there are the books that you read once and never take off the shelf again. These are always easily identified because they have shiny bindings and look nice on the shelves. Then there are those books that are so indispensable that you find yourself referring to them almost every day. Over time, their bindings become broken and the cover becomes shopworn. They are respected members of your professional family. This book by

Kocienski will definitely fall into this latter category. It possesses a number of noteworthy features: it is well organized, covers useful information, and is eminently readable—an excellent combination.

The topic of protecting groups is important to anyone who has to synthesize organic compounds. This book complements other books on this topic, most notably Greene and Wuts' excellent compilation of protecting group methodology. Unlike the book by Greene and Wuts, however, which is a listing of methods with limited discussion, Kocienski provides more extensive commentary on the various reagents and methodologies. In many instances, the mechanisms of more obscure protection schemes are discussed briefly, thus freeing the reader to evaluate the relative merits of the methodology without having to resort to reading the original papers. Also, there are numerous drawings in the text that illustrate the topics under discussion.

No book of this nature is going to be useful to the community unless it is both well organized and highly referenced. This volume fulfills both requirements admirably. A chart of protection methods and functional groups is located inside the front cover and provides almost immediate access to any transformation that is of interest. Additionally, the index is very thorough and provides access in a more traditional manner.

The coverage of the text is extensive and includes references from 1990 to 2001, which appear at the end of each chapter. There are several other distinctive features that make this volume noteworthy: for example, at several junctures, the characteristic features of the H-1 and C-13 NMR spectra of the protecting group are noted. Again, this makes practical information immediately at hand so the reader does not have to access the original literature to obtain this information. Also, the key functional groups undergoing the reaction are highlighted in blue in the drawings.

Finally, the price is right, well within the means of students and faculty alike. Although the book is paperback, the price is very reasonable considering that this is the sort of book that will remain in your library for many years to come and will take its place alongside the other indispensable volumes used daily in research. At the moment, this volume looks bright and new sitting on my bookshelf, but I anticipate that it will quickly take on the well-worn patina of a book that sees extensive use by everyone in my lab.

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Metal Catalysed Reactions in Ionic Liquids. By Paul J. Dyson and Tilmann J. Geldbach (Ecole Polytechnique Fédérale de Lausanne, Switzerland). from the series: Catalysis by Metal Complexes. Edited by Brian James and Piet W. N. M. van Leeuwen. Springer: Dordrecht. 2005. x + 246 pp. $159.00. ISBN 1-4020-3914-X.

This volume is the 29th in the well-received series *Catalysis by Metal Complexes* published by Springer. The book opens with a historical chapter on the beginnings of biphasic catalysis, which then leads to a discussion of the use of ionic liquids in catalysis. The historical prospective is interesting as well as informative. The authors have done an excellent job framing the importance, and limitations, of alternative solvents, specifically ionic liquids. The second chapter is an overview of the basic properties and common methods of synthesis of ionic liquids. Although a great deal of information is contained in this chapter, a discussion of the purification and recycling of ionic liquids would have benefited the readers of this book. The authors also mention that many naming systems for ionic liquids have appeared in the literature but do not describe them, which would have been welcome. These are very minor omissions from an otherwise excellent treatment of a rapidly growing field. Overall, the first two chapters are very well written and should be required reading for students and professionals in the field of catalysis in alternative solvents.

The volume really shines in Chapters 3−9, each of which focuses on a specific catalytic reaction utilizing ionic liquids, including chapters on hydrogenation, hydroformylation, oxidation reactions, carbon−carbon coupling reactions, olefin metathesis, dimerization−polymerization, and finally a chapter on miscellaneous reactions. Most of the chapters start with a brief, but informative and well-referenced, overview of the catalytic reaction in traditional organic solvents and other alternative solvents (water, $scCO_2$, etc.). The bulk of each chapter centers on the use of ionic liquids as solvents, and at times reagents, in the catalytic reaction at issue, which is covered in depth. Not surprisingly, the chapter on carbon−carbon coupling reactions is the longest and the most detailed, as this has been an area of primary focus for many in the field of catalysis in ionic liquids. Probably the most useful aspect of the book is the tables contained in each chapter that provide a summary of the various catalysts, reagents, and ionic liquids utilized for the specified reaction, including useful comments on the reaction, such as recyclability of the catalyst. These tables offer a great deal of information and will be invaluable to anyone who wants to learn about the current state-of-the-art on this topic.

The figures and tables presented throughout the text are clear, accurate, and germane to the discussion. The occasional sentence reads with some difficulty, but on the whole the volume is well written and organized. One especially impressive aspect of this book is the extensive and broad coverage of the references, which extend to the beginning of 2005, with most from 2002 to 2004. This book makes an excellent companion to Piet W. N. M. van Leeuwen's book *Homogeneous Catalysis: Understanding the Art* and a previous volume in this series *Aqueous Organometallic Catalysis* by Ferenc Joó.

Dyson and Geldbach's book would be an excellent choice of text for a graduate course on alternative solvents and is a must read for anyone in or thinking of entering the field of chemistry in alternative solvents. *Metal Catalysed Reactions in Ionic Liquids* belongs in all scientific libraries and many personal collections; I know it will remain within close reach on my bookshelf.

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