

Book Review

Multiple Bonds Between Metal Atoms, 3rd ed Edited by F. Albert Cotton, Carlos A. Murillo (Texas A&M University), and Richard A. Walton (Purdue University). Springer Science + Business Media, Inc.: New York. 2005. xxx + 818 pp. \$149.00. ISBN 0-387-25084-0.

P. Power

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This book is the third edition of a very important reference volume that has been an invaluable resource for over 25 years for all practitioners in the area of transition metal chemistry. In contrast to previous editions, the editors have entrusted a number of prominent inorganic chemists with the authorship of several of its 16 chapters, although the late F. A. Cotton has contributed the lion's share of these. Nonetheless, despite the use of multiple authors, a high degree of stylistic and scientific continuity is maintained throughout the book. The standard of presentation is uniformly outstanding and clearly shows great care in the quality of the illustrations and tables. The latter are comprehensive in their presentation of structural data. This collection of tabular information alone makes the volume worthy of purchase.

The book begins with an engaging introduction that provides a first-hand account of how multiple bonding was first identified between d-block elements and a summary of the key concepts involved. The body of the book presents a detailed review of metal-metal bonding throughout the groups of the d-block. Each chapter is organized either by specific element or by structural archetypes. A notable addition concerns the rapidly expanding field of dinuclear Rh-Rh bonded complexes, which is covered in a chapter on the structure and catalytic applications of their chiral variants. As the authors mention in the Preface, "In every chapter the objective has been to be comprehensive, if not encyclopedic", and as such, each chapter covers a topic in considerable detail, with significant emphasis on the structural, spectroscopic, and theoretical aspects of the molecular class reviewed. Furthermore, it is evident that a great deal of effort has been expended to ensure that current work (up to late 2004) is comprehensively surveyed with relevant citations listed in their entirety, making this book an excellent and timely reference guide. The book concludes with a final chapter that provides further discussion of the guiding principles behind the structural and spectroscopic data observed in metal-metal bonded species. Particular attention is also given to recent advances in theoretical methods that now better describe metallic bonding interactions by taking into account factors such as electron correlation and relativistic effects within the transition metal elements. This chapter is essential to any chemist who wishes to gain a deeper understanding of the title complexes and includes important cautionary advice against deriving the extent of multiple bonding from structural data alone.

It should be mentioned that, contrary to the title, the book does not deal exclusively with multiply bonded transition-metal compounds. Many species with little multiple character in their M-M bonds are also included. This is particularly true for

chapters dealing with the rapidly expanding topic of complexes of the late transition metal elements such as iron, rhodium, the group 10 elements, and several extended metal atom chains where multiple bonding is relatively scarce. However, inclusion of these species is easily justified on the basis that they are often structurally related to their multiply bonded counterparts. As a result they help illuminate the factors needed to stabilize a compound with a multiple bonded framework.

In general the book provides enriching historical information relevant to each structural class being discussed. Relatively minor attention is given to the known diatomic species, M_2 , which can display formal bond orders as high as six. However, this topic was covered in greater depth in the two previous editions of the book, so the reduced emphasis on this work in the third edition is understandable. It is noteworthy that recent research in this field is mainly theoretical in focus.

Overall this volume is an extremely thorough and well-written conspectus of the field. With some background knowledge, each chapter can be read independently of its neighbors which, in our view, is a hallmark of any preeminent reference work. Undoubtedly, it will be the most important resource available for this area, which is one of the cornerstones of modern inorganic chemistry. It is a fine monument to all workers who have contributed to the field, but especially to the late F. A. Cotton and his coauthors.

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Theilheimer's Synthetic Methods of Organic Chemistry, Volume 70. Edited by Alan F. Finch (Cambridge). S. Karger AG and the Thomson Corporation: Basel, Switzerland. 2006. xxvi + 430 pp. \$659.25. ISBN 3-8055-8217-X.

This volume, the second of *Theilheimer's* for 2006, contains abstracts of new synthetic methods and supplementary data from papers published in the literature up to March 2006. As with previous volumes, it also features the section "Further Trends and Developments in Synthetic Organic Chemistry 2006", which highlights new developments in the field, and a collection of reviews in synthetic organic chemistry published from April to September 2006. A detailed subject index and a list of supplementary references complete the book.

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The Investigation of Organic Reactions and Their Mechanisms. Edited by Howard Maskill (University of Newcastle upon Tyne, U.K. and University of Santiago de Compostela, Spain). Blackwell Publishing: Oxford. 2006. xxii + 370 pp. \$199.99. ISBN 978-01-4051-3142-1.

Unsigned book reviews are by the Book Review Editor.

This book was designed for “chemists who do not have a strong background in physical/mechanistic organic chemistry but who want to characterize an organic chemical reaction and investigate its mechanism.” There are 12 chapters written by a group of European experts in the various techniques discussed that cover three main areas, according to the editor: (1) methods of investigating reactions, such as product analysis, kinetics, electrochemical methods, etc.; (2) types of reactions, such as those involving reactive intermediates and catalysis; and (3) special reaction conditions, such as multiphase processes. Each chapter can stand alone, although there are many cross references between chapters. The authors and editor focus throughout on how to investigate an organic chemical reaction, rather than merely listing the various mechanisms involved. Each chapter is well referenced, and many also provide a bibliography for further reading. A subject index completes the book.

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Biomaterials From Aquatic and Terrestrial Organisms. Edited by Milton Fingerman and Rachakonda Nagabhushanam (Tulane University, New Orleans). Science Publishers: Enfield, NH. 2006. xii + 610 pp. \$128.00. ISBN 1-57808-429-6.

This book covers some of the latest research in the development of natural products into commercially viable products to benefit mankind. Some of the topics covered in the 15 chapters include the use of compounds from plants to treat Alzheimer’s disease, anti-inflammatory and antiallergic properties of triterpenoids from plants, antiangiogenic compounds from marine invertebrates, and anticancer compounds from higher plants, to name a few. A subject index completes the book.

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Metal Ions in the Life Sciences, Volume 2: Nickel and Its Surprising Impact in Nature. Edited by Astrid Sigel, Helmut Sigel (University of Basel), and Roland K. O. Sigel (University of Zürich). John Wiley & Sons, Ltd.: Chichester. 2007. xxvi + 702 pp. \$355.00. ISBN 978-0-470-01671-8.

This book covers the latest research on nickel and its complexes and their role in Nature. There are 17 chapters written by an international group of experts in nickel chemistry who discuss a range of topics, such as the biogeochemistry of nickel and its release into the environment, the role of nickel in enzymes, and nickel toxicity and carcinogenesis, to name a few. An extensive subject index completes the book.

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The Chemistry of Organozinc Compounds, Parts 1–2. Edited by Zvi Rappoport (The Hebrew University, Jerusalem, Israel) and Ilan Marek (Technion-Israel Institute of Technology, Haifa, Israel). John Wiley & Sons, Ltd: Chichester. 2006. 1140 pp. \$930.00. ISBN 0-470-09337-4.

The fascinating structures, distinct reactivity, and broad utility of organozinc compounds continue to attract the interest of chemists. As a result, the in-depth summaries and recent advances in the field as contained in this monograph are timely and valuable. The 19 chapters are written by experts who provide extensive references to the primary literature and reviews. The two volumes focus on the synthesis, structure, and reactivity of organozinc compounds and their applications to synthetic organic chemistry. Their contents should be appreciated by those interested in or practicing organometallic chemistry and organic synthesis.

The first six chapters are primarily devoted to characterization of organozinc compounds. Chapter 1 is a brief outline of reaction mechanisms of zinc-containing enzymes. Although out of place in the context of organozinc chemistry, its contents are interesting and address the role of zinc in some classes of enzymes, e.g., oxidoreductases, transferases, hydrolases, and lyases. The second chapter, which provides a comprehensive description of structural organozinc chemistry, is a real gem. Not only are the structural aspects clearly presented, the syntheses of many of these fascinating compounds are outlined as well. Brief chapters on organozinc thermochemistry, ^{67}Zn NMR spectroscopy, and mass spectrometry follow. The latter is a description of the use of various ionization techniques to identify a host of organozinc complexes—neutral, ionic, polymetallic, etc.—their reactivity, and fragmentation in the MS. In Chapter 6, the dynamic behavior of organozinc compounds is described, with focus on the most studied areas, viz., exchange of organic groups between zinc centers, and stereodynamics of zinc-bound carbon. Rather than highlight organozinc compounds exclusively, the dynamic processes of organometallics based on Li, Mg, Hg, Cd, Al, In, and Zn are compared, making this contribution quite valuable by putting zinc chemistry in context.

Chapters 7–19 are largely concerned with the synthesis and reactivity of organozinc complexes, beginning with zinc carbenoids and their reaction with carbon–carbon double bonds to form cyclopropanes. After an up-to-date discussion of the structure and reactivity of zinc carbenoids in Chapter 7, the reader is guided through reaction mechanisms, substrate scope, and enantio- and diastereoselective cyclopropanations with stoichiometric promoters and asymmetric catalysts. An excellent review on the synthesis and reactions of functionalized organozinc reagents is the subject of Chapter 8. Both direct reactions of functionalized organozinc reagents and those catalyzed by other metals are covered. Sandwiched in the thick of the chapters on organozinc chemistry is an incongruous chapter (9) on the photochemistry of zinc-based porphyrins and phthalocyanines. Allenylzinc reagents are the topic of the following chapter, with emphasis on their preparation, reactivity, and utility in natural product synthesis. The often perplexing stereochemical consequences of allenylzinc additions to electrophiles are clearly addressed. The first volume concludes with Chapter 11, an exhaustive account of organozinc reagents in cross-coupling reactions and their application to organic synthesis. Here, organozinc precursors are compared with their Mg, Al, and Zr counterparts. Optimization of these coupling reactions can involve a myriad of parameters, many of which are outlined, making this review a valuable starting point.

Volume 2 begins with Chapter 12, in which enantioselective 1,2- and 1,4-additions of a host of organozinc reagents, including

autocatalytic processes, are highlighted. The diverse rearrangements of organozinc compounds are succinctly reviewed in the following chapter in a clear and organized fashion. The rearrangements typically form carbon–carbon bonds and new organometallic species, which can be further elaborated. By addressing the synthesis and reactions of 1,1-bimetallic reagents, the author of Chapter 14 nicely highlights the utility of these interesting compounds in tandem reactions. A chapter on the preparation and chemistry of highly reactive organozincates follows. Through comparison of the various types of zincates, the reader is acquainted with the broad reactivity and utility of these species in organic synthesis. On the other end of the reactivity spectrum are fluorinated organozinc reagents, the subject of Chapter 16, which are considerably less nucleophilic with respect to their non-fluorinated counterparts. A thorough overview of their synthesis and reactivity is given. As an alternative to the traditional preparation of organozinc halides, the following chapter covers the advantages of electrochemical generation of these compounds. The use of transition metal catalysts in the electrochemical generation of organozinc complexes is quite interesting, and discussion of the reaction

mechanisms is educational. The authors present a convincing case that electrochemical generation of organozinc reagents can be easily accomplished. The subject of the penultimate chapter is the chemistry of zinc enolates. Beginning with the classic Reformatsky reaction, the reader is quickly introduced to the latest developments including catalytic asymmetric variants. Zinc enolates react with an array of substrates, and representative examples of each are provided. Carbozincation reactions are covered in detail in the final chapter. The addition of zinc carbon bonds across unsaturated carbon–carbon double and triple bonds is examined with and without catalysts. The fascinating reactivity of allylic and allenylzinc reagents is highlighted. While each chapter is completely independent, there is some redundancy.

This treatise supplies many useful examples and will give the reader a real appreciation of the diverse nature of organozinc chemistry. I highly recommend that chemistry libraries add these volumes to their collection.

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