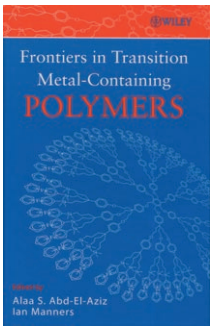
Frontiers in Transition Metal Containing Polymers



Edited by *Alaa S. Abd-el-Aziz* and *Ian Manners*. John Wiley & Sons, Hoboken 2007. 533 pp., hardcover € 125.00.—ISBN 978-0-471-73015-6

The emergence of metallopolymers as functional materials is at the center of the intense current interest in metal-containing polymers, as pointed out in an informative preface by the editors of this book, Alaa Abd-el-Aziz and Ian Manners. This drive towards new applications is, of course, only possible through the major progress that has been achieved in the controlled synthesis of metal-containing polymers. As shown by the beautiful illustrations throughout the book, more complex polymer architectures are now readily accessible, including metal-containing block copolymers, telechelic polymers, and dendritic structures. Fueled by these advances in synthesis, new applications of metallopolymers continue to emerge. These take advantage of the unique electronic, magnetic, and optical characteristics of transition-metal complexes, as well as their versatile catalytic behavior. The editors have done an outstanding job in assembling a superb line-up of world-renowned leaders in the field, who, throughout the 13 chapters, demonstrate to us how appropriate choices of the transition metals, the surrounding ligands, and the supporting polymer architecture lead to the fascinating properties that many functional metallopolymers possess.

The book is organized in a highly intuitive way. The introductory chapter by Pittman and Carraher provides plenty of details about how, and with what aims, organometallic polymers were developed in "the early days"—the kind of information that is often not contained in the original research articles. In addition, the vivid description of the authors' initial experiences adds a pleasant personal touch. In the following chapter, Abd-el-Aziz and Shipman provide a more general overview of recent advances in the area of organometallic polymers. There is considerable overlap with material presented in the later chapters that deal with more specific research topics. However, to avoid that is difficult, and perhaps it is unimportant, because the first two chapters will certainly be appreciated by newcomers to the field, and at the same time they provide a general resource for the more experienced researchers.

Most of the subsequent chapters are focused on specific areas of intense current interest and are more detailed in their coverage, although the scope and depth varies somewhat from chapter to chapter, as is usually found for edited books. The chapter by Rider and Manners expands naturally on the previous discussion about organometallic polymers, in that it concentrates on block copolymers with transition metals in the main chain. The main focus is on ferrocene-containing block copolymers, their assembly properties in solution, and the formation of unusual nanostructured materials in the bulk. Metal-coordination complexes used for the supramolecular assembly of polymers are also discussed briefly here, but are treated more extensively in a separate chapter by Chan and Cheng, which is specifically concerned with the formation of nanostructured materials from metal-coordination polymers. In this context, Chan and Cheng also discuss some of the exciting recent research on the self-assembly properties of organic block copolymers in which transition-metal complexes are coordinated as side groups to one of the constituent blocks.

Two chapters are devoted to conjugated metallopolymers. MacLachlan provides a comprehensive overview of π-conjugated polymers and their modification with transition metals, either as part of the side chain or incorporated into the main chain through M–C bonds (organometallic complexes) or M–X bonds (coordination complexes). Their versatile applications as sensors and optoelectronic materials are covered in depth, and a concluding section offers an interesting personal view by the author about the future directions and challenges ahead. Polymetallaynes are discussed separately by Wong and Ho. Details of the unusual photophysical properties of these polymers and their potential applications are nicely incorporated, which makes this chapter particularly valuable for readers interested in optoelectronic materials.

The interaction of polymers with light is also the key aspect in the area of metal–metal-bonded polymers, as described by Tyler. However, one of the most important features of interest, especially in the case of organometallic derivatives, is the occurrence of photochemical reactions that lead to selective, and in some cases reversible, cleavage of the metal–metal bond. An intriguing and still evolving area that is briefly covered is the formation of infinite metal chains, in which supporting ligands typically serve to stabilize and solubilize the metal chains. Finally, the chemistry of coordination polymers that feature metal–metal-bonded species or metal clusters follows more closely the typical characteristics of coordination polymers. Thus, this topic connects seamlessly to the following chapter by Harvey on metal coordination and organometallic polymers with diphosphine and diisocyanide ligands, which have recently taken on an important role as an alternative to the more commonly used amine-type ligands.

Nishihara introduces several (selected) examples of redox-active multinuclear complexes, where electronic communication through π-conjugated bridging ligands is investigated. Some aspects mentioned in the above review of conjugated polymers containing transition metals are discussed here in greater depth. The chapter also briefly discusses some very recent stud-

ies of the bottom-up construction of coordination polymers on surfaces, where different transition metals can be placed at well-defined positions through alternate deposition of terpyridine ligands and the desired transition metals. Controlled placement of transition metals in polymeric structures is also possible by using dendrimers as scaffolds. Hwang and Newkome describe recent advances in these areas, by looking primarily at coordination complexes using dendrimers and their applications, whereas, in a separate chapter, Astruc specifically covers iron complexes and their uses as "molecular batteries" and in the area of anion recognition.

A chapter by Mahmoud and Kraatz on the incorporation of transition metals into peptide-like structures, and a brief account by Shionoya on the preparation of artificial metallo-DNAs and peptides, conclude the book, thereby paying tribute to metal-containing biopolymers, one of the latest frontiers in the use of transition metals in polymeric structures.

In summary, the exceptionally high quality of the individual chapters, which concisely and comprehensively cover focused areas of research within the general context of transition-metal-containing polymers, make for an attractive, timely, and highly informative book. Viewed as a whole, the contributors strike an excellent balance between providing a more general overview and offering details from—in many cases very recent—original research. The book certainly does not aim to be fully comprehensive, but the wide variety of different topics presented makes it very useful, both for researchers in the field and for newcomers. A detailed index helps to locate specific information of interest in the individual, self-consistent chapters. I highly recommend this text as an excellent resource for anyone interested in learning more about metal-containing polymers, be it to get the latest inside scoop on a specific topic or to be fascinated by the bigger picture of this rapidly evolving field of polymer science.

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