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BOOK REVIEWS

Inclusion Polymers. Edited by Gerhard Wenz (Universität Saarlandes, Saarbrücken, Germany). From the series, Advances in Polymer Science, 222. Springer-Verlag: Berlin, Heidelberg.2009. xii + 240 pp. $249. ISBN 978-3-642-01409-3.

This book focuses on a discussion of the formation of supramolecular inclusion complexes between polymers and cyclic host molecules, mainly cyclodextrins—and to a much more limited extent, cucurbiturils. Cyclodextrins, cyclic oligomers of α(1→4)-linked anhydroglucose units, are by far the most commonly used hosts for the formation of inclusion complexes involving a wide range of molecular guests. In my opinion, the editor accomplishes three main objectives with this book: reporting interesting interactions between cyclodextrin hosts and polymers as guests; describing the differences between polymeric supramolecular structures and regular polymers; and investigating the applications of cyclodextrin inclusion complexes of polymers. These objectives are accomplished through a targeted and concise overview of the physical, chemical, and host properties of cyclodextrins and their inclusion complexes with polymers written by the editor, followed by five chapters written or cowritten by other leading researchers in the field, in which they describe specialized applications of cyclodextrin inclusion complexes of polymers, focusing primarily on their own research programs.

The first chapter is a well-written overview of cyclodextrins and cyclodextrin host−guest chemistry, in which the binding and molecular recognition of monomers and polymers are described. It could be used as an introduction to these topics by any chemist interested in cyclodextrin chemistry. Particularly useful is a table that provides a "supramolecular toolbox" of cyclodextrins, including the cavity size, solubility, substituents, and degree of substitution of a wide range of native and common commercially available modified cyclodextrins. Wenz also discusses the molecular recognition of various types of polymers, including those with appended guest binding sites, those with binding sites in the polymer chain, and block copolymers.

The subsequent four chapters cover specific applications of cyclodextrin inclusion complexes of polymers. The second chapter addresses drug delivery and focuses on cyclodextrin polyrotaxanes. Polyrotaxanes are also discussed in the third chapter, which covers both physical (supramolecular) and chemical cross-linking of cyclodextrin-included polymers resulting in the formation of hydrogels, which also have potential applications in drug delivery. The fourth chapter is an extensive description of the modification of polymers using cyclodextrins, either through nanostructuring involving the coalescence of cyclodextrin−polymer inclusion complexes or by covalent binding of cyclodextrins to polymers, either as side chains or in the polymer backbones. This latter approach allows for the facile incorporation of additives with specific properties, such as antibacterials, insect repellents, and flame retardants. The fifth chapter is a description of the inclusion of monomers as guests in cyclodextrins and the resulting improvements in the polymerization process that can be obtained.

The final chapter is less directly connected to the others. It covers the inclusion complexes both of cyclodextrins and of cucurbiturils, another macromolecular ring-shaped host compound, with dendrimers. Although, as the authors argue, dendrimers can be considered as polymers, their regular, finite structures make them quite different from typical polymers as guests. The most interesting section in this chapter is the use of CB[8], a relatively large cavity host, to provide redox control of the self-assembly of dendrimers with single binding sites, resulting in the formation of supramolecular dimers.

My main criticism of the book is that it lacks cohesion: there is limited flow between the chapters. There is too much repetition at the start of each chapter concerning the basic properties of cyclodextrins, and there is a range in the quality of the writing by the various authors. Unfortunately, the book reads more like a set of independent review articles and research accounts rather than a concerted effort to present a focused monograph on inclusion polymers. There is also a significant mistake in the text (p. 187) in which it is stated that the fluorescence intensity of 8-anilino-1-naphthalenesulfonic acid (ANS), a commonly used polarity-sensitive fluorescent probe, increases with increasing polarity of the medium with an accompanying blue shift; in fact, the opposite dependence of intensity with polarity occurs.

Despite the aforementioned criticisms, there are some important and well-described underlying themes that run throughout the book and all of its chapters. First, supramolecular chemistry can be successfully applied to polymers and polymerization. Second, the formation of cyclodextrin inclusion complexes significantly changes guest polymer properties, leading to a variety of useful applications. Third, inclusion is a reversible process; therefore, the cyclodextrin hosts can be removed after polymerization or modification. Finally, cyclodextrins are nontoxic, bioassumable, and biodegradable, and thus the resulting polymer inclusion complexes have tremendous applications in health, e.g., as drug carriers, as well as environmental sciences.

Overall, this book is well written and comprehensive, successfully covering the current state of knowledge of (mainly) cyclodextrin inclusion complexes of polymers, their applications, and their potential and future research directions. *Inclusion Polymers* is recommended for polymer and supramolecular chemists alike and represents a significant contribution to the literature.

Brian D. Wagner, *University of Prince Edward Island*

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