Inclusion Polymers

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1. Auflage 2009. Buch. xi, 240 S. Hardcover
ISBN 978 3 642 01409 3
Format (B x L): 15,5 x 23,5 cm
Gewicht: 589 g

Preface

Since Hermann Staudinger coined the concept of macromolecules as covalently linked very large molecular entities in 1922, the main focus of ongoing research has been on the synthesis of polymers and copolymers leading to a great variety of stable, structural, and functional materials. On the other hand, during the last 15 years the knowledge about supramolecular self-organization of polymers with low molecular-weight compounds by reversible non-covalent interactions gained increasing attention. In particular, the interactions of cyclic molecules, called hosts, with polymers became increasingly attractive, since the properties of polymers such as solubility or crystallinity can be altered without the need of chemical reactions. In contrast to regular polymers or copolymers, supramolecular structures comprised of polymers and ring-shaped hosts are not totally stable. Therefore they can show programmable lifetimes or adapt specifically to different environments. In this respect polymeric supramolecular structures resemble living systems more than regular polymers.

This volume is mainly devoted to a very fascinating class of ring-shaped cyclic $\alpha(1\rightarrow4)$ linked oligo-glucans, named *cyclodextrins*. Cyclodextrins are industrially produced from the renewable resource starch. They are especially suitable for the self-assembly of water based supramolecular structures, and they are highly biocompatible. Cyclodextrins are able to complex both monomers and polymers which offer suitable hydrophobic binding sites. The driving forces are mainly van der Waals and hydrophobic interactions. This complexation process is called *inclusion* and the resulting supramolecular structures *inclusion compounds*. In addition, Chapter 6 of this volume is devoted to another interesting host, a cyclic urea compound called cucurbituril, which is able to recognize cationic guest molecules in aqueous solution.

In the first chapter I shall describe basic principles of molecular recognition of monomers and polymers by cyclodextrins (G. Wenz, in Volume 222, Chapter 1) and try to provide an overview of inclusion polymers with cyclodextrins. The following chapters are more specialized. They are about functional cyclodextrin polyrotaxanes for drug delivery (N. Yui, R. Katoono, A. Yamashita, in Volume 222, Chapter 2), cyclodextrin inclusion polymers forming hydrogels (J. Li,

in Volume 222, Chapter 3), molecular processing of polymers with cyclodextrins (A.E. Tonelli, in Volume 222, Chapter 4), polymerization of included monomers and behaviour of resulting polymers (S.W. Choi, S. Amajjahe, H. Ritter, in Volume 222, Chapter 5), and cucurbituril and cyclodextrin complexes of dendrimers (W. Wang, A.E. Kaifer, in Volume 222, Chapter 6).

We have described the versatile field of inclusion polymers from several directions and have tried to contribute to some broader application of cyclic host molecules for the variation of physical and chemical properties of polymers. Hopefully, this volume will be beneficial to readers of the polymer community who like to enter the fascinating field of supramolecular polymer chemistry.

Saarbrücken, Spring 2009 *Gerhard Wenz*