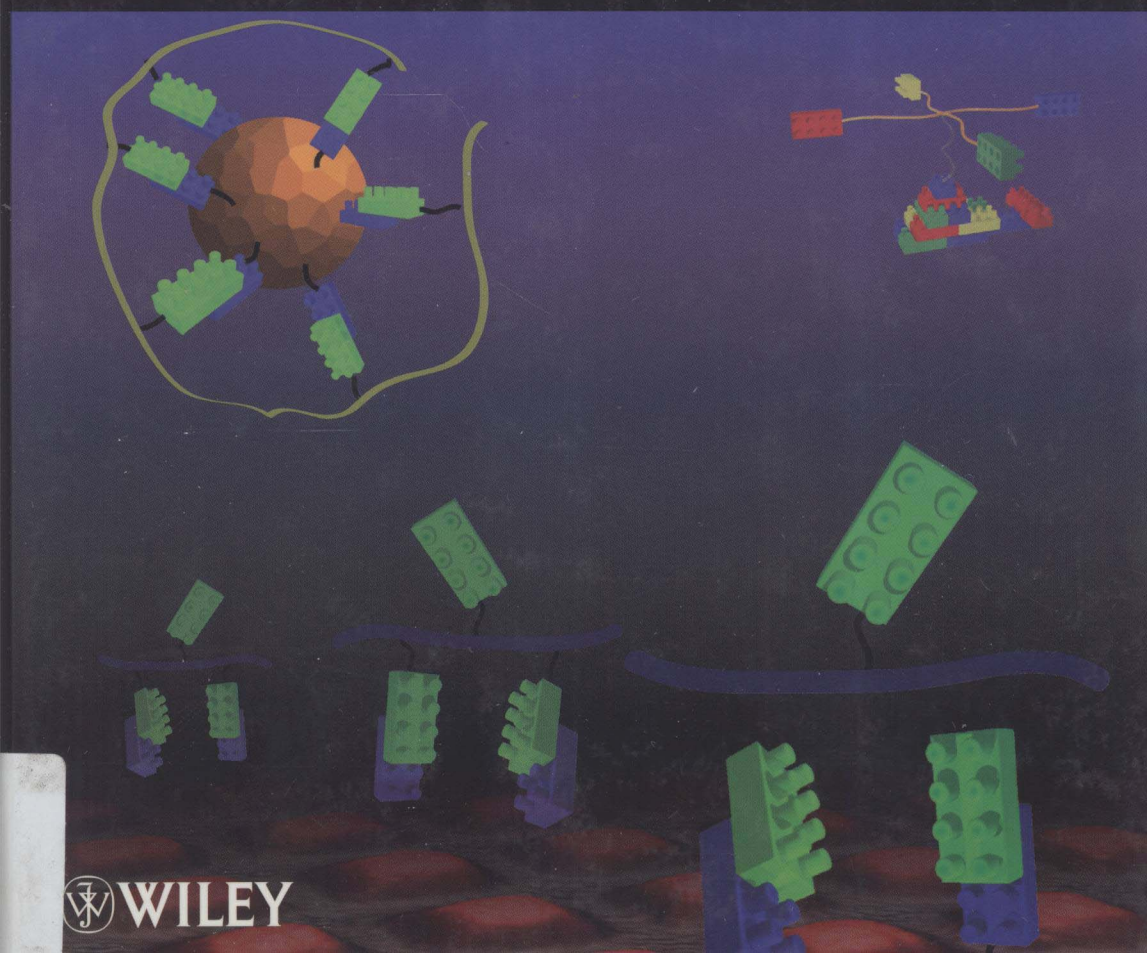
Molecular Recognition and Polymers

Control of Polymer Structure and Self-Assembly

Edited by

Vincent Rotello and S. Thayumanavan



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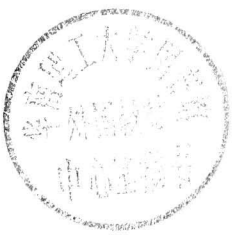

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MOLECULAR RECOGNITION AND POLYMERS

This book is dedicated to the memory of Dmitry Rudkevich, and to his wife, Sasha, and sons, Dmitry Jr. and Eric.

PREFACE

Inter- and intramolecular networks of non-covalent interactions are responsible for a wide array of phenomena in fields of biology and chemistry. Biological systems use specific patterns of complementary functionality to provide exquisite control over biopolymer recognition processes such as protein–protein and protein–polynucleic acid binding. In Nature, these specific supramolecular interactions play many key roles, including stabilization of structure, information storage and transfer, catalysis and self-assembly. Likewise, controlled application of non-covalent interactions provides an effective tool for fabrication of man-made systems, allowing the creation of higher-order architecture required for devices and materials, as well as the dynamic properties required for efficient utilization of these attributes.

The use of specific interactions to control polymer structure and properties is a rapidly emerging field. We have assembled a group of authors at the forefront of this field that are studying both the fundamental science inherent in polymer self-assembly and applications of this strategy to functional systems. This book is designed for researchers in a wide range of areas, and features both fundamental aspects and applications of these fascinating systems.

The book is divided into three sections. The first section provides a general overview of the fundamentals of supramolecular polymers. In Chapter 1, Thibault and Rotello provide a brief introduction to these systems and in Chapter 2, Azagarsamy, Krishnamoorthy, and Thayumanavan describe the rapidly emerging area of amphiphilicity in polymer and dendrimers self-assembly. Interactions at interfaces are sometimes similar but often quite different than those in solution, a topic covered by Loveless, Kersey, and Craig in Chapter 3.

The second section of the book provides a wide variety of examples of the self-assembly of polymer systems. Aspects covered include hydrogen bond-mediated

recognition and self-assembly using block copolymers and telechelic oligomers, as described in Chapter 4 by Mather and Long. Chapter 5 covers the highly versatile "plug and play" non-covalent sidechain modification of polymers, as described by Nair and Weck. Extension of this polymer-mediated assembly to nanoparticles is the focus of Chapter 6 by Chen, Ofir, and Rotello, while Chapter 7 by McKenzie and Rowan describes metallo-supramolecular systems. In Chapter 8, Mason, Steinbacher, and McQuade provide an overview of capsule formation using polymers and biopolymers. Chapter 9 by Gong features the efforts of synthetic chemists to replicate the specific hydrogen bonding patterns found in biology. Chapter 10 focuses on function, with Guan covering the use of supramolecular polymer systems to tailor mechanical properties. Shao and Parquette outline the use of hydrophobicity to control dendrimers structure and dynamics in Chapter 11.

The third section of the book covers the area of biomolecular recognition using polymer systems. The creation of colorimetric sensors using polymers is presented by Basu in Chapter 12. Chapter 13 by Cloninger focuses on glycopolymers and glycodendrimers, while in Chapter 14, Dong, Yuwono, and Hartgerink cover the creation of nanofibers via peptide self-assembly. Finally, in Chapter 15, Wu and Shimizu provide an overview of the field of molecularly-imprinted polymers, describing the formation of these systems and their applications.

Supramolecular chemistry is a beautiful field, featuring modularity, tenability, and versatility. We hope that this book fires your imagination for this emerging field.

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LIST OF FIGURES