

Contents

1	Overview – What is Supramolecular Chemistry?	1
	References	6
2	The Chemistry of Molecular Recognition – Host Molecules and Guest Molecules	7
2.1	Molecular Recognition as the Basis for Supramolecular Chemistry	9
2.2	Molecular Interactions in Molecular Recognition	10
2.3	Crown Ethers and Related Hosts – The First Class of Artificial Host	12
2.4	Signal Input/Output in Crown Ether Systems	14
2.5	Chiral Recognition by Crown Ethers	17
2.6	Macrocyclic Polyamines – Nitrogen-Based Cyclic Hosts	18
2.7	Cyclodextrin – A Naturally Occurring Cyclic Host	21
2.8	Calixarene – A Versatile Host	24
2.9	Other Host Molecules – Building Three-Dimensional Cavities	28
2.10	Endoreceptors and Exoreceptors	30
2.11	Molecular Recognition at Interfaces – The Key to Understanding Biological Recognition	32
2.12	Various Designs of Molecular Recognition Sites at Interfaces	34
	References	38
3	Controlling Supramolecular Topology – The Art of Building Supermolecules	45
3.1	Fullerenes – Carbon Soccer Balls	46
3.2	Carbon Nanotubes – The Smallest Tubular Molecules	49
3.3	Dendrimers – Molecular Trees	52
3.4	Rotaxanes – Threading Molecular Rings	59
3.5	Catenanes and Molecular Capsules – Complex Molecular Associations	63
	References	70

4	Molecular Self-Assembly –	
	How to Build the Large Supermolecules	75
4.1	Programmed Supramolecular Assembly	77
4.2	Supramolecular Crystals	83
4.3	Macroscopic Models of Supramolecular Assembly	87
4.4	Supramolecular Assembly through Fuzzy Interactions	88
4.5	Structures and Formation Mechanisms of Cell Membranes	89
4.6	Micelles – Dynamic Supramolecular Assemblies	90
4.7	Liposomes, Vesicles, and Cast Films – Supramolecular Assembly Based on Lipid Bilayers	93
4.8	Monolayers and LB Films – Controllable Layered Assembly	101
4.9	Self-Assembled Monolayers – Monolayers Strongly Bound to Surfaces	106
4.10	Alternate Layer-by-Layer Assembly – Supramolecular Architecture Obtained with Beakers and Tweezers	110
4.11	Hierarchical Higher Organization – From Bilayers to Fibers and Rods	113
4.12	Artificial Molecular Patterns – Artificially Designed Molecular Arrangement	117
4.13	Artificial Arrangement of Molecules in a Plane – Two-Dimensional Molecular Patterning	119
	References	125
5	Applications of Supermolecules –	
	Molecular Devices and Nanotechnology	137
5.1	What is a Molecular Device?	138
5.2	Reading Signals from Molecular Device	140
5.3	Molecular Electronic Devices – Controlling Electricity Using Supermolecules	144
5.4	Molecular Photonic Devices – Controlling Light with Supermolecules	149
5.5	Molecular Computers – Supermolecules that can Think and Calculate	150
5.6	Molecular Machines – Supermolecules that can Catch Objects, Move and Rotate	155
5.7	Molecular Devices with Directional Functionality – Supermolecules that Transmit Signals in a Desired Direction	161
5.8	Supramolecular Chemistry & Nanotechnology toward Future References	166 167

6	Biological Supermolecules – Learning from Nature	175
6.1	Supramolecular Systems Seen in the Biological World	177
6.2	Controlling Material Transport – Ion Channels	179
6.3	Information Conversion and Amplification – Signal Transduction	181
6.4	Energy Conversion – Photosynthesis	183
6.5	Material Conversion – Natural and Artificial Enzymes	185
6.6	Cleaving Genes – Restriction Enzymes	188
6.7	Tailor-Made Enzymes – Catalytic Antibodies	191
6.8	Key to the Origin of Life – Ribozymes	193
6.9	Combinatorial Chemistry and Evolutionary Molecular Engineering	194
	References	196
Subject Index	205