

## Contents

### Preface ix

<b>1</b>	<b>Introduction</b>	<b>1</b>
	<i>Chuanlai Xu, Hua Kuang, and Liguang Xu</i>	
1.1	Chirality and Asymmetry	1
1.2	Chiral Origin of Nanomaterials	2
1.2.1	Chiral Geometries of Nanoparticles	2
1.2.2	Structural Origins of Chirality	6
1.3	Relationship with Known Chiral Materials	10
1.3.1	Similarity to Chiral Inorganic and Organic Molecules	10
1.3.2	Similarity to Biological Nano- and Mesoscale Compounds	11
1.3.3	Hierarchical Chirality	11
1.4	Characterization Methods	12
1.4.1	Optical Spectra of Chiral Nanostructures	12
1.4.2	Methodological Aspects for Computational Studies	14
1.4.3	Selected Computer Modeling Study	17
	References	20
<b>2</b>	<b>Chiral Nanocrystals</b>	<b>27</b>
	<i>Chuanlai Xu, Liguang Xu, and Si Li</i>	
2.1	Synthetic Methods	28
2.2	Chiral Semiconductors	29
2.2.1	Semiconductor Nanoparticles	29
2.2.2	Semiconductor Helicoids	38
2.3	Chiral Metal Nanostructures	40
2.3.1	Metal Nanoparticles/Nanorods	41
2.3.2	Metal Nanohelices	50
2.3.3	Metal Nanorings and Superstructures	54
2.4	Chiral Metallic Compound Nanoparticles	59
2.4.1	Chiral Oxide Nanoparticles	59

- 2.4.2 Chiral Sulfide/Selenide Nanoparticles 64
- 2.4.3 Ceramic Nanohelices 69
- References 71
  
- 3 Chiral Nanoassemblies 79**  
*Chuanlai Xu, Xiaoling Wu, and Changlong Hao*
- 3.1 Twisted Nanorod Pairs 80
- 3.2 Chiral Nanoparticle Dimers 85
- 3.3 Tetramer Assemblies 90
- 3.4 Nanoparticle Helices 100
- 3.5 Chiral Nanochains 111
- 3.6 Core-Satellite Nanoassembly 113
- 3.7 Nanoplatelets and Chiral Films 129
- 3.8 Chiral Supraparticles 134
- References 139
  
- 4 Chiral Nanostructures for Biorecognition and Bioanalysis 149**  
*Chuanlai Xu, Yuan Zhao, and Xiaoling Wu*
- 4.1 Chiral Analysis Strategy 149
- 4.2 DNA Detection 150
- 4.3 Biomarker Bioanalysis 156
- 4.4 Enzyme Bioanalysis 164
- 4.5 Metal Ion Bioanalysis 170
- 4.6 Small Molecule Detection 175
- 4.7 Chiral Recognition 184
- 4.8 Future Prospects and Outlook 193
- References 193
  
- 5 Chiral Nanomaterials for Emerging Biological Effects 199**  
*Chuanlai Xu, Maozhong Sun, and Yuan Zhao*
- 5.1 Photothermal Therapy 199
- 5.2 Photodynamic Therapy 209
- 5.3 Multimodal Therapy Methods 220
- 5.4 Photochemical Effects 233
- 5.5 Future Prospects and Outlook 237
- References 237
  
- 6 Chiral Nanomaterials for Biocatalysis 241**  
*Chuanlai Xu, Wei Ma, and Hua Kuang*
- 6.1 Chiral Nanomaterials Based Enantioselectivity in Biocatalysis 241
- 6.2 Biocatalysis of Chiral Drugs and Related Chemical Intermediates Based on Chiral Nanomaterials 249
- 6.3 Biocatalysis of Peptides Based on Chiral Nanomaterials 257
- 6.4 Biocatalysis of Biological Macromolecules Based on Chiral Nanomaterials 261

6.5	Biocatalysis Based on Enzyme-Encoded Chiral Complex Nanomaterial System	264
6.6	Chiral Nanomaterials Based Biocatalysis In Situ for Emerging Biological Applications	269
	References	282
	<b>Index</b>	287

