

Contents

1 Fundamentals on Bionanotechnologies	1
1.1 Transport Phenomena at the Nanoscale	1
1.2 Nanotechnologies for Bionanoelectronic Devices	18
1.2.1 Deposition Techniques for Bionanoelectronic Devices	18
1.2.2 Nanolithography	20
1.2.3 Nanomaterials	27
1.3 Conduction Properties of Biological Materials	35
1.4 Microfluidics and Nanofluidics	46
References	54
2 Sensing of Biomolecules	57
2.1 Nanotransistors Based on Nanotubes, Nanowires, and Graphene for Biosensing	57
2.2 DNA Detection and Sequencing Using Nanopores	73
2.3 MEMS/NEMS Biodetection	80
2.4 Plasmonics Biodetection	87
2.5 Nanoelectronic Noses and Various Disease Detection	98
References	102
3 Imaging and Manipulation of Biomolecules	107
3.1 Bioapplications of Atomic Force Microscopy	107
3.2 Bioapplications of Scanning Tunneling Microscopy	114
3.3 Manipulation of Biological Materials	117
References	123
4 Nanomedicine	127
4.1 Drug Delivery and Healing Based on Nanomaterials	127
4.2 Biochips—DNA Arrays and Other Chips for Diagnosis	144
4.3 Artificial Tissues and Organs	146
References	148

5 Biomolecular Architecture for Nanotechnology	151
5.1 DNA-Based Molecular Architectures	152
5.2 Self-Assembled DNA Nanowires	155
5.3 Two- and Three-Dimensional Bioarchitectures as Scaffolds	159
5.4 Nonperiodic Biological Scaffolds for Inorganic Structures	165
5.5 Inorganic Scaffolds for Biomolecules	169
References	170
6 Biomolecular Machines	173
6.1 Biological Actuators and Switches	174
6.2 Biological Walkers	180
6.3 Biological Motors	183
References	187
7 Biomolecular Computing	189
7.1 Principles of Biomolecular Computing	189
7.2 Boolean Biomolecular Computing	192
7.3 Self-Assembly Biomolecular Computing	198
7.4 Biomolecular Logical Deductions	200
7.5 Biomolecular Memory Devices	201
7.6 Logical Drug Delivery and In Vivo Computation	203
References	205
8 Bioinspired Devices	207
8.1 Bioinspired Materials	208
8.2 Bioinspired Devices	215
8.3 Bioinspired Technological Processes	222
8.4 Devices Mimicking Biological Organs/Functionalities	224
References	229
9 Nano-Bio Integration	233
9.1 Nano-bio Materials for Electronics and Optoelectronics	233
9.2 Nano-bio Mechanical Devices	236
9.3 Nanobioelectronics and Optoelectronics	239
References	246
Index	249
About the Authors	253