

Table of Contents

Acknowledgements	v
Preface	vii
About the Authors	ix
1. Introduction and Historical Perspective	1
1.1 The Development of Nanoscale Science	1
1.2 The Nanoscale	7
1.3 Examples of Interesting Nanoscience Applications	8
2. Classical Physics at the Nanoscale	19
2.1 Mechanical Frequency	20
2.2 Viscosity	24
2.3 Brownian Motion of Nanoscale Objects	25
2.4 Motion at the Nanoscale	27
3. Brief Review of Quantum Mechanics	31
3.1 Basic Quantum Physics and Quantum Confinement	31
3.2 Basic Postulates of Quantum Mechanics	35
3.3 Hydrogen-Like Atoms: Orbitals and Atomic Structures	49
3.4 Spin	55
4. From Atoms and Molecules to Nanoscale Materials	61
4.1 Atoms and the Periodic Table of Elements	61
4.2 Molecules and Molecular Interactions	64
4.3 From Atoms to Solid Materials	76
4.4 From Molecules to Supramolecules	85
5. Surfaces at the Nanoscale	93
5.1 Surface Energy	93

5.2	Surface Reactivity and Catalysis	100
5.3	Surface Stabilisation	102
6.	Low-Dimensional Nanostructures	109
6.1	From 3D to 0D Nanostructures	109
6.2	Electron Transport Properties in Low Dimensional Systems	122
6.3	Quantum Dots, Quantum Wires	131
7.	Formation and Self-Assembly at the Nanoscale	141
7.1	Some Basic Thermodynamic Definitions	141
7.2	The Bottom-Up Approach	146
7.3	The Self-Assembly Processes	150
8.	Nanotools and Nanofabrication	159
8.1	Optical Microscopy	159
8.2	Electron Microscopy	162
8.3	Scanning Probe Microscopy	176
8.4	Optical Tweezers	190
9.	Future Trends	201
9.1	Nanotechnology and the Developing World	202
9.2	Beyond Moore's Law	203
9.3	Spintronics and Surface Chemistry	204
9.4	Carbon Electronics	206
Index		211