

Contents

1. Platonic Solids: Geometry and Symmetry	1
1.1 The Platonic Solids and Their Duals	1
1.2 Elements of Symmetry in Space	9
1.3 Polytopes in the Four Dimensional Space and Their Projections onto the Physical Space	13
1.4 Elements of Crystallography	18
1.5 The Reciprocal Lattice	29
2. Structural Order	33
2.1 Order and Disorder	33
2.2 Rules of Order	35
2.3 Order Parameters	37
2.4 Cellular Disorder and Topological Disorder	42
2.5 Structurally Disordered Materials	44
2.6 Description of Disorder Through Entropy	49
3. The Glass Transition	55
3.1 The Phenomenology of Glass Transition	55
3.2 Theories of the Glass Transition	69
3.3 Ease of Glass Formation	83
4. The Structure of Disordered Systems	95
4.1 Why We Study the Structure of Amorphous Systems	95
4.2 The Distribution Functions	97
4.3 Diffraction	106
4.4 X-ray absorption spectroscopy (XAS)	124
4.5 Mössbauer Spectroscopy	135
4.6 Vibrational Spectroscopies	139
4.7 Short Range Order	159
4.8 Medium Range Order	174
4.9 Structural Models	189
4.10 Collective Excitations	197

5. Clusters	207
5.1 Definition of an Atomic Cluster	207
5.2 Synthesis and Detection of Atomic Clusters	213
5.3 Structure of van der Waals Clusters	215
5.4 Structure of Alkali-Metal Clusters	232
5.5 The Fullerene C ₆₀	249
5.6 Nanostructured and Cluster-Assembled Materials	258
6. Quasicrystals	267
6.1 Periodic and Aperiodic Crystals	267
6.2 The Enlarged Notion of Crystal	274
6.3 Quasicrystals and Tilings	279
6.4 Model Structures and Crystalline Approximants	285
6.5 Structural Properties and Stability of Real Quasicrystals	298
A. Appendix	315
References	319
Index	325