## **CONTENTS**

CHAPTER 1	The Formation of Amorphous Solids			1
	1.1	Freezi	ng into the Solid State: Glass Formation	
		versus	Crystallization	1
	1.2	Prepar	ation of Amorphous Solids	5
	1.3		ıre, Solidity, and Respectability	10
	1.4	The G	lass Transition	16
	1.5	Applic	ations of Amorphous Solids	23
CHAPTER 2	Amo	orphous	Morphology: The Geometry and	
	Topology of Disorder			
	2.1	Introd	uction: Geometry, Chemistry, and the	
		Prima	cy of Short-Range Order	33
	2.2	Review	v of Crystalline Close Packing	35
	2.3	Partial	Characterizations of Structures	38
		2.3.1	Coordination Number	38
		2.3.2	Radial Distribution Function	40
		2.3.3	EXAFS	43
		2.3.4	Froth—The Honeycomb of Aggregated	
			Atomic Cells	45
		2.3.5	Atomic Polyhedra versus Polyhedral	
			Holes	47
	2.4	Rando	om Close Packing	49
		2.4.1	Empirical rcp Structure	49
		2.4.2	Theoretically Derived rcp	51
		2.4.3	Characterizations of the rcp Structure	54
		2.4.4	Peas in a Pot	56
		2.4.5	Dimensionality Considerations and the	
			Extendability of Local Close Packing	58
	2.5	Contin	nuous Random Network	60
		2.5.1	The Simplicial Graph	60
		2.5.2	Mathematical Bonds and Chemical	
			Bonds: The Covalent Graph	60
		2.5.3	The Continuous-Random-Network	
			Model of Covalent Glasses	63
		2.5.4	Prototype Elemental crn: Amorphous	
			Silicon	67

## **X** CONTENTS

	2.6	2.5.5 Prototype Binary crn: Fused Silica Experimental RDFs versus rcp and crn Models	72 73	
CHAPTER 3	Chalcogenide Glasses and Organic Polymers			
	3.1	Molecular Solids and Network Dimensionality	86	
	3.2 3.3	One- and Two-Dimensional-Network Solids Compositional Freedom in Chalcogenide	90	
		Glasses and in Oxides	97	
	3.4	The $8 - n$ Rule and the "Ideal Glass"	101	
	3.5	Topological Defects and Valence Alternation	104	
	3.6 3.7	The Random Coil Model of Organic Glasses Random Walks, Drunken Birds, and	107	
	3.8	Configurations of Flexible Chains SAWs, Mean Fields, and Swollen Coils	113	
		in Solution	120	
	3.9	Why Overlapping Coils are "Ideal"	127	
	3.10	Scaling Exponents and Fractal Dimensions	129	
CHAPTER 4	The Percolation Model			
	4.1	Introduction	135	
	4.2	An Example: The Vandalized Grid	136	
	4.3	The Percolation Path	139	
	4.4	Applications to Phase Transitions	146	
	4.5	Close to Threshold: Critical Exponents, Scaling, and Fractals	153	
	4.6	Trees, Gels, and Mean Fields	167	
	4.7	Continuum Percolation and the Critical		
		Volume Fraction	183	
	4.8	Generalizations and Renormalizations	191	
CHAPTER 5	Localization ↔ Delocalization Transitions			
	5.1	Localized-to-Extended Transitions in Amorphous Solids	205	
	5.2	Dynamic Modeling: Monte Carlo		
	0.4	Simulations of the Glass Transition	206	
	5.3	The Free-Volume Model of the Glass Transition	212	
	5.4	Free Volume, Communal Entropy, and		
		Percolation	218	
	5.5	Electron States and Metal ↔ Insulator		
		Transitions	223	

		CONTENTS	хi
	5.6	Disorder-Induced Localization: The Anderson	
		Transition	231
	5.7	Scaling Aspects of Localization	242
CHAPTER 6	Optical and Electrical Properties		
	6.1	Local Order and Chemical Bonding	252
	6.2	Optical Properties	260
	6.3	Electrical Properties	274
	6.4	Native Defects and Useful Impurities	289
	Ind	ex	297