

Contents

Chapter 1.	Introduction	1
	1.1. Thermodynamic Properties at Low Temperatures	1
	1.2. Implications for Design of Equipment	11
	1.3. Useful Theoretical Concepts	13
	1.4. Plan of This Book	24
Chapter 2.	Basic Theory and Techniques	27
	2.1. Introduction	27
	2.2. Thermodynamics	27
	2.3. Statistical Mechanics	37
	2.4. Bonding and Interatomic Potentials	45
	2.5. Some Model Systems	48
	2.6. Lattice Vibrations	54
	2.7. Approximate Equations of State	73
	2.8. Anisotropic Strain and Stress: Elasticity	76
	2.9. Calculation of Θ_0^{el} , γ_0^{el} and $\gamma_{\lambda,0}^{el}$ from Elastic Data	86
	2.10. Internal Strain	88
Chapter 3.	Measurement Techniques	89
	3.1. General Principles	89
	3.2. Heat Capacity . . . by S. J. Collocott	93
	3.3. Thermal Expansion	105
	3.4. Elastic Moduli	118

Chapter 4.	Fluids	129
	4.1. Introduction	129
	4.2. Gases	130
	4.3. Liquids and Dense Gases	137
	4.4. Quantum Fluids; Liquid Helium	141
Chapter 5.	Non-Metals	153
	5.1. Introduction	153
	5.2. Rare Gas Solids	154
	5.3. Rocksalt Structure	157
	5.4. Fluorite Structure	161
	5.5. Tetrahedrally Bonded Crystals	162
	5.6. Useful Oxides: α -Al ₂ O ₃ , MgO, α -SiO ₂ , TiO ₂ , ThO ₂ , ZrO ₂ (stab.)	171
	5.7. Glasses and Glass Ceramics	174
	5.8. Highly Anisotropic Crystals	188
	5.9. Polymers	192
	5.10. High T_c Superconductors	200
	5.11. Non-Metallic Magnetic Crystals	210
	5.12. Mixed Systems, Dipoles etc.	217
Chapter 6.	Metals	225
	6.1. Introduction	225
	6.2. Cubic Metals	228
	6.3. Non-Cubic Metals	239
	6.4. Magnetic Metals	246
	6.5. Type I and Type II Superconductors	254
	6.6. Heavy Electron Metals	262
Chapter 7.	Polycrystals, Composites and Aggregates	267
	7.1. Introduction	267
	7.2. Theory	269
	7.3. Experiment	274
Chapter 8.	Cryocrystals, Clathrates and Curiosities	277
	8.1. Cryocrystals	277
	8.2. Other Rotationally Disordered Crystals	281
	8.3. Clathrates	284
	8.4. Curiosities	287

Chapter 9. Conclusion	295
Appendix A. Axes and Unit Cells in Crystals	297
Appendix B. Manipulating Thermodynamic Expressions	299
Appendix C. Tables	303
Appendix D. Commonly Used Symbols	311
References	313
Index	333