

Contents

Preface	vii
---------------	-----

Part I. Shock-Compression Science 1

Chapter 1. Introduction	3
1.1. Shock Compression of Solids	3
1.2. Fluidlike Deformation of Shock-Compressed Solids	4
1.3. Shock-Compression Paradigms: Benign and Catastrophic	5
1.4. Origins of Shock-Compression Science	6
1.5. Pressure Scale of Events	7
1.6. Review Articles	9
1.7. The Layout of this Work	11
1.8. A Note on Sign Conventions	12

Part II. Mechanical Response of Shock-Compressed Solids 13

Chapter 2. Basic Concepts and Models	15
2.1. Regimes of Mechanical Response	15
2.2. Nonlinear Elastic Compression	21
2.3. Stress Tensors	26
2.4. The Hugoniot Elastic Limit	27
2.5. Elastic-Plastic Deformation	31
2.6. Hydrodynamic Flow	36
2.7. Phase Transformations	37
2.8. Release Waves	41
2.9. Other Mechanical Aspects	44
2.10. First- and Second-Order Behaviors	51

Chapter 3. Experimental Methods	53
3.1. Shock-Loading Methods	55
3.2. Measurement of Wave Profiles	62
3.3. Physical Categories of Detectors	65
3.4. Shock-Compression Gauges Cannot Be "Calibrated"	66
3.5. Advances in Measurement Technology	67
Part III. Physical Properties of Shock-Compressed Solids	69
Chapter 4. Physical Properties Under Elastic Shock Compression	71
4.1. Nonlinear Piezoelectric Properties	72
4.2. Normal Dielectrics	85
4.3. Shock-Induced Conduction in Elastic Dielectrics	87
4.4. Semiconductors Under Large Elastic Strain	90
4.5. Elastic Physical Properties	94
Chapter 5. Physical Properties Under Elastic-Plastic Compression	97
5.1. Piezoelectric Responses of Crystals in the Elastic-Plastic Range	98
5.2. Piezoelectric Polymers	103
5.3. Ferroelectric Solids	113
5.4. Ferromagnetic Solids	114
5.5. Resistance of Metals	126
5.6. Shock-Induced Electrical Polarization	128
5.7. Electrochemistry	134
5.8. Elastic-Plastic Physical Properties	136
Part IV. Chemical Processes in Shock-Compressed Solids	139
Chapter 6. Shock-Compression Processes in Solid State Chemistry	141
6.1. Background	141
6.2. Conceptual Models	144
6.3. Mathematical Models	148
6.4. Shock Compression of Porous Powder Compacts	149
6.5. Sample Preservation Technique	151

Chapter 7. Shock Modification and Shock Activation: Enhanced Solid State Reactivity	160
7.1. Shock Modification	160
7.2. Shock Activation: Enhanced Solid State Reactivity	172
Chapter 8. Solid State Chemical Synthesis	179
8.1. Zinc Ferrite Synthesis	180
8.2. Intermetallic Compound Synthesis	184
8.3. Metal-Oxide Systems	192
8.4. Shock-Induced Solid State Chemical Synthesis	194
Part V. Shock Compression of Solids as a Mechanical. Physical. Chemical Process	195
Chapter 9. The Shock-Compression Processes	197
9.1. Solid State Physics and Solid State Chemistry	197
9.2. Future Directions in Shock-Compression Science	199
References	201
Subject Index	215
Author Index	219