

# Contents

Preface .....	V
<b><i>Defining Ceramics</i></b> .....	XIV
1. Advanced Ceramics .....	1
<b><i>Understanding Ceramics</i></b> .....	14
2. Structures .....	15
2.1 <i>Chemical Structures</i> .....	16
2.1.1 Ionic Bond .....	22
2.1.2 Covalent Bond .....	29
2.1.3 Van der Waals Bond .....	47
2.1.4 Metallic Bond .....	49
2.2 <i>Crystal Structures</i> .....	59
2.2.1 Lattice Types .....	64
2.2.2 Crystal Types .....	74
2.2.3 Defect Types .....	111
2.3 <i>Microstructures</i> .....	143
2.3.1 Microstructure Features .....	143
2.3.2 Microstructure Design .....	150
2.3.3 Microstructure Visualization .....	157
<b><i>Observing Ceramics</i></b> .....	170
3. Properties .....	171
3.1 <i>Chemical Properties</i> .....	171
3.1.1 Phase Equilibria .....	171
3.1.2 Oxygen Environments .....	199
3.1.3 Technical Environments .....	199
3.1.4 Biological Environments .....	199
3.2 <i>Physical Properties</i> .....	210
3.2.1 Thermal Properties .....	210
3.2.2 Electromagnetic Properties .....	218
3.2.3 Optical Properties .....	236

3.3	<i>Mechanical Properties</i> . . . . .	238
3.3.1	Elastic Properties . . . . .	238
3.3.2	Plastic Properties . . . . .	248
3.3.3	Strength and Fracture . . . . .	260
3.4	<i>Special Issues</i> . . . . .	272
3.4.1	Superplasticity . . . . .	272
3.4.2	Superconductivity . . . . .	272
3.4.3	Bond Sensitivity . . . . .	326
<b><i>Manufacturing Ceramics</i></b> . . . . .		334
4.	<b>Technologies</b> . . . . .	335
4.1	<i>Powder-Based Technologies</i> . . . . .	341
4.1.1	Basic Procedures . . . . .	341
4.1.2	Advanced Procedures . . . . .	372
4.2	<i>Powder-Free Technologies</i> . . . . .	380
4.2.1	Chemical Procedures . . . . .	380
4.2.2	Vapour Deposition Procedures . . . . .	398
4.2.3	Bio-Inspired Mineralisation Procedures . . . . .	408
<b><i>Pointing into the Future of Materials</i></b> . . . . .		428
5.	<b>Future Materials</b> . . . . .	429
5.1	<i>Advanced Conceptions</i> . . . . .	430
5.1.1	Advanced Modeling of Particles/Spins . . . . .	430
5.1.2	Advanced Modeling of Substances/Materials . . . . .	445
5.1.3	Advanced Modeling of Threshold Ranges . . . . .	459
5.2	<i>Advanced Applications</i> . . . . .	488
5.2.1	Artificial Gravitation Technologies . . . . .	489
5.2.2	Energy Production Technologies . . . . .	489
<b>Bibliography</b> . . . . .		491
<b>Index</b> . . . . .		501