

INDEX

- Ab initio thermodynamics, 66
Absolute internal energy, 66
Absorption, 109
Adiabatic flame temperature, 201
Adsorption, 109
 chemical, *see* Chemisorption
 enthalpy of, 114
 physical, *see* Physisorption
Adsorption isotherm, 110
Aerogel, 168
Asymmetric unit, 21. *See also* Lattice point
Atomic diffusion, 84
 mechanism of
 in amorphous substances, 98
 in crystalline substances, 94
 non-steady-state, 85
 steady-state, 85
Atomic layer epitaxy, *see* Epitaxial deposition,
 atomic layer

Bivariant equilibrium, 58
Blanking, *see* Plastic deformation processing,
 blanking
Buerger, M. J., biography, 20
Brass texture, 259
Bravais-Friedel rule, 17
Bridgman technique, 36
Brunauer-Emmett-Teller (BET) isotherm, 110
Bulk metallic glass (BMG), 165
Burton-Cabrera-Frank (BCF) model, 29

Cage effect, 99
Calculation of phase diagrams (CALPHAD)
 method, 64
Casting, 156, 244
 die, 251
 ingot, 247
 investment, 249
 sand, 248
 semi-solid, 252
 single crystal shaped, 251
 table of techniques, 246
Cathodic reduction, 179
Ceramic method(s), 184
 flow system, 192
 flux agent, 188
 pellet method, 187
 sealed tube, 189
Chemical self assembly, 1, 39
Chemical vapor deposition (CVD), 125
 types of, 128
Chemisorption, 110
Chevron cracking, 265
Cluster source, 214
Coincidence site lattice (CSL), 31
Coining, 267. *See also* Plastic deformation
 processing, coining
Cold work, 243
Collision frequency, 107
Colloid, 168
Columnar zone, 156
Combustion synthesis, 199
Compound energy formalism, 64
Computational thermochemistry, 63
Conformal coating/film, 134, 176
Congruent melting, 155
Consolidation methods, 273
 dual action pressing, 275
 isostatic pressing, 276
 plastic forming, 284
 powder pressing, 273
 sintering, 286
 slip casting, 277
 tape casting, 280
Cooling rate, table of, 158
Complex permittivity, 204
Coprecipitation synthesis, 196
Coring, 159
Coupled growth, 37
Critical radius for nucleation growth, 147

- Cross rolling, 259
 Crystal forms, 10
 closed, 14
 open, 14
 table of, 11
 Crystallographic point groups, 25
 Cube texture, 237
 Cut-and-project method, 48
 Czochralski, J., biography, 38
 Czochralski method, 35

 D'Arcy's law, 278
 Decomposition reactions, 152
 Defects, *see* Point defects
 Dendrites, 160
 Dendrite arm spacing, 247
 Dendrite morphology, 160
 Devitrification, 166
 Diffusion coefficient, 51, 84, 183
 Diffusion controlled processes, 94
 Diffusion equation (Fick's second law), 85
 Diffusivity, *see* Diffusion coefficient
 Dislocations, 3, 240
 Displacement shift complete (DSL) lattice, 33
 Doctor blading, *see* Tape casting
 Donnay-Harker method, 17
 Double displacement reaction, 199
 Draft, 248
 Drawing, *see* Plastic deformation processing,
 drawing
 Ductile to brittle transition temperature (DBTT),
 243
 Ductility, 243

 Elastic modulus, 241
 Electrochemical synthesis, 176
 Electrogeneration of base, 179
 Electrolytic cell, 176
 Electron beam physical vapor deposition
 (EB-PVD), *see* Physical vapor deposition,
 EB-PVD
 Electronic energy, 69
 Electroplating, 176
 Electrostatic energy, 66
 Elementary reaction, 87
 Ellingham diagram, 61, 62
 Elongation, 241
 Enthalpy of adsorption, *see* Adsorption,
 enthalpy of
 Entropy, 54
 Epitaxial deposition, 127
 atomic layer, 133
 hydride vapor-phase epitaxy (HVPE), 133
 molecular beam epitaxy (MBE), 136

 Equal channel angular extrusion (ECAE),
 see Plastic deformation processing, ECAE
 Equiaxed zone, 156
 Equilibrium, 53
 Equilibrium constant expression, 55, 88
 Equilibrium crystal shape (ECS), 75
 Eutectic, 37
 Extrusion, *see* Plastic deformation processing,
 extrusion

 Faceted crystal, 14
 Feynman, R. P., biography, 213
 Fiber texture, 237
 Fick's laws of diffusion, 84, 85
 Filtered vacuum arc deposition, 124
 Fir-tree crackng, 265
 Flash, 266
 Flemings, M., biography, 254
 Float zone process, 162
 Flux, 107
 Flux agent, 188, 175
 Forging, *see* Plastic deformation processing,
 forging
 Form, *see* Crystal form
 Fractal, 22
 Frank-Kasper phase, 167
 Frank source, 29
 Frank, F. C., biography, 47
 Frank-van der Merwe growth, 115
 Freeze drying method, *see* Spray drying method
 Frenkel defect, *see* Point defects
 Full mold process, 249

 Galvanic (voltaic) cell, 176
 Galvanoplasty, *see* Electroplating
 Gibbs free energy, 54
 Gibbs-Thomson equation, 143
 Glass, 44, 163
 Glass transition temperature, 163
 Grain boundaries
 effect on plasticity, 241
 energy, 82
 structure, 30
 Grain boundary engineering, 1, 33
 Green compact, 276

 Habit, 14, 16
 Half-reaction, 177
 Hall-Petch relationship, 242
 Hard sphere broken bond model, 77
 Hartman-Perdok theory, 18, 150
 Helmholtz free energy, 54
 Hess' law, 62
 Heterogeneous reaction, 88

- Holohedral, 1
Holosymmetric symmetry, 17
Homogeneous reaction, 86
Homologous temperature, 243
Hydride vapor-phase epitaxy (HVPE),
 see Epitaxial deposition, HVPE
Hydrothermal recrystallization, 34
Hydrothermal synthesis, 171, 219
- IBM nanoparticle synthesis, 229
Ideal gas law, 105
Idiomorphic grains, 38
Impurity diffusion, 84
Inclusions, 245, 247
Incongruent melting, 156
Incongruent reaction, *see* Peritectic reaction
Induction heating, radio-frequency, 123
Interdiffusion, 84
Interdiffusion coefficient, 86
Interface controlled reactions, 89
Interface plane scheme, 32
Interface velocity, 90
Interfacial structure, 30
Interstitialcy mechanism, 94
Interstitial mechanism, 94
Invariant equilibrium, 57
Invariant reactions, 57
Ionic liquids, 173, 175
Irreversible process, 53
Irreversible thermodynamics, 84
Isopleths, 59
Isotherms, 59, 110
Ivantsov model, 161
- JANAF (Joint Army Navy Air Force) tables, 63
- Kink site, 29, 78
Kirkendall effect, 86, 185
Knife coating, *see* Tape casting
Knudsen flow, 108
Knudsen number, 108
Kohn, W., biography, 73
- LaMer crystallization model, 144
LaMer, V. K., biography, 145
Langmuir-Hinshelwood mechanism, 90
Langmuir, I., biography, 113
Langmuir isotherm, 110
Laser ablation, 135
Laser lift off, 133
Lattice energy, 67
Lattice points, 22
Law of mass action, 87
Ledge site, 29, 78
- Linear combination of atomic orbitals (LCAO)
 method, 70
Liquation, 160
Long range order, 44
Lost foam casting (LFC), 249
Loss tangent, 205
- Macrosegregation, 162
Madelung constant, 67
Magic numbers for solute particle
 association, 147
Mass action equilibrium principle, 88
Mass transport, 83. *See also* Atomic diffusion
Maxwell velocity distribution, 106
Mean free path, 107
Mechanical alloying (mechanical attrition), 196,
 214
Mechanochemical synthesis, 214
Merohedry
 syngonic, 18
 metric, 18
Mesocrystal, 43
Mesoscale self-assembly, 40
Metastable state, 55
Metathesis, *see* Double displacement reaction
Micelles, 221
Micelle-assisted routes, 221
Microemulsion, 221
Microporosity, 245
Microscopic reversibility, 85
Microshrinkage, *see* Microporosity
Microwave synthesis, 202
Miller indices, 27
Milling, 214
Microstructure, 21, 234
Molecular beam epitaxy, *see* Epitaxial
 deposition, MBE
Molecular flow, 108
Molten salts, 173
 nonreactive, 175
 reactive, 173
Morphology, 1, 3, 9, 156. *See also* Habit
Mushy zone, 253
Mutual diffusion coefficient, *see* Interdiffusion
 coefficient
- Nanomaterials synthesis, 211
 bottom-up approaches, 216
 top-down approaches, 213
Nanothermodynamics, 65
Necking, 241
Nernst equation, 55, 154, 177
Net, *see* Plane lattice
Neumann's principle, 3

- Nonequilibrium thermodynamics, 83
- Nonfaceted crystal, 14
- Nucleation, 114
 - heterogeneous, 147, 156, 164, 228
 - homogeneous, 146
- Nucleation rate, 148

- Olation, 168
- Onsager's theorem, 5
- Orientation distribution function, 236
- Ostwald ripening, 74, 142
- Ostwald's step rule, 142
- Overpotential, 178
- Oxide dispersion-strengthened (ODS) alloys, 197
- Oxolation, 168

- Periodic bond chain method, *see* Hartman-Perdok theory
- Peritectic reaction, 167
- Phase, 57
- Phase diagrams, 58
- Phase field, 58
- Phase rule (Gibbs phase rule), 56
- Physical vapor deposition (PVD), 120
 - electron beam (EB-PVD), 123
 - filtered vacuum arc deposition, 124
 - glancing angle deposition (GLAD), 125
 - sputtering, 123
- Pigtail, 251
- Plastic deformation processing
 - blanking, 267
 - coining, 267
 - drawing, 261
 - deep, 261
 - wire, 263
 - equal-channel angular extrusion (ECAE), 216, 268
 - extrusion, 264
 - forging, 265
 - rolling, 256
 - stamping, 267
 - swaging, 267
- Point defects
- Precipitation reactions, 151
- Principal axes, 5
- Principle of maximum symmetry, 17
- Periodic-bond-chain (PBC) method, *see* Hartman-Perdok theory
- Photolysis, 224
- Physiosorption, 110
- Plane groups, 22
- Plane lattice, 23

- Platonic solids, 46
- Point defects, 94
- Pole figures, 21, 235
- Polyol method, 228
- Ponderomotive force, 206
- Potential surface, 71
- Pourbaix diagrams, 154
- Powder pressing, *see* Consolidation methods, powder pressing
- Predominance diagram, *see* Pourbaix diagram

- Quadric, 7
- Quasicrystals, 44
 - structure, 45
 - synthesis, 166

- Rate law, 87
- Reciprocal relation, 5
- Reconstruction, *see* Surface reconstruction
- Reduction potential, *see* Standard reduction potential
- Relaxation, *see* Surface relaxation
- Resistive heating evaporation, 121
- Reverse Hall-Petch effect, 242
- Reverse micelle, 221
- Reversible process, 53
- Rheocasting, 253
- Rolling, *see* Plastic deformation processing, rolling

- Salt bridge, 176
- Scale invariance, 22
- Scherrer formula, 187
- Schottky defect, *see* Point defects
- Segal, V., biography, 270
- Selective laser sintering, 290
- Self-assembly, 1, 39
- Self-diffusion, 84
- Self-propagating high-temperature synthesis (SHS), *see* Combustion synthesis
- Sendzimir, T., biography, 260
- Severe plastic deformation (SPD), 215. *See also* Plastic deformation processing
- Shadowing effect, 108, 125
- Shear modulus, 240
- Shell method, 250
- Short range order, 44
- Singular surface, 29
- Sintering, *see* Consolidation methods, sintering
- Size distribution focusing, 225
- Skulling, 123
- Slab method, 244
- Slip, 3, 83, 240

- Slip casting, *see* Consolidation methods, slip casting
- Sol-gel process, 167, 195, 226
- Solidification, 34, 141, 142, 155
- equilibrium, 158
 - nonequilibrium (Scheil), 159
 - rapid, 163
- Solidification front, 160
- Solidification rate, 159
- Solid-liquid interface, 29, 141
- Solid-solid interface, 30. *See also* Grain boundaries
- Solvothermal technique, 171
- Solid-vapor interface, 29. *See also* Adsorption
- Sonochemistry, *see* Sonolysis
- Sonolysis, 225
- Space groups, 26
- Space lattice, 21
- Spontaneous process, 53
- Spray drying method, 196
- Sputtering, *see* Physical vapor deposition, sputtering
- Stable state, 55
- Stamping, *see* Plastic deformation processing, stamping
- Standard reduction potential, 177
- Step coverage, *see* Conformal coating/film
- Stockbarger method, 37
- Stranski-Krastanov model, 115
- Submerged-seed solution growth (SSSG), 35
- Supersaturation, 144
- Surface energy, 74
- Surface reconstruction, 80
- Surface relaxation, 80
- Surface stress, 74
- Surface tension, 74
- Swaging, *see* Plastic deformation processing, swaging
- Syneresis, 170
- Tape casting, *see* Consolidation methods, tape casting
- Templating agent, 40, 42
- Templated grain growth, 288
- Tensor, 4
- field, 4
 - matter, 6
 - rank, 4
 - symmetrical, 5
- Terrace site, 29, 78
- Terrace-Ledge-Kink (TLK) model, 29, 78
- Texture, 21, 234
- effects on materials properties, table of, 239
- Thermite reaction, 199
- Thermolysis, 224
- Thixocasting, 253
- Top-seeded solution growth (TSSG), 35
- Total energy, 70
- Toughness, 241
- Transition flow, *see* Knudsen flow
- Twin, 18
- gliding, 19
 - growth, 19
 - transformation, 19
- Ultimate tensile stress, 241
- Undercooling
- constitutional, 93, 161
 - kinetic, 161
- Unit cell, 25
- Univariant equilibrium, 57
- Unstable state, 55
- Vacancy mechanism, 94
- Van't Hoff equation, 55
- Vapor phase intercalation, 116
- Vicinal surface, 29, 90
- Viscous flow, 108
- Vitrification, 163
- Volmer-Weber growth, 115
- Volmer-Weber-Kossell-Stranski model, 90
- Wagner, C., biography, 96
- Wagner model, 95
- Wulff construction, 75
- Wyckoff position, 26
- Xerogel, 168
- Yield point (yield stress), 241
- Zone, 10
- Zone melting techniques, 162

