

Index

- alkali halides, 133, 136
 alkali metals, 115, 153
 alkaline earth fluorides, 161
 alloys and compounds, 156
 amplitude function at surface, 256
 angular momentum, 45
 angular momentum quantum numbers, 53
 anisotropy, 155
 anisotropy and ionicity fraction, 168
 atomic vibrations and shear stiffness, 171
 Avogadro, 31
- Balmer series, 52
 band gap density and shear stiffness, 167
 bend-gliding, 190
 Berzelius, 31
 body forces, 9
 Bohr, 34
 bond charge model, 59, 69
 bonding requirements (amplitude functions), 69
 breaking mode of cracking, 249
 bulk modulus, 23, 110
 bulk stiffness, 7
 bulk stiffness of elements, 111
- Casimir forces, 98, 103
 Cauchy, 10
 Cauchy ratio, 155
 Cauchy's relations, 27, 146, 152, 164
 chain molecules (polymers), 89
 chalcogenides, 137
 characteristic rate law, 269
 chemical hardness, 123, 179, 180
 chemical hardness and shear stiffness, 181
 chemical theory of dislocation mobility, 220, 224
 cleavability and polarizability, 265
 cleavage faces, long-range attraction, 262
 cohesion of atoms, 63
 collective polarization, 262
 color change, deformed AuAl_2 , 238
 commutation, 40, 58
 compatibility and fracture, 192
 compatibility relations, 16, 19
 compression, 16
- computed crack in silicon, 250
 contracted notation, 24
 coordinate axes, 10
 Coulomb, 31
 Coulombic energy, 78
 covalent bonds, 67
 covalent crystals, 129, 162
 cracking, 247
 crack kink velocity, 269, 273
 crack propagation, 249
 crystal anisotropy, 23
 crystallographic axes, 10
 crystal symmetry, 22
 cubic cluster model, 28
 cubic crystals, 23
- de Broglie, 34, 37
 deformation tensor, 17
 d-electrons, 118
 density functional theory, 59
 dependence of inelastic work on intrinsic surface energy, 252
 Derjaguin forces, 103
 deviator part of stress tensor, 14
 diamond, 165
 diatomic chains, 90
 difference between C_{44} and C^* , 145
 dilatational strain, 9
 dilation tensor, 17
 dipole debris, 196
 dipole–dipole crystals, 103
 dipole–dipole energy, 97
 dipole forces, induced, 263
 dipole interaction, 99
 dipole moment, 97
 dipole polarizability, 148
 dipole vibration frequency, 98
 direction cosines, 10
 dislocated crystal, 194
 dislocation, definition, 202
 dislocation kinematics, 198
 dislocation kinks, 227
 dislocation mobility, 199, 201
 dislocation mobility and chemical stability, 234

278

dislocation mobility, chemical theory, 224
 dislocation mobility in carbides, 216
 dislocation mobility in Group V elements, 225
 dislocation mobility in ionic compounds, 213
 dislocation mobility in molecular solids, 234
 dislocation mobility in silicon carbide, 218
 dislocation mobility in transition metals, 211
 dislocation mobility in tungsten carbide, 223
 dislocation motion in oxides (including silicates),
 238
 dislocations, 9
 displacement, 188
 displacement, definition, 17
 distinction between elastic and plastic deformation,
 187
 distribution of electron density, 68
 double cantilever crack, 248
 ductility, 250
 dynamic fatigue, 273

edge dislocation, 194
 Edison, 31
 effective atom, 147
 effect of dynamic interactions on dislocation mobility,
 241
 effect of ionicity, 166
 effect of pressure on compressibility, 112
 effect of symmetry, 69, 72
 elastic compliances, 20
 elastic displacements, 16
 elasticity tensor, 20
 elastic stiffness, 5, 20
 elastomers, 175
 electron affinity, 180
 electron charge, 36
 electron densities, 39
 electron density at surface, 256
 electronegativity difference, 137
 electronegativity difference densities of alkali halides,
 137
 electron exchange, 65, 83
 electronic chemical potential, 180
 electron magnetic moment (spin), 36, 49
 electron mass, 36
 electron mechanics, 31
 electron tunneling, 263
 electron viscosity, 207
 element of a plane, 11
 embedded reactions at dislocation cores, 220, 228
 energy balance, 249
 energy bands, 95
 energy condition for cracking, 249
 enthalpic elasticity, 174
 entropic elasticity, 174
 entropic stiffness, 175
 environmental effects on cracking, 252
 exponential dislocation growth, 196
 extension, 16
 extrinsic barriers to dislocation motion, 206
 extrinsic resistance to dislocation motion, 206

Index

Faraday, 31
 fluctuating dipoles, 98
 fluorites, 137
 force constant, 98
 force to move dislocation kink, 230
 forms of anisotropy, 210
 fracture energies, 248
 fracture mechanics, 248
 fracture surface energy, 249
 fracturing rates, 267
 Frank definition of close-packing, 212
 Franklin, 31
 free energy, 175
 free radicals, 273

Galileo, 9
 Gaussian pulse envelope, 59
 generalized deformation rate equation, 195
 generalized strain, 16
 generalized stress, 9
 glide activation energies and LUMO–HOMO gaps,
 219
 glide in rocksalt on cube plane, 214
 glide in rocksalt on primary plane, 214
 glide plane in galena, 216
 Goudsmit, 35
 Griffith, 249

hard metals, 128
 hard metals (interstitial compounds), 157
 hardness, 179
 Heisenberg, 34, 35
 Heisenberg Principle, 40, 56, 73, 78, 123
 Hellman–Feynman theorem, 64
 heterogeneous deformation, 186
 high mobility, metals, 212
 Hock, 176
 Hooke's Law, 9, 20
 Hund's Rule, 54
 hybridization, 87
 hydrogen atom, 45, 60
 hydrogen bonding, 66, 75, 106
 hydrogen molecular ion, 77, 82
 hydrogen molecule, 79
 hydrostatic compression, 19
 hydrostatic stress, 15

impact fatigue, 273
 importance of dislocation mobility, 199
 indentation hardness, 182
 indentation hardness and band gaps, 235
 induced dipole forces, Drude theory, 263
 inelastic cracking, 251
 inelastic processes, 251
 inelastic work at crack tips, 251
 interfacial energies, 262
 intermetallic compounds, 129
 intermolecular shear stiffness, 171
 intramolecular cohesion, 77
 intrinsic resistance to dislocation motion, 207

- intrinsic surface energy, 249
 inversion formulae, 26
 ion core radii, 117
 ionic bonding, 73
 ionic crystals, 133, 159
 ionization energy, 180
 isoelectronic alkali halides, 147
 isotope effect (diamond), 169
 isotropic solids, 21
- Joule, 31
- Keyes parameter, 115, 181
 Keyes potential, 85
 kinetic energy, 78
 kinetic theory of gases, 176
 kinks on cracks, 269
 Koehler multiple-cross-glide process, 196, 197
- lanthanides, 128
 LCAO theory, 69
 Lennard-Jones energy, 106, 140
 Lennard-Jones equation, 105
 Lennard-Jones repulsion, 104
 Leonardo da Vinci, 9
 limiting bond types, 66
 linear dipole pairs, 263
 linear dislocation transport, 193
 London–Casimir forces, 65
 London forces, 74, 97, 171, 263
 low mobility, covalent crystals, 204
- macroscopic plastic deformation, 185
 Madelung constant, 134
 magnetic effect, 120
 mechanical activation of motion, 241
 mechanics of cracks, 247
 mechanism of mechanochemistry, 183
 mechanochemistry, 183
 metallic bonding, 73
 metalloid–metal compounds, 128
 metals, 113
 microscopic plastic deformation, 193
 Miller indices, 11
 Millikan, 32
 mobile fraction of dislocations, 198
 mobility, definition, 202
 mobility, effect of stress, 204
 mobility in alloys, 236
 mobility in anisotropic metals, 209
 mobility in intermetallic compounds, 236
 mobility in metallic glasses, 239
 mobility in Nylon, 236
 mobility in simple metals, 208
 mobility in titanium carbide, 220
 mobility theory of Grimvall and Thiessen, 222
 modes of crack propagation, 249
 modes of plastic deformation, 189
 modulation envelope, 57
- molecular crystals, 139
 molecular segments, 177
 Morse potential, 85, 270
 motion at dislocation cores, 207
 multiplication of dislocations, 195
- N-atom loop, 94
 Navier, 27
 nitrates, 135
 noble gas crystals, 104, 139
 non-existence of “plastic modulus”, 188
 normalization, 72
- octahedral shear stiffness, 23, 167
 operators, 58
 orbital shapes, 44, 53
 orientation convention, 15, 22
 orientation dependence of surface energy, 257
 Orowan’s equation, 193
 orthogonalization condition, 88
 overlap, 70
- particle on a ring, 40
 particle on a sphere, 42
 patterns of electrons, 52
 Pauli, 35
 Pauli Exclusion Principle, 50, 104
 Pauli repulsive forces, 104
 Peierls mobility theory, 204
 phonon viscosity, 207
 photon exchange, 65, 81
 Planck, 35
 plane biaxial stress, 15
 plasmons, 124
 plastic anisotropy in rocksalt structure, 215
 plastic compatibility, 191
 plastic deformation versus elastic strain, 193, 194
 plastic equation of state, 188
 plastic kinking, 190
 plastic yielding, 186
 polarizability, 100, 138, 160, 171, 262, 265
 polarizability and dislocation mobility, 266
 polarizability tensor, 97
 polyatomic chains, 92
 polyatomic molecules, 87
 polymers, 170, 174
 pressure, 9, 14
 principal directions, 15
 principal quantum numbers, 52, 53
 principal stresses, 14
 probability amplitudes, 39
 proton exchange, 65
 punch-gliding, 190
 pure plane shear, 15
- quadrupolar polarizability, 149
 quadrupole energy, 97
 quantum states, 37
 quasicrystals, 169

280

radial potentials (failure), 150
 relativity effect, 66
 resolution of a force element, 12
 resolution of an area element, 11
 resonance theory, 80
 reversibility of crack propagation, 249
 rotation, 16
 rotation-gliding, 190
 rotation tensor, 17
 rubbery elasticity, 176
 Rutherford, 33
 Rydberg function, 179

Saint-Venant, 10
 schematic electron distributions, 67
 Schrödinger, 34, 37
 Schrödinger pressure, 74
 screw dislocation, 194
 screw dislocation in b.c.c. structure, 212
 screw dislocation in diamond structure, 228
 shear, 16
 shear angles at crack tips, 253
 shear-induced chemical reactions, 182
 shear-induced phase transitions, 182
 shearing mode of cracking, 249
 shear modulus, 23, 142
 shear stiffness, 7, 143
 shear strain, 9
 shear strains at crack tips, 252
 shear tensor, 17
 “shuffle” versus “glide” regions of glide planes, 228
 silicates, 139
 simple metals, 113
 solidity index, 110, 146
 specification of a plane, 10
 spectroscopic term symbols, 53
 spherical part of stress tensor, 14
 spin pairing, 69
 splitting a “rail”, 247
 splitting at crack tip, 250
 stacking fault energies, 210
 standard deviation, 56
 state of stress, 12
 static equilibrium, 13
 static fatigue, 273–5
 steadiness of dislocation motion, 205
 Stern–Gerlach, 36, 50
 Stoner’s Rule, 55
 Stoney, 32
 strain energy, 24
 strain hardening, 240
 strain tensor, 17
 stress activation of dislocation motion, 243
 stress components, 13
 stress, definition, 10
 stress equivalence, 270
 stress-intensity factors, 248

Index

stress-rupture, 267
 stress tensor, 13
 strong resonance (hopping), 82
 sub-critical crack velocities, 273
 surface electronic states, 250, 255
 surface energy, 254
 surface energy and atomic radii, 259
 surface energy and Periodic Table, 255
 surface energy, covalent crystals, 257
 surface energy from elastic stiffness, 260
 surface energy from Heisenberg’s Principle, 258
 surface energy from plasmon theory, 261
 surface energy, ionic crystals, 257
 surface energy, Schmit–Lucas theory, 262
 surface energy, simple metals, 258
 surface states, 89
 symmetry breaking at dislocation kinks, 227

Tamm states, 89, 250
 tearing mode of cracking, 249
 temperature dependence of mobility, 231
 tetrahedral bonds, 87
 theories of shear stiffness, 147
 theory of bulk modulus, 123
 thermal activation, fracture, 267
 thermal activation of dislocation motion, 242
 Thomson, 31
 tough polymers, 265
 tractions, 9
 transition metals, 117
 transition state for dislocation kink, 230
 translation-gliding, 189
 tunneling probability, 272
 twin-gliding, 189
 twist-gliding, 190
 two shear coefficients, 145

UBER, 117, 179
 unit vector, 10
 universality, 179

valence electron density, 65, 163, 164, 168, 254
 Van Arkel–Ketelaar diagram, 66
 Variation Principle, 71
 vector algebra, 58
 viscous resistance to dislocation motion, 208
 Voigt, 13, 27

Walsh correlation diagram for dislocation kink, 230
 wave fields, 38
 weak resonance (London forces), 81

yield stresses versus Peierls theory, 217
 Young’s modulus, 25

Zener–Hollomon parameter, 188
 Zener tunneling, 267, 271
 zero-point energy, 81, 98