

Index

a

ab initio calculations 273
 A15 compounds 23–27
 acoustic (phonon) branch 77, 242
 activated carbon 309
 actuators 316–317
 adiabatic approach 84, 105, 235
 adsorbates 117
 aggregates 290
 Aharonov–Bohm effect 12, 198
 air mass 297
 Alchemists' gold 29–31
 amber 271
 amorphous (glassy) metals 163
 amorphous semiconductors 163
 amorphous solids 58
 amplitude mode 240–242
 Anderson–Mott transition 176
 anisotropy 159, 200
 annihilation 140
 anti-bonding state 14
 anti-localization 198
 anti-noise 311
 anti-soliton 139–140
 antistatic additives 313
 antistatic protective bags 311–313
 antistatic transparent films 311
 aromatic state 147
 artificial muscles 316, 317
 atomic crystals 61
 Aviram–Ratner rectifier 271

b

backward scattering 239, 240
 bacteriorhodopsin 322, 324
 ballistic transport 91, 265
 band bending 145, 146
 band gap 109

band width 248
 basis (of crystal lattice) 59
 BCS gap 213
 BCS superconductivity 19, 83, 211
 Bechgaard salts 31–34, 220, 222
 Berry's phase 9
 bianthrone 106, 273–275
 bi-morph 317
 biocomputing 323–324
 bipolaron 149, 181
 Bloch model 92
 Bloch theorem 93, 128–132
 Bloch waves 85
 blue bronzes 38, 39
 bonding and antibonding 123
 bond length alternation parameter 133
 bond order wave 134, 236
 Bosonic quasi-particles 83
 bosons 85
 bottom-up 2
 Bragg condition 76
 Bravais lattice 63
 breakdown field 287
 break junction 53
 brightness 285, 286
 Brillouin scattering 81
 Brillouin zones 75, 130
 buckypaper 321
 built-in electrical field 295
 bulk heterojunction 297
 bundles 69, 198, 199
 butadiene 125, 126

c

candle 277, 278
 capacitors 309–310
 carbanion 143
 carbocation 143

- carbon nanotube 12, 49–51, 65–66, 98–102, 265–268
 - mats 317
 - carbon solids 7–13
 - carrier density 168
 - cell phones 277
 - cellular automaton 264–265
 - ceramic superconductor 210
 - channels 266
 - charge density wave 16, 134, 236–240
 - charge generation layer (CGL) 288, 289
 - charge transfer compounds 31–34
 - charging energy 256, 257
 - chemical potential 96
 - chemical vapor deposition (CVD) 48
 - chemiluminescent emitters 277
 - chiral angle 51, 65, 100
 - cis-transoid* 65
 - clay 47
 - closed circuit current 296
 - coaxial cables 309
 - cogwheel 243
 - coherence length 211, 226
 - collision time 160
 - color coordinates 286
 - colossal magnetoresistance 197
 - commensurability 243–248
 - condensed matter 57
 - condensed metal clusters 38
 - conditional switching 264
 - conductance 159
 - conductance quantum 91
 - conducting oxide 214
 - conducting polymers 40–44
 - conduction band 121
 - conduction electrons 84
 - conductivity 159–163
 - chart 184, 185
 - of small particles 169–171
 - conformational degree of freedom 106, 257
 - conjugated double bonds 10, 119–122, 134
 - conjugated polymers 118, 119
 - conjugational defect 132–135
 - connectivity 14
 - contact resistance 164, 165
 - Cooper pairs 24, 83, 211–213
 - coordination number 14
 - correlation effects 160
 - correlation energy 113
 - correlation function 58
 - corrosion protection 321–322
 - Coulomb blockade 256
 - Coulomb gap 237, 238
 - Coulomb interaction 236–240
 - creep phenomena 246
 - critical current density 210
 - critical magnetic field 210, 213
 - critical temperature 209
 - crystal lattice 57–66
 - crystalline solids 58
 - crystallographic axes 62
 - crystal momentum 72
 - cumulated double bonds 9, 119
 - cumulene 9
 - Curie law 181
 - Curie susceptibility 181
 - current equation 90, 266
 - current-induced annealing 200
 - current-voltage characteristics 275–276
 - cyclotron energy 221
- d**
- dangling bonds 132, 133
 - Davidov splitting 98
 - Debye frequency 212
 - Debye temperature 83
 - defects 287, 288
 - degenerate ground state 131, 142
 - De Haas–van Alphen (dHvA) oscillations 221
 - delocalization 84, 120–121
 - density of states (DOS) 15, 95
 - detailed balance 282
 - Dexter energy transfer 281, 282
 - diamond 7–8
 - dimensionality 1–2
 - diode 280
 - Dirac comb 92
 - Dirac points 99
 - discharge layers in electron-beam lithography 313
 - dislocations 246
 - dispersion relations 28–29, 71–83, 137
 - distributed Bragg reflector 290
 - domain boundaries 132
 - domain wall 132–133
 - doping 97, 117
 - double bonds 120
 - double-wall carbon nanotube (DWNT) 51
 - double well potential 137
 - drain 255
 - drift velocity 243, 245
 - Drude model 85, 90, 161, 179, 245
 - Dyestuff 134
- e**
- effective mass 6, 85, 160
 - efficacy 285, 286

- Einstein relation 160
- elastic interactions 80
- electroactive materials 271
- electrochemical battery 314
- electrochemical plating 310, 311
- electrochemical polymer actuators 316–317
- electrochemical sensors 319–320
- electrochromics 317–319
- electroluminescence 284, 286
- electrolyte capacitor 309
- electromagnetic compatibility (EMC) 308
- electromagnetic interference (EMI) 308
- electromagnetic shielding 308
- electron beam lithography 170
- electron correlation 119, 142
- electron-hole symmetry 97
- electron in a box 11, 87
- electron-lattice coupling 14
- electron nuclear double resonance (ENDOR) 141
- electron-phonon coupling 105–114
- electron spin resonance (ESR) 133, 239
- electron statistics 85–86
- electroplating 310–311
- electrostatic discharge (ESD) protection 311
- elementary cell 62
- encapsulation 286
- endohedral chemistry 51
- energetic confinement 279
- energy bands 91–97
- energy gap 91–97
- entropy 257, 258
- equipartition theorem 82
- equivalent circuit 165
- ethylene 125
- Ewald sphere 68
- excimers 290
- excitons 19, 150, 295
- extend pair approximation model 192
- external power efficiency 285
- extrinsically conducting 118
- f**
- factor-of-ten superiority 315
- Fermi–Dirac expression 86
- Fermi energy 86
- Fermi gas 94
- Fermi level 3, 36
- fermiology 221
- fermions 85
- Fermi points 99–100
- Fermi statistics 83
- Fermi surface 5, 86–87, 220–222
 - warping 112–113
- Fermi temperature 181
- Fermi wavelength 3, 11, 86
- Fermi wave vector 86
- field-activated electroluminescence 286
- field dependent mobility 283, 298
- field effect transistor 255, 263
- field effect transistor configuration (FET) 170, 200, 268
- field-induced electroluminescence 286
- field-induced polymer electroluminescent lamp (FIPEL) 286
- field-induced spin density wave 248–250
- field smoothening 308–309
- figure of merit 301
- filling factor 296–297
- fine structure constant 91, 177
- first Brillouin zone 75
- flat-band condition 146
- flip-flop memory 268
- floor tiles 313
- fluctuation induced (assisted) tunneling 186–194
- fluids 58
- focused ion beam (FIB) 170
- Förster energy transfer 281
- forward scattering 239
- four lead method 164–165
- four point method 166
- Fowler–Nordheim 283
- fractal 1
- fractional charges 151–153
- fractionalized quasi-particles 114
- fractional quantum Hall effect 168
- free electron model 87–91
- fullerene 11–12, 210, 220
- fullerite 12
- g**
- gain 254, 255
- gap-less semiconductor 99
- gas separating membranes 320–321
- gate 255
- generalized phase diagram 224, 225
- genetic engineering 322
- geometrical factor 166
- giant conductivity 244, 245
- giant magnetoresistance 197
- g-ology 213, 239, 240
- graphene 43, 49, 60
- graphite 8–9, 31, 36
- gravimetric surface area 321
- Greninger charts 71
- guard ring electrode 171

h

halides 38–40
 Hall bars 168–169
 Hall effect 221
 Hall voltage 168
 Halobacterium halobium 322
 halogen-bridged mixed-valence transition metal complexes 44–45
 harmonic wave 136, 137
 heat capacity 81
 Heisenberg spin chain 238–239
 helicity 51
 heterogeneous conduction 174
 highest occupied molecular orbital (HOMO) 121
 high impedance samples 171
 highly conducting polymers 195–196
 high- T_c materials 213
 holes 97
 hologram 322
 holographic computing 272, 322–323
 holographic storage 322–323
 honeycomb lattice 60, 62
 Hooke's law 74
 hopping conductivity 186–194, 283
 hopping mechanisms 186
 Hubbard band 114
 Hubbard model 236, 237
 Hubbard U 257
 human brain 324
 hydrogen atom 123, 124
 hydrogen hype 321
 hydrogen storage 321
 hyperfine interaction 239

i

ideal diamagnetism 212, 217
 incommensurability 243–244
 indices (crystallographic) 62
 indices of nanotubes 50, 65
 inelastic interactions 80
 information 257–258
 injection-limited interface 283
 insulator-to-metal transition 144
 intercalation 38, 212, 227
 interface 287–289
 – states 287, 288
 intermolecular conductors 223
 internal quantum efficiency (IQE) 285, 286
 intersoliton hopping 161, 180
 interstitial doping 97
 intramolecular conductors 223
 intrinsically conducting 118
 invariant symmetry operations 63

inverter 268
 isolated double bonds 9, 119
 isotope effect 212

j

Jahn–Teller effect 26, 107
 jellium 138, 242, 243
 Josephson effect 216, 219

k

Klitzing constant 177
 Kohn anomaly 29, 111–112, 235, 236
 Kondratiev cycles 327
 Korteweg–deVries equation 136
 Krogmann salts 27–29
 Kronig–Penney model 92

l

Landauer–Büttiker (LB) formalism 90, 91
 Landau orbits 221
 Landau quantization 249
 Landau theorem 16
 Langevin-type rate equations 283
 Langmuir–Blodgett techniques 262, 271, 274–277
 laser diode 292
 lattice parameters 62
 lattice points 62
 lattice vectors 62
 leakage currents 285
 Leonhardt charts 71
 levitation train 218
 lifetime 284, 286, 298
 light-emitting device 277–294
 Li-ion batteries 321
 linear combination of atomic orbitals (LCAO) 92, 128
 lithium-polyaniline battery 315–316
 Little's superconductor 19, 20
 localization 175–178
 long range order 59
 Lorentz force 168, 201, 221
 loudspeakers 311, 312
 lowest unoccupied molecular orbital (LUMO) 121
 luminescence 279
 luminous efficacy of radiation (LER) 285

m

macrocycles 36–38
 macro-solid 227
 magnesium bromide 215
 magnetic field 168–169
 magnetic monopoles 152

magnetic resonance imaging (MRI) 218
 magnetic susceptibility 180, 221
 magnetochiral anisotropy 199
 magneto-resistance 168, 197–202
 magnons 238
 many body problem 235
 Martensitic transition 24
 maximum metallic resistance 177
 maximum power rectangle 296
 Maxwellian demon 108
 mean free path of electrons 2
 Meissner effect 212, 216
 metal insulator transition 237
 metallic carbon nanotubes 220
 metallic islands 193
 methyl radical 123
 MgB_2 215
 microcavity effects 283
 microcontacts 169
 microelectrochemical tweezers 317
 microwave cavity 172
 midgap states 135
 mini-solid 227
 mobility 156, 160
 mobility of solitons 179
 molecular cellular automaton 264–265
 molecular crystals 61, 271
 molecular electronics 253, 272
 molecular engineering 271
 molecular materials 271–302
 molecular orbital approach 97–98
 molecular rectifier 261–262
 molecular shift register 262–264
 molecular transistor 256
 Moore plots 253
 morphology of polyacetylene 183
 Mott gap 114
 Mott–Hubbard insulator 237
 Mott insulators 113
 Mott relations 174
 Mott's $T^{-1/4}$ law 193
 multiple tunnel junctions 257
 multi-wall carbon nanotube (MWNT) 51
 mutual induction 216
 MX chains 44

n

nanoparticles 289
 nanowires 46–48, 52–53
 narrow band noise 246
 nearly-free electron model 91–97, 160
 negative-differential-resistance 255
 negative magnetoresistance 197
 nesting 113, 235

neutron scattering 29, 153
 non-degenerate ground state polymers 142
 non-radiative recombination 279
 NOR gate 268
 nuclear magnetic resonance (NMR) 239

o

Ohmic interface 283
 Ohm's law 90, 159
 open circuit voltage 297
 optical (phonon) branch 77, 241
 optical conductivity 172
 optically pumped organic laser 289
 optical storage 322
 orbital effects 201
 order-of-magnitude advantage 327
 organic electronics 253, 271
 organic ferromagnets 46
 organic field effect transistor 298–299
 organic lasers 277, 289–294
 organic light emitter transistor 289–294
 organic light emitting device (OLED) 145, 277–294
 organic photovoltaics (OPV) cells 294, 296, 297
 organic superconductors 220–229
 organic thermoelectrics 300–302

p

pair approximation (hopping) 188
 pattern recognition 322, 323
 Pauli exclusion principle 85, 237
 Pauli susceptibility 181
 Peierls distortion 107–110
 Peierls–Fröhlich mechanism 242–243
 Peierls instability 110
 Peierls transition 16, 28, 105–114, 134, 212, 235
 pellets 171
 percolation 13
 percolation threshold 14, 312
 phase angle 289
 phase mode 242
 phase slip center 246
 phasons 242
 phonons 71–79
 – softening 111–112
 phosphorescence 286
 phosphorescent dyes 280
 photoabsorption switching 272–274
 photoactive materials 271
 photoexcitations 97
 photogeneration 145
 photoinduced peak 272, 273

- photoluminescence 145
 - photoluminescence quantum yield (PLQY) 290
 - photopic response 286
 - photoresist 271
 - photovoltaic effect 296, 297
 - phthalocyanine 36–38
 - physical-chemical dictionary 150
 - pinned CDW 245
 - Planck distribution 82
 - platinum thermometer 197
 - p–n junctions 97, 280, 294
 - point groups 63
 - polarization current 287
 - polarized electrons 200
 - polaron injection 279
 - polarons 15, 117–156, 257, 279, 293–294
 - poly(ethylene-dioxythiophene) (PEDOT) 313
 - polyacetylene 10, 64, 65, 105–106, 132
 - polycarbene 45, 46
 - polycarbyne 9
 - polycrystalline 59
 - poly-decker 45–46
 - polydiacetylene 41, 42
 - polyenes 10, 123–128
 - polyfractiolene 151
 - polymer actuators 316–317
 - polymer batteries 314–316
 - polyphenylene 147
 - polyspinolene 152
 - polysulfurnitride 34–36
 - Poole–Frenkel factor 283
 - population inversion 291
 - power conversion efficiency 298
 - power efficiency 295
 - power felt 302
 - Poynting vector 287
 - primitive crystal structure 62
 - printed circuits 310, 311
 - pseudo-Fermi level 266
 - pseudo-spin 140
 - pump and probe technique 154, 273
 - pumping 292
 - purple membrane 322
 - push-pull olefin 259
- q**
- quantized Hall effect 248–250
 - quantum bits 258
 - quantum conductance 91
 - quantum dot 11, 227, 256
 - quantum Hall effect 198
 - quantum resistance 266–267
 - quantum size effects 256
 - quantum step 328
 - quantum wire 11, 51–52, 256
 - quark 150
 - quasi momentum 72
 - quenching 288, 290
 - quinoidal state 147
- r**
- radiative energy transfer 281
 - radiative recombination 279
 - radical 143
 - Raman scattering 80–81
 - random walk 15
 - real gas 113
 - reciprocal lattice 67–71
 - reciprocal space 67–71
 - recombination zone 279
 - rectifying Langmuir–Blodgett layers 274–277
 - redox processes 97
 - register 243
 - relaxation time 160
 - residual resistance 160
 - resistance 159
 - resistivity 159
 - resonance structures 120
 - resonator structure 290, 292
 - retinal 322, 324
 - Richardson–Dushman thermionic emission 283
 - ring oscillator 268
 - robotics 316
 - roll-up vector 65
- s**
- scalar 159
 - Schottky barrier 294, 297
 - Schottky junction 280
 - schubweg 156
 - Seebeck coefficient 173, 301
 - Seebeck effect 172–175, 300
 - segmented polyacetylene 188
 - self-trapping 179
 - semiconducting carbon nanotubes 100
 - short circuit current 296
 - Shubnikov–de Haas (SdH) oscillations 198, 221
 - Siemens (Unit) 159
 - Sine-Gordon equation 136, 246
 - single crystal 59
 - single-electron transistor 256
 - single-molecule rectifier 254
 - singlet only device 280
 - singlets 280, 291–293

- singlet superconductivity (SS) 239, 240
 - singlet-triplet conversion 202
 - single-wall carbon nanotube (SWNT) 51
 - singly connected 167
 - singularities in DOS 26
 - sliding velocity 243
 - smart windows 317–319
 - soft exponential equation 187
 - soft mode 25
 - solar cells 294–298
 - solar standard 297
 - solid state polymerization 41
 - solitary wave 137
 - soliton 15, 117–156, 257, 272, 273
 - band 179
 - bifurcation 259
 - confinement 150
 - detector 259
 - lifetime 155
 - reversal 259
 - switching 258–261
 - valve 259
 - solution processing 280
 - Sommerfeld model 85
 - sound waves 71
 - source 255
 - spin-charge inversion 143
 - spin density wave 224, 248–250
 - spin-flip scattering 200
 - spin-ice 153
 - spin of the electron 201
 - spin-orbit coupling 280
 - spin Peierls (SP) transition 239
 - spin valve 200
 - spring constant 74
 - Sprungtemperatur 211
 - square sample method 167
 - static random access memory (SRAM) 268
 - stimulated emission 290
 - substitutional doping 97
 - super capacitor 309
 - superconducting cables 218
 - superconducting coils 218
 - superconducting quantum interferometer devices (SQUID) 216
 - superconductivity 12, 209–231, 307
 - switching molecules 272–277
 - synthetic metals 118
- t**
- temperature coefficient 163
 - tensor 159
 - thermoelectric generator 302
 - thermoelectric power (thermopower) 172–175, 301, 302
 - thermovoltage 172, 301
 - thousand islands 193
 - three terminal system 255
 - threshold (for CDW) 244
 - through-hole electroplating 310–311
 - tight binding model 237
 - time of flight 154
 - measurements 285
 - $T^{-1/4}$ law 190
 - top-down 2
 - topological insulators 118
 - transfer integral 248
 - transfer matrix 267
 - transition metal chalcogenides 38–40
 - transition metal halides 38–40
 - translational invariance 63
 - translational symmetry 57–66
 - translation vector 60
 - transparent conducting films 317–319
 - transparent nanotube transistors 318
 - trans*-transoid 65
 - traps 279
 - triplets 280, 293
 - triplet superconductivity (TS) 239, 240
 - tsunamis 137
 - tunability 280
 - twistons 78, 101
 - two state system 291
 - type I (elemental) superconductor 214
 - type II superconductors 215
 - type N polyacetylene 184
 - type S polyacetylene 184
- u**
- umklapp processes 112, 239
 - universal conductance fluctuations 161, 199, 267
 - universal curve (conductivity) 191
- v**
- valence band 121
 - Van der Pauw method 167
 - Van Hove singularities 96, 101, 219
 - variable range hopping 174, 189
 - vector potential 198
 - vibronic cooling 291
 - vibronic states 291–292
 - Von Klitzing constant 177
 - Von Klitzing effect 249
 - vortex state 214

w

washboard model 246
wave vector 72–74
welding of plastics 314
whispering gallery mode 290
white emission 284
work function 284, 285, 297
wrapped Fermi surface 112–113
Wulff net 71

x

X-ray reflection 68

y

Young's modulus 109

z

Zeemann splitting 27, 221
Zener tunneling 289
zeolite 46, 47
zero magnetoresistance 201
Zinngeschrei 246