

Index

A

- absorption process, 109–110, 117–118
- active gain medium, 106
- adiabatic approximation, 44, 325–326
- AFM. *See* atomic force microscopy
- AIII-BV semiconductors, 243–245
- ALD. *See* atomic layer deposition
- AlGaAs alloy, 130, 131, 137, 145, 147
- arylation, 36, 37f
- atomic force microscopy (AFM), 145, 219, 225, 231–247
 - contact mode of, 226, 232–233
 - DFM. *See* dynamic force microscopy
 - optical detection system, 233f
 - SFM. *See* scanning force spectroscopy
 - tip-surface interaction, 231, 232f
- atomic layer deposition (ALD), 206, 214, 215, 219
- atomic structure, 53–56, 259f, 260. *See also specific topics*
- Aviram-Ratner model, 19–20, 24

B

- band-narrowing factor, 331
- band-to-band transitions, 110–111, 117
- Bardeen-Cooper-Schrieffer (BCS) superfluids, 308
- BCS. *See* Bardeen-Cooper-Schrieffer superfluids
- Bessel functions, 114, 184
- BiCGSTAB (BiConjugate Gradient Stabilised) method, 271
- blackbody radiation, 110

- Bloch band, 305, 326–327
- Bohm theory, 272
- Bohr radius, 312
- Boltzmann constant, 17, 107
- Boltzmann statistics, 276, 284f
- Boltzmann temperature relation, 211
- Boltzmann transport equation (BTE), 270, 271
- Born-Oppenheimer approximation, 44, 325–326
- Bose liquid, 308
- bottom-up theory, 53–54
- Bragg condition, 159
- Brillouin zones, 128, 317
- Brownian motion, 51
- BSIM model, 293
- BST materials, 205
- BTE. *See* Boltzmann transport equation
- bypyridinium ring, 338, 351

C

- cadmium selenide (CdSe), 153, 156, 159
- CaF₂ crystals, 238, 238f, 243
- capacitors, 248f. *See also* dielectrics
- Casimir effects, 42
- cavities, lasers and, 122–129
- CdSe. *See* cadmium selenide
- cell phones, 199
- charge assignment, 277–280
- charge pumping, 83
- chemical etching, 8
- chemical synthesis, 140–141, 156–157

- chemical vapor deposition (CVD), 9, 174, 181
 atomic layer method, 9
 CIC. *See* cloud-in-cell method
 low-pressure, 10
 nanocrystal formation, 182
 plasma-enhanced, 10
 process of, 194
 classical physics, 56
 cloud-in-cell (CIC) method, 279
 complementary MOS (CMOS), 173, 200–204
 basic architecture of, 68f
 flash memory. *See* flash memory
 intrinsic fluctuations in, 260–270, 292
 molecular electronics and, 18–31, 257–301
 MOSFETs and. *See* MOS field-effect transistors
 radiation and, 69
 simulation of, 276–301
 SPT and, 31–33
 computation, theory of, 15–18
 condensation, 36
 contact-potential difference (CPD), 247
 continuous models, 258–259, 259f
 corner effects, 98
 Coulomb blockade, 174–189, 189
 Coulomb interactions, 114, 306, 309, 326–329
 Coulomb scattering, 219, 283–284, 290–292
 coupling, 78f, 88, 321
 CPD. *See* contact-potential difference
 crossbar architectures, 22, 24, 25, 25f, 26f, 33, 35f, 42
 crystals
 Bloch band, 305
 defects in, 128
 dielectrics and. *See* dielectrics
 dimensions of, 127
 doping and. *See* doping
 energy levels of, 114
 nanocrystals. *See* nanocrystals
 optical phonons in, 311
 polarons in, 305, 315
 quantum wires and, 152–153. *See* quantum wires
 self-trapping phenomenon, 305
See also specific devices, types
 CVD. *See* chemical vapor deposition
 cycloaddition, 36, 37f
- D**
 DBR. *See* distributed Bragg reflectors
 DD. *See* drift-diffusion method
 Debye momentum, 321
 decoherence, 44, 44n, 51
 demultiplexing, 40
 density gradient method, 271–274
 deposition, 9–10. *See specific processes*
 design gap, 14
 DFB. *See* distributed feedback lasers
 DFM. *See* dynamic force microscopy
 DFT calculations, 215
 DG approximation, 281, 284f
 DIBL. *See* drain-induced barrier lowering
 dielectrics, 200–201, 202t, 204, 208f
 atomic-scale variation of, 269f
 band gap and, 204, 204f
 d-electrons and, 206–213
 high-*k* materials, 200–206, 202t, 204f, 213
 interface, 219
 MOSFETs and., 92–93
 new developments, 199–220
 polarizability and, 201
 trapping and. *See* electron trapping
 diffusion, of dopants, 7–8
 dimensional effects, 84–94
 dimensions, reduction of, 116
 discretization method, 263, 276
 distributed Bragg reflectors (DBR), 126–127
 distributed feedback (DFB) lasers, 159
 DIVSB. *See* drain-induced virtual substrate biasing
 doping, 7–8, 110, 260–264, 277
 drain current, 84, 86f
 drain-induced barrier lowering (DIBL), 85, 271
 drain-induced virtual substrate biasing (DIVSB), 85
 DRAMs. *See* dynamic random access memories, 2
 drift-diffusion (DD) method, 263, 271–274

dynamic force microscopy (DFM), 225, 233–234
 ac-detection mode, 234
 AIII-BV materials, 243–245
 block scheme of, 234, 235f
 cantilever vibrations, 234–236
 chemical sensing with, 244–247
 contrast formation, 240
 damping signal, 241
 embedded nanotip, 240
 FM-detection scheme, 234
 imaging artifacts, 243
 ionic insulator surfaces, 241–243
 KPFM technique, 247, 252
 snap-to-contact effect, 239
 stable performance of, 239
 STM and, 243
 tip-surface interaction, 236–240, 240–241, 247
 dynamic random access memories (DRAMs), 2, 69

E

EDA. *See* electronic design automation
 EFTEM. *See* energy-filtered transmission electron microscopy
 Ehrenfest theorem, 56
 electrical gate oxide thickness (EOT), 199
 electrically programmable ROMs (EPROMs), 2, 26
 electron trapping, 212f
 characteristic time, 209
 d-electrons and, 206–213
 DC measurements, 208
 detrapping, 209, 210f, 213f
 dielectrics and, 210f. *See also* dielectrics
 fast transient model, 208–209
 orbitals of, 201f, 206–213
 pulse time and, 213f
 quantum effects and, 206–213
 shallow, 211, 212
 tunneling and, 134
 vibrons and, 345
 electronic design automation (EDA), 293
 electrons
 coupling and, 308
 energy of, 107–108

phonons and, 309, 311, 326–329, 332
 polarons and, 305
 Schrödinger equation, 128
 semiconductors and, 107
 trapping. *See* electron trapping
 electrostatic force, 248f
 eltran process. *See* epitaxial layer transfer
 energy-filtered transmission electron microscopy (EFTEM), 181, 182
 EOT. *See* electrical gate oxide thickness
 epitaxial growth, 69–70, 137–138
 epitaxial layer transfer (eltran), 71–72
 EPROMs. *See* electrically programmable ROMs
 erase function, 46, 188, 189f, 190f
 etching, 8–9, 135, 141
 exponential autocorrelation, 266
 extraction strategies, 294–296

F

Fabry-Perot cavities, 122, 129
 fast transient charging, 208–209
 FBEs. *See* floating-body effects
 Fermi-Dirac golden rule, 343, 348
 Fermi-Dirac statistics, 106, 273, 276, 307
 Fermi energy, 229
 Fermi levels, 111, 229, 248
 fermion operators, 335
 FFM. *See* friction force microscopy
 FG. *See* floating-gate memory
 fiber communication systems, 113–122
 field theory, 53
 FIPOS. *See* full isolation by porous oxidized silicon
 flash memory, 44–52, 45f, 47f, 50f
 floating-body effects (FBEs), 78, 87, 90
 floating-gate (FG) memory, 171
 FN erasure. *See* Fowler-Nordheim erasure
 four-gate FET, 99–100
 Fourier transforms, 270, 317, 347
 Fowler-Nordheim (FN) erasure, 46, 171, 175, 180
 friction force microscopy (FFM), 225, 233
 Fröhlich constant, 316, 318, 320

Fröhlich polaron,, 308, 317–321, 333, 335
 full isolation by porous oxidized silicon
 (FIPOS), 73

G

GaAs alloys, 139, 155, 244, 246
 cap layer, 150
 heterostructures of, 106
 lasers and, 147. *See also* semiconductor
 lasers
 quantum wires, 137–139. *See also*
 quantum wires
 substrate, 149
 gain enhancement, 116
 Gaussian autocorrelation, 266–267
 geometrical magnetoresistance, 90
 Giessibl equation, 237
 grafting, 27, 42
 Green's function, 276, 339–342
 Gummel approach, 273
 gutterlike potentials, 272

H

Hall effect, 82
 Hamaker constant, 239
 Hamiltonian function, 335, 345
 hardware demultiplexing, 40
 harmonic oscillator, 236, 323
 Hartree-Fock potential, 311
 Heisenberg operator, 341, 347
 Heisenberg relation, 15, 51
 Hermite polynomials, 323
 heterostructures, 106
 Hewlett-Packard. *See* HP-UCLA
 collaboration
 HfO₂ films, 204, 215, 218–219, 218f
 highly ordered pyrolytic graphite (HOPG),
 230
 history effects, 78, 91
 Holstein model, 321–323, 334
 HOMO. *See* highest occupied molecular
 orbital
 HOPG. *See* highly ordered pyrolytic
 graphite
 host-guest technology, 29
 hot-carrier injection (HCI), 187
 HP-UCLA collaboration, 22–24, 43–44

hydrosilation, 36–39, 37f
 hysteresis, 79

I

impact ionization, 79
 InAs alloy, 244
 information theory, 17
 InGaAs layers, 158
 InSb surfaces, 244, 245f, 246, 253f
 interband transitions, 108, 110–111
 International Technology Roadmap for
 Semiconductors (ITRS), 12, 60, 69,
 199, 257
 intrinsic parameter fluctuation, 292–301
 ion implantation, 7
 ionic insulator surfaces, 241–243
 ionic switching, 338
 irreversibility, 59
 ITRS. *See* International Technology
 Roadmap for Semiconductors

J

Jahn-Teller interactions, 203, 211, 308, 345

K

KBr films, 242f, 249, 253f
 Kelvin probe force microscopy (KPFM),
 225, 240, 245–253
 kink effect, 78
 KPFM. *See* Kelvin probe force microscopy
 Kronecker symbol, 348

L

λ -ridge quantum wire lasers, 149–150
 Lang-Firsov transformation, 329, 333, 334,
 346
 Langmuir-Blodgett (LB) film, 22
 large-scale integration (LSI), 11
 lasers
 band-to-band transitions, 117
 nanoscale design, 105–169
 photons and, 117
 semiconductors and. *See* semiconductor
 lasers
 spontaneous emission, 117

- latch, 79
lateral dimension, 135
lateral force microscopy (LFM), 225, 233
lattice polarons, 305–353
LB film. *See* Langmuir-Blodgett film
LDD. *See* low-doped drain
LDOS. *See* local density of states
Lee-Kumpf model, 244
LER. *See* line-edge roughness
LFM. *See* lateral force microscopy
line-edge roughness (LER), 265–268
lithography, 5–7, 40–42, 135–138, 154–157. *See also specific topics*
local density of states (LDOS), 230
Lorentz noise, 91
low-doped drain (LDD), 79
lowest unoccupied molecular orbital (LUMO), 18
LSI. *See* large-scale integration
LUMO. *See* lowest unoccupied molecular orbital
- M**
macroscopic events, 59
magnetic force microscopy (MFM), 225
masking, 173f
Maxwell demon, 57
Maxwell equations, 128
MBE. *See* molecular-beam epitaxy
mean-field approximation (MFA), 309, 343, 345
measurement problem, 55–59
medium-scale integration (MSI), 11
memory, 24, 171
 array fabrication, 191–195
 characterization of, 191–195
 checkerboard programming, 194, 194f
 CMOS technology and, 192f
 erasure, 46, 188, 189f, 190f
 flash. *See* flash memory
 FN erasure. *See* Fowler-Nordheim erasure
 functional molecules, 60
 nanocrystals and, 192f, 193f
 nonvolatile, 171–196
 NVM, 171–196, 172f
 physics of, 174–181
 process flow for, 192f
 RAM/ROM, 2
 READ operations, 186, 189, 190, 191
 rotaxanes and, 23, 25f
 silicon devices, 171–196
 SRAM cell, 298
 threshold voltage distributions, 193, 193f
 tunneling and, 188
 write, 46
mesh sensitivity, 281–282
mesoscopic level, 27
metal-organic chemical vapor deposition (MOCVD), 130, 131–132, 141
metal-oxide-semiconductor field-effect transistors. *See* MOS field-effect transistors
metastability, 59, 77
MFA. *See* mean-field approximation
MFM. *See* magnetic force microscopy
microdisk cavities, 129
microelectronics, growth of, 12–13, 13f
microprocessors (MPUs), 199
mobility-thickness correlation, 89
MOCVD. *See* metal-organic chemical deposition
molecular-beam epitaxy (MBE), 130–131, 182
molecular electronics, 18–31
 Avogadro number and, 1
 charge conduction, 49
 CMOS, 1–67
 decoherence and, 44n
 dedicated approach, 29, 31–42
 defined, 18
 designed, 18f
 electrical probes, 18
 electrical properties and, 22
 energy structure, 43
 external redox, 20–21
 flash memory. *See* flash memory
 hybrid devices, 27–31, 29f, 59
 internal redox, 19–20
 nanowires. *See* quantum wires
 production costs, 60
 quantum dots. *See* quantum dots
 redox center, 48
 supramolecular systems, 21
 switching and, 338–345, 351

- molecular electronics (*cont.*)
wires. *See* quantum wires
See also electrons; *specific devices, topics*
- molecular quantum dots (MQDs),
338–348, 340f
- Monte Carlo simulators, 271, 283–284
- Moore's laws, 257, 351
first law, 2, 3f, 12–15
ITRS and, 12
MOSFET paradigm, 2–5
second law, 3, 4f, 14
- MOS field-effect transistors (MOSFETs),
174, 257, 282
atomic-scale variation of, 269f
atomistically doped, 278f
average price of, 3
body potential, 90
boundary conditions and, 274
carrier distributions in, 77
channel thickness, 87–89
classification of, 2
corrections for holes, 283
current technology, 6f
defect coupling, 77
depletion and, 80f
design gap, 14
dielectrics. *See* dielectrics
dimensional effects, 84–94
doping and. *See* doping
double-gate, 88, 94–95
electrical characteristics, 82–83
FBE and, 87–90
Fin Fets, 95
flash devices, 44, 45
front-channel characteristics, 74f
future of, 11
gate-all-around, 98–99
geometrical magnetoresistance, 90
GIFBE in, 90
hole concentration, 284f
length scaling, 85
lithographic limit, 14
logics and, 2
main electrical features, 14
memory. *See* memory
MIGFETs, 95
mobility in, 89
Moore's law and, 2–5
MOSFET paradigm, 10
multiple-gate, 94–100
narrow channels, 86–87
new materials in, 12
p-n junctions, 267
physical limit, 14
potential distribution, 269f
quantum corrections for, 280
quantum simulations for, 98
random dopants, 260–264
Schmitt trigger, 29
self-heating, 92
short-channel effects, 12, 85–86, 93
simulation of, 274, 277, 280, 282–285
SOI basics and, 67–104
source/drain regions, 279
supercoupling, 88
thickness effect, 89
threshold voltage, 74, 174
transconductance, 76, 91
transient time, 80, 84
trapping of holes, 282
triple-gate, 98–99
volume inversion, 76–77, 88
wafer characterization, 81–82
See also specific devices, topics
- MPUs. *See* microprocessors
- MQDs. *See* molecular quantum dots
- MSI. *See* medium-scale integration
- multiplexing, 40
- multipolaron problem, 309
- multispacer patterning, 31, 33–34
- N**
- nanocrystals, 174–181, 176
adatom diffusivity, 184
average charge in, 179
band-gap energy, 114
bitcell characteristics, 185–191
charge loss in, 178
chemical synthesis, 156–157
CMOS and, 257–301. *See*
complementary MOS
coalescence of, 183
CVD and, 182
deposition and, 184f, 192
engineering of, 181–185
erase performance, 176

evolution of, 181f
 exclusion zone equation, 184
 FG memories, 173
 growth of, 183
 MBE deposition and, 182
 memory and, 173, 176, 180, 185–191,
 192f, 193f
 nucleation and, 183, 183f
 optimum size of, 175
 passivation, 192
 preservation of, 184
 quantum dots. *See* quantum dots
 self-assembly, 182
 self-capacitance of, 174, 175
 self-organization, 182, 194
 silicon, 171–196
 simulation of, 257–301
 SONOS devices, 177, 177f, 180
 threshold voltage decay, 179
 tunneling and, 176, 187
 wavefunction inside, 176
 wires. *See* quantum wires
See also specific types, topics
 nanodevices, defined, 30, 30n
 nanometer length scale (NLS), 15, 58
 nanostructures, 120, 160, 223–256. *See*
 specific types
 nanotechnology, 223
 nanowires, 40–41, 140, 305–353
 nanozones, 42
 nearest grid point (NGP), 279, 281–282
 nearest-neighbor approximation, 332
 negative-U Hubbard model, 311, 338–345
 Neumann boundary conditions, 274, 275
 NGP. *See* nearest grid point
 NLS. *See* nanometer length scale
 noise factor, 84
 nonlinear current-voltage character, 14
 nonlinear rate equation, 348
 nonvolatile memory (NVM) devices
 array fabrication, 191–195
 bitcell characteristics, 185–191, 193,
 193f
 lifetime of, 178
 mask adders for, 173f
 nanocrystals and, 174–185
 NVRAMs, 2, 189–191
 TEM image of, 193f
See also specific topics

NOR architecture, 192f
 nucleation, 182, 183f
 numerical simulations, 260, 309
 NVMs. *See* nonvolatile memory

O

observer, role of, 56
 optical cavities, 106, 128–129
 orbitals structure of, 18, 201f, 206–213,
 206–213, 329, 352
 oxidation, 7
 oxide thickness fluctuations, 268–270
 oxide-trimming, 13

P

parasitic bipolar transistor, 79
 Pauli principle, 232
 Pekar model, 311, 314
 perovskites, 200, 336
 perturbation theory, 237, 323, 326, 341
 phase-lock loop (PLL) device, 234, 235f
 phonons, 335, 345–348
 photoconductivity, 82
 photoluminescence excitation (PLE), 148
 photons, 117
 emission of, 134
 Maxwell equations and, 128
 semiconductor lasers and, 117, 122–129
 physical etching, 8
 physical theory, 53–56
 physical vapor deposition (PVD), 9
 Planck constant, 16, 110, 230, 271
 PLE. *See* photoluminescence excitation
 PLL. *See* phase-lock loop
 PMMA. *See* polymethyl methacrylate
 Poisson equation, 176, 263, 271, 273, 276
 Poisson process, 51, 52
 Poisson-Schrödinger functions, 276
 polarizability, 201, 202, 203
 polarons, 321–338
 band, 329–331
 coupling, 311–321
 crystals and, 305
 effective mass of, 315–317, 319
 electrons and, 305
 interaction between, 337f
 lattice polarons, 305–353

- polarons (*cont.*)
 radius of, 315
 small, 321, 323–325
 switching and, 345–351
 wavefunction for, 305
- polyacetylene, 338
- polycrystals, 213
- polymethyl methacrylate (PMMA), 157
- polyphenylenevinylene (PPV), 338
- PPV. *See* polyphenylenevinylene
- prepatterned substrates, 138–140
- pseudo-MOS transistor, 81f
- PVD. *See* physical vapor deposition
- Q**
- quantum confinement, 115–116, 281
- quantum dots, 115
 chemical synthesis of, 156, 159
 density of states of, 345–348
 energy levels, 304f
 fabrication technologies, 153–157
 Green's function and, 340–342
 lithography and, 135, 157
 MQDs. *See* molecular quantum dots
 self-organization, 154–159
 semiconductor lasers and, 157–160
 switching and, 305–353
- quantum effects
 d-electrons and, 201, 203, 206–213
 decoherence, 44, 44n, 51
 density gradient method, 271
 density of states of, 116–117, 129
 electron evolution, 52
 electron trapping, 206–213
 etching and, 135
 lateral dimension of, 135
 limits posed by, 27, 57
 lithography and, 135, 157
 measurement problem, 55–56
 molecular effects, 42–52
 nanostructures and, 115
 orbitals, 18, 206–213, 252, 329
 polarizability, 201
 quantum corrections, 280–281
 Zeno effect, 52
See also specific topics
- quantum Monte Carlo (QMC) methods,
 309, 333
- quantum numbers, 115
- quantum potentials, 274, 275
- quantum well lasers, 115, 121, 129–134,
 133f, 154
- quantum wires, 40–41
 crystalline, 152–153
 epitaxial growth and, 137
 heterostructures for, 136–137
 lithography and, 137, 141–143
 nonplanar substrates, 139–140
 self-organization and, 137, 143–147,
 145
 semiconductor lasers and. *See*
 semiconductor lasers
- SILO process, 136
- strain-induced lateral ordering,
 136–137
 switching and, 308–355
 T-intersection, 140, 140f, 150–152
 V-groove, 138–140, 145, 147–149
- R**
- random access memory (RAM), 2, 23–27.
See also memory
- random doping, 261f, 263, 298, 300
- random telegraph signal (RTS), 84
- rapid thermal annealing (RTA), 267
- rate equation, 340–343, 348–351
- read operation, 298–299
- real-space representation, 329
- recombination processes, 84, 110–111
- redox center, 47, 47f, 48
- reductionism, 52
- resist-ashing, 13
- Roadmap. *See* International Technology
 Roadmap for Semiconductors
- rotaxanes, 20–25, 25f, 43
- RTA. *See* rapid thermal annealing
- RTS. *See* random telegraph signal
- S**
- scanning electron microscopic (SEM), 143,
 181
- scanning force microscopies (SFM),
 223–256, 241
- scanning near-field optical microscopy
 (SNOM), 225

- scanning probe microscopy (SPM),
 224–227
 main components of, 224f
 tip for, 224–226
 two principal modes of, 227
- scanning tunneling microscopy (STM),
 225, 228–231
 cantilever deflection, 232
 tip for, 226f
 tip-surface interaction forces, 232
 tunneling effect, 228–230
- scattering, 219, 290–292, 296
- Schmitt trigger, 29
- Schrödinger equation, 107, 114, 128, 228,
 322, 325
- self-heating, 92
- self-organization, 27, 136–137, 143–147,
 154–159
- self-trapping phenomenon, 305
- SEM. *See* scanning electron microscopic
- semiconductor lasers
 band-to-band transitions, 109, 117
 basic elements, 106
 buried heterostructure, 124
 carrier confinement, 125
 cavity structures, 122–129
 color range, 105–169
 confinement and, 125
 current status of, 105–160
 double-heterojunction, 158, 158f
 edge-emitting, 123–125, 125
 efficiency of, 121, 124
 fiber communication systems, 113–122
 four basic types, 122–123
 fundamental concepts, 106–111
 impact of, 105–169
 interband transitions, 108
 low threshold, 105–169
 miniaturization of, 105–169, 112
 modulation bandwidth of, 121
 nanoscale design, 113–122
 optical cavities, 123–125
 optical gain, 105–169
 photon confinement, 117, 122–129
 quantum cascade lasers, 133–134
 quantum dots. *See* quantum dots
 quantum well lasers, 121, 130–134, 133f
 quantum wire lasers, 134–153
 reduced dimensions, 115
 room-temperature lasing, 147
 self-organized, 136, 143–147, 157–159
 spontaneous emission, 117
 stimulated emission, 124
 surface-emitting, 129
 threshold conditions, 118–122
 VCSEL model, 125
- semiconductor-oxide-nitride-oxide-
 semiconductors (SONOS) memory,
 173–178, 177f, 180
- semiconductors
 band-to-band transitions, 109f, 117
 carrier density, 118
 crystalline quality, 112
 density of states, 116
 doping, 110, 263, 277. *See* doping
 electrons in, 106–108
 gain function, 116–117
 lasers. *See* semiconductor lasers
 nanocrystals and, 156. *See* nanocrystals
 p-n junctions, 110–112
 photons in, 108–110
 quantum dots. *See* quantum dots
 scaling down in, 199
 transistor densities, 199
See also specific types, topics
- SFM. *See* scanning force microscopies
- Shannon-von Neumann-Landauer theory,
 17
- Sharfetter-Gummel method, 274
- short-channel effects, 85–86, 93
- Si/SiO₂ interface, 275–276, 287, 288f, 289f
- silanization, 36, 37f
- silicates, 205, 214
- silicon crystals, 171–195, 172f, 205
- silicon-insulator-silicon (SIS) capacitor, 83
- silicon lattice basis, 264, 264f
- silicon-on-insulator (SOI) technology, 13
 basic materials, 70–73, 70f
 capacitance and, 83
 electrical properties, 81–84
 MOSFETs and, 74–81
 principles of, 68–70
 state-of-the-art technologies, 67
 wafer technologies, 70–74
See also specific devices, topics
- silicon oxide. *See* SiO₂
- SILO. *See* strain-induced lateral ordering
 process

- SIMOX material, 72
- SiO₂ layers
- dielectrics and, 192, 199–200, 214–215
 - inter facial, 215–217, 217f, 218f, 275–276, 287, 288f
 - nanocrystals and, 181–188
 - replacement of, 204–205
- SIS. *See* silicon-insulator-silicon capacitor
- snap-to-contact effect, 232, 239
- SNM. *See* static noise margin
- SNOM. *See* scanning near-field optical microscopy
- SOI. *See* silicon-on-insulator technology
- SONOS. *See* semiconductor-oxide-nitride-oxide-semiconductors memory
- SOR. *See* successive over-relaxation
- SOS. *See* silicon-on-sapphire
- SP-STM. *See* spin-polarized scanning tunneling microscopy
- spacer patterning technology (SPT), 13, 31–33
- spectroscopy, 247
- spin-polarized scanning tunneling microscopy (SP-STM), 225
- SPM. *See* scanning probe microscopy
- spontaneous emission lasers, 117
- SPT. *See* spacer patterning technology
- sputter-cleaned surfaces, 244
- SRAM. *See* static random access memory
- SrTiO₃ materials, 205
- static noise margin (SNM), 297
- static random access memory (SRAM), 296–298
- statistical compact models, 293
- stimulated emission, 117
- STM. *See* scanning tunneling microscopy
- Stoker model, 182
- strain-induced lateral ordering (SILO) process, 136, 143–145
- Stranski-Krastanov growth mode, 155
- strip-formation stage, 42
- successive over-relaxation (SOR), 271
- superconductors, 308, 309
- supercoupling, 88
- switch point voltage, 300
- switching, 79, 348–351
- computation and, 22
 - current controlled, 352
 - nanowires and, 305–353
 - polarons and, 338, 345–351
 - quantum dots and, 305–353
 - reversible, 351, 352
 - for simple molecules, 338
- Szilard's solution, 57
- T**
- T-intersections, 150–152, 151f
- Taurus process, 267, 267f
- thermodynamic processes, 206
- thin films, 211–215. *See specific types*
- threshold current density, 120
- threshold voltage, 118–122, 179
- TMI. *See* trimethylindium
- TOP. *See* trioctylphosphine
- TOPO. *See* trioctylphosphine oxide
- transconductance, 76, 77, 78f, 91
- transient effects, 91
- transient time, 79, 84
- transistor latch, 79
- trimethylindium (TMI), 140
- trioctylphosphine oxide (TOPO), 156
- trioctylphosphine (TOP), 156
- tunneling, 46, 228–230, 229f, 230f, 310, 336, 348
- U**
- UCLA-HP project, 22–24, 43–44
- uncertainty principle, 15, 16, 56
- unibond, 71, 81f
- V**
- V-groove lasers, 145, 147–149
- van der Waals forces, 27, 71, 231, 238, 240
- vapor deposition, 9–10. *See specific processes*
- vapor-liquid-solid process, 140
- variational approach, 311–315
- VCO. *See* voltage-controlled oscillator
- VCSELs. *See* vertical cavity surface emitting laser
- vertical cavity surface emitting laser (VCSELs), 125
- vibration wavefunction, 325

voltage-controlled oscillator (VCO),
235
volume inversion, 76–77, 88
von Neumann model, 57

W

wafer technologies, 70–74
Wannier representation, 326–329,
335
wavefunctions, 229, 305. *See* equation
XX
Wentzel-Kramers-Brillouin (WKB)
approximation, 176, 275
Wigner function, 271
Wilson chamber, 58
wires. *See* quantum wires
write operation, 46, 300

X

X-ray photoemission spectroscopy (XPS),
39

Y

Yablonovitch gap, 127
yttrium-lithium fluoride (YLF) laser, 150

Z

Zeno effect, 52
zeroth mask, 42
ZMR. *See* zone melting recrystallization
methods
ZnO nanowires, 152, 152f, 153
zone melting recrystallization (ZMR)
methods, 69, 73