

Index

• Numerics •

3rd Tech, Inc., 60
21st Century Nanotechnology Research
and Development Act, 321
2001: A Space Odyssey (film), 117

• A •

Abbot Laboratories, 284
The Abyss (film), 271
accelerometer, 191
Accelrys, 286
Action Group on Erosion, Technology,
and Concentration, 36, 38
action potential, 118
active imaging, 179–180
adaptive optics, 179–181
adenosine triphosphate (ATP), 235
Advanced Battery Technologies, Inc., 26
Advanced Bio Prosthetic Surfaces, 274–275
AFM (atomic force microscope)
description of, 54–55, 56, 59–60
tips for, 143–144
writing with, 135
Agilent Technologies, 222, 226, 288
Agriculture, U.S. Department of, 293
air, cleaning, 214
airbag sensor, 18
airplanes
nanofiber and, 101
shape-memory alloy and, 107, 108
algorithms, 117
alignment and nanofiber, 97–98
Alivisatos, Paul (researcher),
241, 312, 322, 331
all-optical switch, 171–173
Altair Nanotechnologies, Inc., 26, 210, 285
Altsys Corporation, 321
AMD/Motorola, 132
American Pharmaceutical Partners,
Inc., 284
amine, 263
ammonia, 187
amorphous phase of chalcogenide, 149
amphiphiles, 252–253
anode, 210–211
antibody, 265
antioxidants, buckyballs as, 71–72
apatite, 277
apoptosis, 261, 262
applications. *See also* electronics; energy;
healthcare field
natural resources, 16, 214–217
overview of, 12
security field, 14–15, 120
Applied Nanofluorescence, 287
Aprilis, 148
aramid fiber, 30
argon, 43
Argonne National Laboratory, 295
Arizona State University, 315
armchair nanotube, 76, 78
armchair quantum wire, 79, 98
Arrayx, Inc., 232
arsenic, 44
artery, expanding from inside, 271, 273–275
artificial gravity, creating, 102–103
Asian investment, 300–302
Asia-Pacific Nanotechnology Forum, 329
associative retrieval, 147–148
atom. *See also specific types of atoms*
anatomy of, 40–41
chemical bonding and, 42–43
electromagnetic or electrostatic force
and, 41–42
heat and, 50
size of, 42
strong nuclear force and, 41
topography of, 53
Atomate, 134
atomic force microscope (AFM)
description of, 54–55, 56, 59–60
tips for, 143–144
writing with, 135
ATP (adenosine triphosphate), 235
attractive electrostatic force, 41–42

August Technology, 123
 Avouris, Phaedon (scientist), 123
 awful-glop factor, 34
 Ayurveda India, 289
 azonano.com Web site, 328

• B •

Babolat, 285
 Bakelite, 86
 ballistic transport, 78
 bases of DNA, 242–244
 batch chemical process, 195
 battery, lithium-ion, 210–211
 beam splitter, 146
 beam-steer, 174
 Beckman, 284
 Belcher, Angela (biomedical engineer), 198, 313, 323
 Bell Labs, 282, 288, 297
 Ben-Gurion University, 239, 311
 benzene, 67
 benzene ring, 195
 bilayer, 253, 255
 binary symbols, 118
 Binnig, Gerd (scientist), 14
 bioactive material, 277
 bioavailability, 250, 251
 Biofriendly Corporation, 214
 biometrics, 15, 120
 biomimetics
 artery, expanding from inside, 271, 273–275
 joint-replacement therapy, 275–277
 overview of, 268–269
 oxygen delivery improvement, 269–271, 272
 biomolecular motor, 235
 Bionova, 289
 biopore, 248
 biosensor, 189–190, 236–238
 biotechnology patent applications, 250
 bit, 118
Blade Runner (film), 136
 blood transfusion, drawbacks of, 269–271
 blood-brain barrier, 240
 blood-pressure sensor, 191
 blue laser, 148
 body armor, 99–100

bone and joint-replacement therapy, 275–277
 book companion Web site, 5, 327–328
 boron, 44
 Boston Micromachines Corporation, 177–178
 bottom-up approach to fabricating at nano scale, 12
 brain, linking with computer, 118–119
 Breslow, Ronald (professor), 307
 Brookhaven National Laboratory, 295
 bubble, economic, 23–25
 buckminsterfullerenes (buckyballs)
 as antioxidants, 71–72
 carbon nanotubes and, 73
 creating, 70–71
 description of, 69–70
 discovery of, 14
 drug-delivery mechanisms and, 72, 258–260
 imaging and, 72, 240
 research on, 72–73
 toxicity of, 35–36
 buckypaper, 110
 buffer fluid, 226–227
 bulletproof vest, 99–100
 byte, 119

• C •

C Sixty, Inc., 71, 72, 240
 California Institute of Technology, 321
 Caliper Technologies, 226
 Cambridge Research and Instrumentation, 241
 Cambrios Technologies Corp., 313, 323
 cancer
 description of, 261, 262
 nanoshell and, 261–268
 research spending on, 261
 cantilever, 54, 56
 capturing, 53
 carbon atom. *See also* buckminsterfullerenes (buckyballs); carbon nanotube
 benzene and, 67
 description of, 65–66
 electronegativity of, 66
 graphite, 68–69

- carbon dioxide in air, 214
Carbon Nanotechnologies Inc., 285, 320
carbon nanotube
 as chemical sensor, 237
 color screen and, 92
 creating, 75
 description of, 73–74
 electronic applications for, 196
 fluorescence and, 242
 hydrogen storage and, 209
 light from, 185–186
 metallic, 78, 198
 nanofiber and, 96–97
 properties of, 76–79
 semiconducting, 78
 static electricity and, 88–91
 as strain sensor, 110
 structure of, 76
 as tip for atomic force microscope,
 54–55, 56
 transistor and, 123–125
 uses of, 79–80
carbon nanotube field-effect transistor,
 124, 125
carbon nanotube transistor, 13
carbon tetrachloride, 217
Carnegie Mellon University, 139, 282
catalyst, 212–213
catalytic converter, 212
CCD (charge-coupled device) camera, 147
Celanese, 285
cellulose, 86
Center for Functional Nanomaterials, 295
Center for Innovative Technology, 297
Center for Integrated Nanotechnologies
 (CINT), 294, 295
Center for Nanophase Materials Sciences
 (CNMS), 294
Center for Nanoscale Materials, 295
Centers of Excellence in Nanotech-
 nology, 305
chalcogenide, 149
charge-coupled device (CCD) camera, 147
chemical bonding, 42–43
chemical sensor, 79, 187–189, 237
chemical, using nanocatalyst to make,
 212–213
chemical-vapor deposition, 75
chemiresistor, 188–189
chemistry, questions of, 40
Chevron Texaco, 289
China, 301
chiral nanotube, 76, 78
chlorophyll molecule, 208
Chou, Stephen (researcher), 135
CINT (Center for Integrated
 Nanotechnologies), 294, 295
Clarke, Arthur C.
 The Fountains of Paradise (Clarke), 102
 quote on advance technology, 282
 2001: A Space Odyssey based on
 story by, 117
cleanroom, 129
Clemson University, 101
clot in blood vessel, destroying, 273
clothing and nanofiber, 99–101
CNMS (Center for Nanophase Materials
 Sciences), 294
collagen, 275
colloidal self-assembly, 169
color, 48–49
Colorado Nanotech Initiative, 296
colorimetric sensor, 244
Columbia University, 307
combustion synthesis, 70
Community Research & Development
 Information Service Web site, 298
composite. *See also* nanofiber; plastic
 description of, 83
 fiber/matrix interface, 84, 111–112
 as moldable, 84
 self-healing, 112–113
 shape memory alloy, 104–108
Composite Technology Development,
 Inc., 108
computational nanotechnology, 306
computer chip. *See also* lab-on-a-chip
 fabricating, 128–135, 223–225
 molecular-scale devices and, 192–193
computers. *See also* memory technology
 linking brain with, 118–119
 molecular, 197–198
 processing ability and, 117–118
 quantum, 156, 158–160
 speed of processing by, 119–120
 static electricity and, 87
 transistors for, 18, 120–128
 in *2001: A Space Odyssey* (film), 117

- computing, advanced, 14–15
 - conductance state, 186
 - conduction band, 78
 - conjugated bond, 67
 - Connecticut Nanotechnology Initiative, 297
 - Consortium for Nano Functional Materials (Israel), 303
 - contrast agent, 72, 240
 - convergent technology, 61
 - converting microengine output into linear motion, 192
 - copper wire, 111
 - Cornell University, 171–172, 235, 307–309
 - Corning, 288
 - cosmetics companies, 289
 - Coulomb blockade, 126, 127
 - Council for Scientific and Technological Policy (Japan), 301
 - covalent bonding
 - carbon atoms and, 66, 79
 - electrical wire and, 44
 - Coventor, 286
 - Crichton, Michael, *Prey*, 21, 190
 - critical micelle concentration, 253
 - crossbar latch, 196
 - crossbar memory, 150–151
 - cryptography, quantum, 14–15, 154–158
 - crystalline phase of chalcogenide, 149
 - crystallographic structure, 57
 - crystals
 - manipulating light with, 162–163
 - photonic, 166, 171
 - self-assembling, 168–170
 - C₆₀. *See* buckminsterfullerenes (buckyballs)
 - CU dot, 308
 - curing polymer, 224–225
 - Curl, Robert F., Jr. (scientist), 14, 69
 - current blockade, 247
 - cycles per second, 48
- **D** ●
- Dai, Hongjie (professor), 320
 - Dakota Technical College, 313
 - data mining, 147–148
 - decoherence, 160
 - decontaminating groundwater, 216–217
 - defects in photonic crystal, 171
 - Defense Advanced Research Projects Agency (DARPA), 282
 - Defense, U.S. Department of, 293
 - deformable mirror, 178
 - deforming nano-positioner, 176
 - degree in nanotechnology, schools offering, 312–313
 - Dekker, Cees (scientist), 127
 - Delft University of Technology, 127
 - delivery mechanism for drugs, 252–253, 256–260
 - delocalized electron, 44, 67, 194–195
 - dendrimer, 239, 259
 - deoxyribonucleic acid (DNA)
 - mapping, 242–245
 - microarray, 245–247
 - workings of, 247–248
 - designer molecules, producing hydrogen with, 208
 - diagnostics in healthcare field, 15, 81–82. *See also* lab-on-a-chip; molecular imaging
 - diamond, 45, 46, 77
 - Dick, Philip K., *Do Androids Dream of Electric Sheep?*, 136
 - diffraction, 164, 167
 - diffusion, 227
 - digital light processing (DLP), 174
 - digital signals, sorting, 161
 - dip pen nanolithography (DPN), 135
 - disinfectant cleaner, 19
 - dispersion and electrical conductivity, 91
 - display technology, 92–95
 - distillation of salt water into fresh water, 215
 - DLP (digital light processing), 174
 - DNA (deoxyribonucleic acid)
 - mapping, 242–245
 - microarray, 245–247
 - workings of, 247–248
 - DNA-coated nanotube, 125
 - Do Androids Dream of Electric Sheep?* (Dick), 136
 - doping, 44, 130
 - double helix of DNA, 243
 - Dow Chemical, 284
 - Doxa, 277
 - DPN (dip pen nanolithography), 135
 - Draper Fisher Jurvetson, 325

- Drexler, K. Eric, *Engines of Creation: The Coming Era of Nanotechnology*, 20, 324
- drugs
- bioavailability of, increasing, 251–252
 - buckyballs and, 258–260
 - delivery mechanism for, 252–253, 256–260
 - development of, 250–251
 - discovery of, and laminar flow, 226
 - HIV/AIDS, 36
 - intellectual property issues and, 37
 - micelles and, 253–255
 - novel, 15
 - testing, 119–120
- dry nanotechnology, 306
- DuPont
- buckyballs and, 72
 - International Council on Nanotechnology and, 36
 - Kevlar and, 29–33
 - single-walled nanotubes and, 35
 - testing equipment and, 287
- DVDs, 148
- dynamic RAM, 136
- **E** ●
- E Ink, 92, 94
- Eastman Kodak, 283
- EBL (electron-beam lithography), 132–133
- economic issues
- bubble, 23–25
 - control of means of production, 37–38
 - who gets benefit, 36–37
- EcoTru disinfectant cleaner (EnviroSystems), 19
- Edwards, Brad (aerospace engineer), 102
- Einstein, Albert (scientist), 47
- elasticity, 98
- electrical components, evolution of, 13
- electrical routing, 162
- electrical wire, plastic-wrapped, 44
- electrochromatics, 93–95
- electrokinetics, 232–233
- electroluminescence, 185–186
- electromagnetic or electrostatic force, 41–42
- electromagnetic radiation, 47
- electromagnetic spectrum, 49
- electron
- chemical bonding and, 42–43
 - delocalized, 44, 67, 194–195
 - description of, 40
 - fluorescence and, 228
 - intermolecular bond and, 43–45
 - orbital, 50, 67, 68, 184
 - in organic molecules, 194–195
 - primary, 56
 - quantum mechanics and, 152
 - quantum movement of within
 - nanotube, 78
 - secondary, 56
- electron hole recombination, 204
- electron-beam lithography (EBL), 132–133
- electronegativity, 66
- electronics. *See also* sensors
- carbon nanotubes, light from, 185–186
 - micro-electromechanical system, 190–192
 - molecular, 81, 193–194
 - molecular wires and, 198–199
 - nanotubes, nanowires, and, 196
 - organic molecules and, 194–196
 - quantum dots and, 183–185
 - self-assembly process and, 197–198
- electro-osmosis, 232
- electrophoresis, 232, 233
- electrostatic force, 177
- electrostatic painting, 91
- electrostatics, 87–91
- Emory University, 241
- encryption, 158
- endocytosis, 256, 257
- endothelial cell, 274, 275
- energizing quantum dot, 184
- energy
- applications for, 16
 - hydrogen fuel cells, 204–209
 - lithium-ion battery, 210–211
 - problem with supply of, 201–202
 - protecting environment when producing, 213–217
 - reducing consumption of, 211–213
 - revolution in, 17
 - solar cells, 202–204
- energy companies, 288–289
- energy density, 205, 206
- energy levels (orbital), 50, 67, 68, 184

Energy, U.S. Department of, 293, 294–295
Engines of Creation: The Coming Era of Nanotechnology (Drexler), 20, 324
 enigma, 335
 entanglement, 153–154
 environment, protecting when producing energy, 213–217
 Environmental Protection Agency, 35, 293
 equipment
 availability or cost of, 33
 for testing, 287
 ethanol, 168–169
 ethical issues
 economic divide, 36–38
 harm from nanomaterials, 35–36
 European Commission, 298–299
 European investment, 298–300
 European Nanoelectronics Initiative
 Advisory Council, 299
 EUV (extreme ultraviolet) radiation, 130–132
 evolution of technology, 13
 exchange-traded fund, 26
 exocytosis, 256
 expectations
 what we have, 18
 what will be new, 19
 what will improve, 18–19
 what will not happen, 20
 expertise factor, 34
 explosive, detecting, 188
 expression profiling, 247
 extreme ultraviolet (EUV) radiation, 130–132
 Exxon, 72
 eyeglass frames, 104–105
 eyesight, improving, 181

● F ●

fabricating at nano scale, 12
 fabricating computer chips
 companies involved in, 134
 electron-beam lithography and, 132–133
 EUV lithography and, 130–132
 overview of, 128–129

photolithography and, 129–130
 soft lithography and, 223–225
 techniques for, 134–135
 factorization, 158
Fantastic Voyage (film), 249
 fat fingers, 61
 FDA (Food and Drug Administration, U.S.),
 Web site, 329
 FEI Company, 286
 Feynman, Richard, “There’s Plenty of Room at the Bottom,” 13–14, 323
 Fiber Bragg Grating sensor, 110–111
 fiber optics, 110–111, 162
 field-effect transistor (FET), 122–126
 flexure, 176
 fluid. *See* microfluidics
 fluid breathing system, 271
 Fluidigm Corp., 233
 fluorescence
 carbon nanotubes and, 242
 fluids and, 228–229
 quantum dots and, 240–241
 focusing optics, 131
 folding, 248
 Food and Drug Administration (FDA),
 U.S., Web site, 329
 Forbes/Wolfe Nanotech Report Web site,
 328–329
 Foresight Institute, 20, 324, 329–330
 FormFactor, Inc., 282
The Fountains of Paradise (Clarke), 102
 free radical, 71
 Freescale Semiconductor, 141, 283
 Frontier Carbon Corporation, 71
 Fuller, Buckminster (architect and engineer), 70
 fullerene family of molecules, 70. *See also*
 buckminsterfullerenes (buckyballs)
 functionalization, 71, 79, 88, 263–264

● G ●

gadolinium, 72, 240
 gain medium, 168
 gamma wave, 48
 gate, 121

- GEMZ Corporation, 289
gene therapy, 258, 259
General Electric, 285
General Nanotechnology, 287
Georgia Institute of Technology
 blue laser and, 148
 catalysts and, 213
 quantum dots and, 241
 Semiconductor Research Corporation
 and, 282
 TCE in water and, 215
gigabit, 118
gigabyte, 119
gold, 261–262, 264–265
gold nanoparticle, 10, 12, 18
Golovchenko, Jene (researcher), 247, 248
Gore-Tex, 284
government investment
 Asia, 300–302
 Europe, 298–300
 Israel, 302–304
 overview of, 27
 U.S., 291–295
 U.S. state and regional, 296–298
grants for research, 295
graphite, 45, 46, 68–69
“gray goo” scenario, 20
Grier, David (researcher), 232
groundwater, decontaminating, 216–217
- **H** •
- Halas, Naomi (researcher), 324
Han, Jie (researcher), 301
harmonic frequency, 51
Harris & Harris, 26
Harvard University. *See also* Lieber,
 Charles; Whitesides, George
 as Center of Excellence in
 Nanotechnology, 305–306
 DNA mapping and, 247
 nano-imprint lithography and, 135
 nanowires and, 80, 81–82
 harvesting site, 273
HDSS (holographic data-storage system),
 144–148
- healthcare field. *See also* biomimetics;
 drugs; lab-on-a-chip
 applications in, 15
 buckyballs as antioxidants, 71–72
 development time and, 283
 fluorescence and, 229
 higher picture resolution and, 92
 imaging, 185, 239–242, 263
 implants, 268–269, 275–277
 medical imaging, drug delivery, and
 buckyballs, 72
 quantum dots and, 185
 reconstructive surgery, 106
 shape memory alloy and, 106
heat
 computer chips and, 193
 fluorescence and, 228
 light and, 50
Heath, James (researcher), 150, 238, 321
heavy-duty factor, 34
Heisenberg uncertainty principle, 154–155
helium, 43
hemoglobin, modifying, 269–270
heparin, 274
Hertz (Hz), 48
heuristics, 117
Hewlett-Packard
 Agilent Technologies, 222, 226, 288
 molecular memory and, 150
 MRAM and, 141
 nanowires and, 81, 196
 semiconductors and, 282
high-pressure carbon monoxide
 deposition, 75
hip implants, 276–277
history, 13–14
Hitachi, 283–284
holographic data-storage system (HDSS),
 144–148
holographic optical tweezers, 232
home pregnancy test, 18
Homeland Security, U.S. Department of, 293
howstuffworks.com Web site, 330
Hubble Space Telescope, 179
hybridization, 243
hydrocarbons, 194–196

hydrodynamic focusing, 229, 230
hydrogen
 chemical bonding and, 43
 designer molecules, producing with, 208
 photoelectrochemical cells, producing
 with, 206–207
 storing, 209
hydrogen fuel cell
 description of, 204–205
 designer molecules, producing hydrogen
 with, 208
 energy density and, 205
 photoelectrochemical cells, producing
 hydrogen with, 206–207
Hydrogen Solar, Ltd., 206, 289
hydroxyapatite, 275
hysteresis, 137
Hz (Hertz), 48

• 1 •

I, Robot (movie), 9
IBM
 Almaden Research Center, 159
 carbon nanotube resistor and, 123–125
 electroluminescence and, 185–186
 magnetic tunnel junction and, 137–139
 Millipede drive and, 142–144
 semiconductors and, 282
id Quantique, 157
Iijima, Sumio (researcher), 73
Ilse Katz Center for Meso and Nanoscale
 Science and Technology, 311
imaging biological processes
 buckyballs and, 240
 nanoshell and, 263
 overview of, 239
 quantum dots and, 240–242
impedance, 111
implants
 limitations of, 269
 nanotechnology and, 275–277
impurities, 44, 171
in vitro, 266
in vivo, 267
India, 302
Indian Association of Nuclear Physics
 (India), 302
Indian Institute of Science (India), 302

Indian Institute of Technology (India), 302
industry overview, 21–23
information superhighway, 162
infrared light, 47, 48–49
infrared spectroscopy, 51–52
Initiative for Nanotechnology in
 Virginia, 297
InMat, 285
Innerspace (film), 249
InPhase Technologies, 148, 174
Institute for Soldier Nanotechnologies, 14
Institute of Nanotechnology (U.K.), 329
Institute of Physical and Chemical
 Research (Japan), 301
Intel
 EUV radiation, 132
 MRAM, 141
 Pentium 4 Prescott 3.4GHz processor, 121
 PRAM, 150
 semiconductors, 282
intellectual property, as patentable, 24
intensity of light, 47
interdisciplinary approach, 12
interface between fiber and matrix,
 84, 111–113
intermolecular bond, 43–45
International Council on Nanotech-
 nology, 36
Invenios, 134
Investing For Dummies (Tyson), 27
investment tools and strategies, 26–28
ion-beam lithography, 134
iron nanoparticles, 216–217
island, 126
Israel, 302–304
Israel Nanotechnology Trust, 303
Israeli National Nanotechnology Initiative,
 302–303

• 1 •

Jacobson, Joseph (researcher), 135
Jafra Cosmetics, 289
Japan, 300–301
Jawaharlal Nehru Centre for Advanced
 Scientific Research (India), 302
Jelinek, Raz (researcher), 239
joint-replacement therapy, 268–269,
 275–277

Jurvetson, Steve (investor), 325
Justice, U.S. Department of, 293

• K •

Keck telescope, 179
Kevlar
 as body armor, 99–100
 DuPont and, 29–30
 marketing phase, 32–33
 production phase, 32
 research phase, 30–31
knowledge base, scientific, 24
Knowles Acoustics, 288
Konarka Technology, Inc., 203, 289
Kroto, Harold W. (scientist), 14, 69
Kuekes, Philip (researcher), 150
Kwolek, Stephanie (scientist), 30, 33

• L •

LabNow Inc., 287
lab-on-a-chip
 analysis and, 236
 biosensing with nanowires, 236–238
 companies developing, 244
 fabricating with soft lithography, 223–225
 fluid, moving through, 225–227, 229–235
 fluorescence and, 228–229
 overview of, 222–223
laboratories of U.S. Department of Energy,
 294–295
laminar flow, 226–227, 229, 236
laser
 blue, 148
 nanolaser, 167–168
 optical stretching and, 236
Lawrence Berkeley National Laboratory,
 132, 294
Lawrence Livermore Laboratory, 132
LED (light-emitting diode), 168, 185
Lewenstein, Bruce (professor), 308
LG Electronics, 286
licensing discovery, 23
Lieber, Charles (professor)
 career of, 320
 Nano Letters and, 331
 nanosensors and, 237

light
 all-optical switch, 171–173
 frequency of, 48–49
 heat and, 50
 manipulating with crystals, 162–163
 mirrors and, 174–178
 from nanotubes, 185–186
 optical switching, 170–171
 overview of, 46
 photonic band gaps and, 165–170
 photonics and, 163–165
 photons and, 49–50
 quantum dots, 183–185, 211
 surface tension and, 230–231
 theories of, 47
 as wave, 48
light insulator, 165–166
light-emitting diode (LED), 168, 185
light-steering, 175–178
linker, DNA, 244–245
liposome, 257–258, 270
lithium-ion battery, 210–211
load transfer, 84
L'Oreal, 289
Louisiana Tech University, 313
Los Alamos National Laboratory, 157, 294
Lovy, Howard (blogger), 328
Lucent Technologies, 283, 288
Ludwig-Maximilian University, 127
Lund University, 128
Lux Capital, 325
Lux Research, Inc., 26

• M •

magazines, 330–332
MagiQ, 157
magnetic moment, 139
magnetic random-access memory (MRAM),
 137–139, 141
magnetic resonance force microscopy
 (MRFM), 58–59
magnetic tunnel junction (MTJ),
 137–139, 141
magnetic-resonance imaging (MRI), 240
Mahmood, Umar (radiologist), 239
manipulating light with crystals, 162–163
market potential, 32
maskmaking market, 133

- masks, 132
- Massachusetts General Hospital, Center for Molecular Imaging Research, 239
- Massachusetts Institute of Technology (MIT), 60, 70, 314–315, 323
- Massachusetts Nanotechnology Initiative, 296
- materials
 - clothing, 99–101
 - companies making, 284–286
 - molecules and, 43–45
 - properties of, 45–46
 - superior, lightweight, 14
- Materials Modification, Inc., 285
- Matsushita Electronic Industrial Co., 241
- Max Planck Institute, 70, 82, 209
- medical field. *See* healthcare field
- medical imaging, 185, 239–242, 263
- megabit, 118
- megabyte, 119
- memory technology
 - DVDs, 148
 - dynamic RAM, 136–137
 - holographic data-storage system, 144–148
 - magnetic random-access memory, 137
 - magnetic tunnel junction, 137–139
 - millipede drive, 142–144
 - molecular memory, 150–151
 - nanotube RAM, 150
 - phase-change memory, 149–150
 - random-access memory, 136
 - Vertical Magnetoresistive Random-Access Memory, 139–141
- MEMs (micro-electromechanical system), 190–192
- Memscap, 288
- MEMulator software program, 286
- meniscus, 169
- Merci Retriever, 273
- Merck, Inc., 71–72, 284
- mercury vapor in air, 214
- Merrill Lynch Nanotech Index, 26
- metallic bonding, 44
- metallic carbon nanotube, 78
- metallo-fullerene, 240
- methane, 43
- metrology, 123, 144
- micelles, 253–255
- Michigan Tech, 88
- microarray, DNA, 245–247
- microcapsules, 94–95, 112–113
- micro-electromechanical system (MEMs), 190–192
- microfluidics
 - description of, 222, 225–226
 - electrical charge and, 232–233
 - motion and, 233, 235
 - PDMS and, 233
 - surface tension and, 229–232
 - viscosity, 226–227, 229
- microscopy
 - atomic force microscope, 54–55, 56, 59–60
 - magnetic resonance force, 58–59
 - overview of, 53
 - scanning electron microscope, 55–56
 - scanning tunneling microscope, 57–58
 - transmission electron microscope, 57
- millipede drive, 142–144
- Mirkin, Chad (professor), 309
- mirrors
 - light-steering and, 175–178
 - micro-electromechanical systems and, 191–192, 193
 - overview of, 174–175
- MIT (Massachusetts Institute of Technology), 60, 70, 314–315, 323
- MIT Media Lab, 135
- Mitsubishi Corporation, 71, 72
- mixing at micro level, 229, 230
- molecular chemistry, 20. *See also* atom
- molecular electronics, 81, 193–194
- Molecular Electronics Corp., 325
- Molecular Foundry, 294
- molecular imaging
 - buckyballs and, 240
 - overview of, 239
 - quantum dots and, 240–242
- molecular memory, 150–151
- molecular orbital, 68
- molecular wires, 198–199
- molecules. *See also specific types of molecules*
 - description of, 42, 43
 - fullerene family of, 70
 - intermolecular bond, 43–45
 - organic, 194–196
 - self-assembly process and, 197–198
 - structure of, 45–46

- Montemagno, Carlo (researcher), 235
 Moore's Law, 121
 Motorola, 141, 283
 mPhase Technologies, 211
 MRAM (magnetic random-access memory), 137–139, 141
 MRFM (magnetic resonance force microscopy), 58–59
 MRI (magnetic-resonance imaging), 240
 MTJ (magnetic tunnel junction), 137–139, 141
 MTS System Corporation, 287
 multilayer soft lithography, 233, 234
 multiwalled nanotubes (MWNT), 73
 munitions, 15
- *N* •
- Nano Letters* (magazine), 331
 Nano Science and Technology Institute (NSTI) Web site, 330
 Nanobot blog, 328
 NanoBusiness Alliance Web site, 329
 Nano-C, Inc., 70
 nanocatalyst, 212–213
 NanoChromatic Displays, 93
 NanoDynamics, 286
 nanofiber
 airplanes and, 101
 alignment and, 97–98
 clothing and, 99–101
 description of, 95
 nanotube and, 96–97
 tethers in space and, 102–104
 Nanogen, 25, 244
 NanoGram Corporation, 213
 nano-imprint lithography, 135
 nanolaser, 167–168
 nanomanipulator, 59–61
 Nanomaterials, 286
 nanometer, 10
 Nanometrics, 123, 287
 NanoOpto, 135
 Nanoprobes, 284
 Nanoscale Science and Engineering Centers (NSEC), 309
 Nanoscience Instruments, Inc., 54
 nanosensor
 biological, 189–190, 236–238
 chemical, 79, 187–189, 237
 colorimetric, 244
 in composite, 108–111
 nanowire-based, 81–82
 UltraViolet-Visible spectroscopy and, 53
 nanoshell
 attaching antibodies to, 265–266
 coating of, 261–262, 264–265
 as cooking cancer cell, 266–268
 creating, 263–264
 description of, 261
 uses of, 263
 Nanosolar, Inc., 203
 Nanospectra Biosciences, Inc., 261–262, 263–264, 267, 283
 Nanosys, Inc., 25–26, 203, 288, 320
 Nanotech Index (Merrill Lynch), 26
 Nanotech Now Web site, 330
 nanotechnology, definition of, 10, 12
 Nanotechnology Institute, 297–298
 Nanotechnology Technical Advisory Group, 322
 Nanotech.org, 283
 Nano-Tex, 100–101, 284–285
 NanoTitan, 287
 nanotube. *See* carbon nanotube; single-walled nanotube (SWNT)
 nanotube RAM, 150
 nanowire
 chemiresistor and, 189
 description of, 80
 electronic applications for, 196
 growing, 80–81
 lab-on-a-chip and, 236–238
 single-electron transistor and, 128
 uses of, 81–82
 Nantero, 150
 NASA, 81, 293
 Natelson, Douglas (professor), 133
 National Cancer Institute, 261, 329
 National Chemical Laboratory (India), 302
 National Engineering Research Center for Nanotechnology (China), 301
National Geographic (magazine), 331
 National Institute for Materials Science (Japan), 301

- National Institute for Occupational Safety and Health, 293
- National Institute of Advanced Industrial Science and Technology (Japan), 301
- National Institute of Standards and Technology, 81, 82, 293
- National Institutes of Health, 293
- National Nanoscience and Technology Initiative (India), 302
- National Nanotechnology Infrastructure Network, 292–293, 307–308
- National Nanotechnology Initiative (NNI)
definition by, 10
funding by, 22, 295
goals of, 292
Smalley and, 320
Web site, 312–313, 328
- National Physical Laboratory (India), 302
- National Renewable Energy Laboratory, 209
- National Science Foundation
Nanoscale Science and Engineering Center Web site, 310
National Nanotechnology Initiative Web site, 312–313, 328
partnerships of, 305
Web site, 293
- natural resources
air, cleaning, 214
applications for, 16
water, cleaning, 215–217
- Nature* (magazine), 331
- Naval Research Laboratory, 137, 139, 189
- near-infrared wavelength, 262, 263
- NEC, 120, 157
- negative photoresist, 224
- neon, 43
- neuron, 118
- neutron, 40
- New Jersey Nanotechnology Consortium (NJNC), 288, 297
- New York State, 296
- Newton, Isaac (physicist), 47
- Nexia Biotechnologies, 100
- nGimat, 286
- Nitinol, 104–105, 275
- nitrogen atom, 66
- nitrogen dioxide, 187
- nitrogen oxide in air, 214
- NJNC (New Jersey Nanotechnology Consortium), 288, 297
- NNI (National Nanotechnology Initiative)
definition by, 10
funding by, 22, 295
goals of, 292
Smalley and, 320
Web site, 312–313, 328
- noble gases, 43
- noise, 190, 193
- noncovalent force, 88
- nonpolar molecule, 44–45, 53
- Northern California Nanotechnology Initiative, 297
- Northwestern University, 309
- NOT gate, 124
- NSEC (Nanoscale Science and Engineering Centers), 309, 310
- NSTI (Nano Science and Technology Institute) Web site, 330
- NTERA, 92, 93, 95
- NVE Corporation, 141
- 0 ●
- Oak Ridge National Laboratory (ORNL), 214, 294
- Obducat Ab, 287
- object beam, 145–146
- oil resources, 17
- OMNI (Organization for Minnesota Nanotechnology Initiatives), 297
- one-time pad, 154
- ophthalmology research, 181
- optical cavity, 167–168
- optical stretcher, 236
- optical switching, 170–171
- optical tweezers, 231–232
- Optimata, 120
- Optware, 148
- orbital, 50, 67, 68, 184
- Orchid Biosciences, 244
- organic chemical vapors, 214
- organic molecules, 194–196
- organic surfaces, 338
- Organization for Minnesota Nanotechnology Initiatives (OMNI), 297
- ORNL (Oak Ridge National Laboratory), 214, 294

Osaka University, 315
osteoblast, 275
oxidation, 338
oxygen atom, 66
oxygen delivery, improving, 269–271, 272
oxygen molecule, 43, 44–45

● p ●

Pacific Northwest National Laboratory, 214
painting, electrostatic, 91
pairing, 248
palladium, 215
para-aminobenzoic acid, 30
parallel processing, 119
particle board, 83
particle theory of light, 47
PDMS (polydimethylsiloxane), 225, 233
Pennsylvania, 297
percolation theory, 89–90
petroleum, 205
phantomsnet.com Web site, 329
pharmaceutical industry, 37, 250–251.
 See also drugs
pharmacogenetics, 244
phase-change memory, 149–150
phospholipid, 254
phosphor, 92, 228–229
photocoagulation, 283
photoelectric effect, 47
photoelectrochemical cell, producing
 hydrogen with, 206–207
photolithography, 129–130
photon
 description of, 47
 fluorescence and, 228
 light and, 49–50
 as message carrier, 163
photonic band gap, 165–170
photonic crystal, 166, 171
photonic crystal laser, 168
photonics, 163–165
photoresist, 223, 224
photoresist layer, 132
photosynthesis, 208
physics, questions of, 40
picosecond, 171–172
piezoelectric transducer (PZT), 176–177
piezoelectric tube, 57, 58

Pisano, Albert (department chair), 312
plasma, using to produce nanotube, 75
plastic. *See also* polymer
 development of, 86–87
 display technology and, 92–95
 overview of, 84–85
 static electricity and, 87–91
platinum in catalytic converter, 212
polar molecule, 44
Polyaryleneethynylene (PPE) molecule,
 88–89
polydimethylsiloxane (PDMS), 225, 233
polymer. *See also* plastic
 curing, 224–225
 description of, 43
 as drug-delivery vesicle, 258
 hemoglobin-transporting, 271
polymer chain, 85
polymer chemistry, 30
Pople, John (chemist), 309
Popular Mechanics (magazine), 332
Popular Science (magazine), 332
PPD-T, 31
PPE (Polyaryleneethynylene) molecule,
 88–89
PPE-SWNT building block, 89–90
Prey (Crichton), 21, 190
primary electron, 56
Princeton University, 135
“printing” circuit, 135
Proctor & Gamble, 289
producing hydrogen
 with designer molecules, 208
 with photoelectrochemical cells, 206–207
product, getting from idea to
 challenges of, 33–34
 Kevlar example, 29–33
 overview of, 29
product-cycle time, 24
prostacyclin, 274
protecting environment when producing
 energy, 213–217
proton, 40
prototype market, 133
PSI Technologies, 283
punchcards, 142
PZT (piezoelectric transducer), 176–177

• Q •

QD Vision, 185
 Qineti!, 157
 Quake, Stephen (scientist), 233, 238, 321
 quality-control factor, 34
 quantum, 339
 quantum computer, 156, 158–160
 quantum confinement, 241
 quantum cryptography, 14–15, 154–158
 quantum dot, 183–185, 211, 240–242
 Quantum Dot Corp., 241, 322
 quantum information science, 156
Quantum Leap (TV show), 151
 quantum mechanics
 definition of, 184
 entanglement, 153–154
 overview of, 151–152
 superposition, 152–153
 quantum parallelism, 158
 quantum tunneling, 79, 126
 QuantumDot, 285–286
 qubit, 152, 153

• R •

radiation
 electromagnetic, 47
 EUV, 130–132
 radio-frequency (RF) magnetic field, 58–59
 Raman spectroscopy, 52–53
 random-access memory (RAM), 136
 raw material, scarceness of, 34
 reconstructive surgery, 106
 Reed, Mark (scientist), 10, 324–325
 reference beam, 145–146
 refraction, 49
 regulations, 34
 Rennselaer Polytechnic Institute (RSI), 310
 repeater, 167
 repulsive electrostatic force, 41–42
 research
 electron-beam lithography and, 133
 grants for, 295
 resources, natural
 air, cleaning, 214
 applications for, 16
 water, cleaning, 215–217

respirocytes, 271, 272
 reverse micelle, 253, 255
 revolutions, 16–17
 RF (radio-frequency) magnetic field, 58–59
 rhodium, 208
 Rice University. *See also* Smalley, Richard E.
 buckypaper and, 110
 carbon nanotube fluorescence and, 242
 Center for Biological and Environmental Nanotechnology, 36
 EBL and, 133
 molecular imaging and, 240
 Shared Equipment Authority, 23
 The Smalley Group, 306–307
 ring-router, 172
 robotics, 17, 107
 Rockefeller Foundation, 36
 Rohrer, Heinrich (scientist), 14
 rotary, 172
 Rotman, David, “Will the Real Nanotech Please Stand Up?”, 10, 12
 RSI (Rennselaer Polytechnic Institute), 310
 rubber, 86
 Rueckes, Thomas (researcher), 150
 rust, as neutralizing contaminants, 216
 ruthenium, 208

• S •

safety factor, 34
 salt water, distilling into fresh water, 215
 Samsung, 92, 141, 150, 283
 Sandia National Laboratory, 132, 294, 328
 scanner assembly, 146
 scanning electron microscope (SEM), 55–56, 132
 scanning probe microscope, 339
 scanning tunneling microscope (STM), 14, 57–58
 schools active in nanotechnology, 314–315.
 See also specific schools
 Schottky barriers, 125–126
Science (magazine), 331
Scientific American (magazine), 331
 Seagate, 73
 secondary electron, 56
 security field, 14–15, 120

- Seiko, 282
self-assembling crystal, 168–170
self-assembly process, 12, 197–198
self-cleaning clothing, 101
self-healing composite, 112–113
self-replicating nanoassembler, 20, 21
SEM (scanning electron microscope), 55–56, 132
semiconducting carbon nanotube, 78
semiconductor, 44
semiconductor industry, 281–283
Semiconductor Research Corporation, 282
sensing strain, 108–111
sensors
 airbag, 18
 biological, 189–190, 236–238
 chemical, 79, 187–189, 237
 colorimetric, 244
 in composite, 108–111
 nanowire-based, 81–82
 UltraViolet-Visible spectroscopy and, 53
SET (single-electron transistor), 122, 126–128
SGS, 150
Shanghai National Engineering Research Center for Nanotechnology (China), 301
shape-memory alloy (SMA), 104–108, 275
shape-memory polymer (SMP), 107–108, 109
Shared Equipment Authority, 23
Shor's Algorithm, 159
SiC (silicon and carbon) molecule, 108
Siemens, 73, 289
silicon, 44, 121, 123
simulation by computer, 119–120
single-electron transistor (SET), 122, 126–128
single-molecule logic circuit, 124
single-walled nanotube (SWNT)
 description of, 73
 infrared spectroscopy and, 51
 PPE and, 89
 toxicity of, 35
 transistor and, 123–124
situational awareness, increasing, 15
size comparisons, 11
size of company, 23
SMA (shape-memory alloy), 104–108, 275
Small Business Administration, 295
Small Times (magazine), 331
Smalley, Richard E. (scientist)
 buckyballs and, 14, 69, 70
 career of, 319–320
 fat fingers, sticky fingers, and, 61
 molecular manufacturing and, 20
 at Rice University, 306
SMP (shape-memory polymer), 107–108, 109
soft lithography, 223–225, 322
software products, 286–287
solar cell, 202–204
solid-state light emitter, 124–125
solid-state phase change, 105
solid-state transistor, 13
solution, 168
sonication, 88
Sony, 73, 141
sorting digital signals, 161
source-drain bias, 126–127
space elevator, 102–104
spanning cluster, 89
spatial-light modulator, 146
spectrometer, 51
spectroscopy
 infrared, 51–52
 Raman, 52–53
 UltraViolet-Visible, 53
speed of light, 49
spider silk, 100
spill-resistant fabric, 100–101
spinneret, 30
spintronics, 137, 152
sputter deposition, 275
stability of atom, 43
Stanford University, 233, 315, 320
static electricity, 87–91
stealth liposome, 258
stent, 273–275
sticky fingers, 61
STM (scanning tunneling microscope), 14, 57–58
stop-loss point, setting, 28
storing hydrogen, 209
Stormer, Horst (professor), 307
strain and Raman spectroscopy, 53
strained silicon, 121
Strano, Michael (researcher), 242

stress-strain curve, 31
 stroke, 271
 strong nuclear force, 41
 subatomic particle, 40
 substrate, 341
 Sumitomo Corporation Biosciences, 241
 superconductor, 341
 superlattice, 169
Superman (film), 144
 superposition, 152–153
 surface tension, 229–232
 surfactant, 252–253
 SWNT (single-walled nanotube)
 description of, 73
 infrared spectroscopy and, 51
 PPE and, 89
 toxicity of, 35
 transistor and, 123–124
 synapse, 21

• T •

Taiwan University, 72
 talent, shortage of, 24
 TCE (trichloroethylene) in water, 215
 Tech-Net, 295
 The Technical University of Delft,
 Netherlands, 315
 Technion, The Israel Institute of
 Technology, 311
Technology Review (journal), 330
 technology, size and evolution of, 13
 telecommunications field, 288
 telecommunications standard wave-
 length, 165
 TEM (transmission electron micro-
 scope), 57
 tensile strength, 76, 98–99
 teraflop, 159
 terrabyte, 119
 testing equipment, 287
 tethers in space, 102–104
 tetrapod, 322
 Texas Instruments, 283
 Texas Medical Center, 23
 Texas Nanotechnology Initiative, 296
 Thematic Network, 299
 “There’s Plenty of Room at the Bottom”
 (Feynman), 13–14, 323

thermal conductivity, 77
 thermal stability, 139
 thermoset, 86
 3rd Tech, Inc., 60
 thrombosis, 274
 timeline of drug development, 250, 251
 tipsters, 28
 titanium oxide nanoparticles, 289
 TMR (tunneling magnetoresistance), 137
 Tokyo Institute of Technology, 230–231, 315
 top-down approach to fabricating at
 nano scale, 12
 topography of atom, 53
 Toshiba, 210
 Tour, James (chemist), 324–325
 toxicity
 of buckyballs, 35–36
 of quantum dots, 241–242
 of single-walled nanotubes (SWNT), 35
 transistor
 carbon nanotube, 13
 for computers, 18
 field-effect and single-electron, 122–128
 size of, 120–122
 transmission electron microscope
 (TEM), 57
 trichloroethylene (TCE) in water, 215
 tumor, 261
 tunneling barrier, 137
 tunneling current, 57
 tunneling magnetoresistance (TMR), 137
 turbulence, 226, 229, 230, 233
 21st Century Nanotechnology Research
 and Development Act, 321
2001: A Space Odyssey (film), 117
 Tyson, Eric, *Investing For Dummies*, 27

• U •

UAV (unmanned aerial vehicle), 15
 U.K. Royal Society, 35
 ultraviolet light, 47, 48–49
 UltraViolet-Visible spectroscopy, 53
 uncertainty principle, 154–155
 uniformity factor, 34
 United States investment, 291–298
 University of Albany, 313
 University of Antwerp, Belgium, 315
 University of Arizona, 70

University of California at Berkeley, 312, 322
University of California at Davis, 189
University of California at Los Angeles, 81, 150
University of California at Santa Barbara, 315
University of Chicago, 232
University of Colorado, 108
University of Copenhagen, Denmark, 315
University of Delaware, 110
University of Illinois at Urbana-Champaign, 112, 242
University of Kent, England, 315
University of Michigan Center for Biologic Nanotechnology, 239
University of Pennsylvania, 314
University of Rochester, 181
University of Science and Technology of China, 315
University of Southern California, 81
University of Texas, 198
University of Tokyo, 276, 301, 311
University of Washington, 313
University of Wurzburg, Germany, 315
unmanned aerial vehicle (UAV), 15, 17
U.S. Global Nanospace, 25

• V •

vacuum tube, 13
valance band, 78
valence state, 186
van der Waals force, 45, 77, 88
Van Duyne, Richard (chemist), 309
vascular graft with artificial blood vessel, 269
Veeco Instruments, 123, 287
Vertical Magnetoresistive Random-Access Memory (VMRAM), 139–141
vesicle, 253, 255
vibration, 164
Virginia, 297
Virginia Tech, 208
viscosity, 226–227, 229
visible light, 48–49
visual image processing, 178–180
VMRAM (Vertical Magnetoresistive Random-Access Memory), 139–141

voltage inverter, 124
Von Ehr, James, II (CEO Zyvex Corp.), 321
vulcanization of rubber, 86

• W •

water, applications for, 16, 215–217
water molecule, 44, 207
water window, 263
wave theory of light, 47, 48
wavelength
 light and, 48
 near-infrared, 262, 263
 photonics and, 164–165
Web sites
 Abbot Laboratories, 284
 Accelrys, 286
 Agilent Technologies, 288
 Altair Nanotechnologies, 285
 American Pharmaceutical Partners, Inc., 284
 Applied Nanofluorescence, 287
 Argonne National Laboratory, 295
 Arizona State University, 315
 Asia-Pacific Nanotechnology Forum, 329
 Ayurveda India, 289
 azonano.com, 328
 Beckman, 284
 Bell Labs, 288
 Ben-Gurion University, 311
 Bionova, 289
 book companion, 5, 327–328
 Celanese, 285
 Center for Functional Nanomaterials, 295
 Center for Integrated Nanotechnologies (CINT), 294, 295
 Center for Nanophase Materials Sciences (CNMS), 294
 Chevron Texaco, 289
 Columbia University, 307
 Community Research & Development Information Service, 298
 Cornell University, 308, 309
 Corning, 288
 cosmetics companies, 289
 Council for Scientific and Technological Policy (Japan), 301
 Coventor, 286
 Dakota Technical College, 313

Web sites (*continued*)

degrees in nanotechnology, 312–313

DuPont, 287

Eastman Kodak, 283

energy companies, 288–289

Environmental Protection Agency, 35

FEI Company, 286

Feynman talk, 13

Food and Drug Administration, 329

Forbes/Wolfe Nanotech Report, 328–329

Foresight Institute, 329–330

Freescale Semiconductor, 283

funding for research, 295

General Nanotechnology, 287

GEMZ Corporation, 289

Gore-Tex, 284

Harvard University, 305

Hitachi, 283

howstuffworks.com, 330

Hydrogen Solar, Ltd., 289

Ilse Katz Center for Meso and Nanoscale
Science and Technology, 311Indian Association of Nuclear Physics
(India), 302

Indian Institute of Science (India), 302

Indian Institute of Technology (India), 302

Institute of Nanotechnology (U.K.), 329

Institute of Physical and Chemical
Research (Japan), 301

Israel Nanotechnology Trust, 303

Israeli National Nanotechnology
Initiative, 302

Jafra Cosmetics, 289

Jawaharlal Nehru Centre for Advanced
Scientific Research (India), 302

Knowles Acoustics, 288

LabNow Inc., 287

Lawrence Berkeley National
Laboratory, 294

Louisiana Tech University, 313

Massachusetts Institute of Technology
(MIT), 314–315

material-making companies, 284–286

Materials Modification, Inc., 285

medical companies, 283–284

Memscap, 288

Merck, Inc., 284

Motorola, 283

MTS System Corporation, 287

Nano Science and Technology

Institute, 330

NanoBusiness Alliance, 329

NanoDynamics, 286

Nanomaterials, 286

Nanometrics, 287

Nanoprobes, 284

Nanoscale Science and Engineering
Centers (NSEC), 309

Nanosys, Inc., 288

Nanotech Now, 330

nanotechnology, 327–330

Nano-Tex, 284–285

National Cancer Institute, 329

National Chemical Laboratory (India), 302

National Geographic (magazine), 331National Institute for Materials Science
(Japan), 301National Institute of Advanced Industrial
Science and Technology (Japan), 301

national laboratories, 294–295

National Nanotechnology Infrastructure
Network, 292–293, 307–308National Nanotechnology Initiative,
292, 312–313, 328

National Physical Laboratory (India), 302

Nature (magazine), 331New Jersey Nanotechnology Consortium
(NJNC), 297

nGimat, 286

Northwestern University, 309

Obducat AB, 287

Osaka University, 315

phantomsnet.com, 329

Popular Mechanics (magazine), 332*Popular Science* (magazine), 332

Proctor & Gamble, 289

PSI Technologies, 283

Rennselaer Polytechnic Institute, 310

Rice University, 306

Samsung, 283

Sandia National Laboratory, 328

schools active in nanotechnology, 314–315

Science (magazine), 331*Scientific American* (magazine), 331

semiconductor companies, 282–283

Siemens, 289

Small Times (magazine), 331

software product companies, 286–287

- Stanford University, 315
state and regional programs, 296–298
The Technical University of Delft,
Netherlands, 315
Technion, The Israel Institute of
Technology, 311
Technology Review (journal), 330
telecommunications companies, 288
testing equipment companies, 287
Texas Instruments, 283
Thematic Network, 299–300
Tokyo Institute of Technology, 315
University of Albany, 313
University of Antwerp, Belgium, 315
University of California at Berkeley, 312
University of California at Santa
Barbara, 315
University of Copenhagen, Denmark, 315
University of Kent, England, 315
University of Science and Technology of
China, 315
University of Tokyo, 311
University of Washington, 313
University of Wurzburg, Germany, 315
U.S. government agencies, 293
Wired (magazine), 332
Zygo, 287
Zyvex Corporation, 287
Weisman, R. Bruce (researcher), 242
Weizmann Institute of Science, 125
West, Jennifer (researcher), 324
wet nanotechnology, 306
Whitesides, George (researcher)
career of, 322
nano-imprint lithography and, 135
PDMS, microfluidics, and, 225
- “Will the Real Nanotech Please Stand Up?”
(Rotman), 10, 12
Williams, Stanley (researcher), 150
Wilson, Lon (researcher), 240
window, smart, 93–94
wire. *See also* nanowire
carbon nanofiber and, 97
of carbon nanotubes, 79
plastic-wrapped electrical, 44
Wired (magazine), 332
Wolfe, Josh (investor), 325, 328–329
women in nanotechnology, 313
- X •
x-ray lithography, 134
- Y •
Young’s modulus for carbon nanotube,
77, 98–99
- Z •
zigzag nanotube, 76, 78
Zygo, 287
Zyvex Corporation
carbon nanotubes and
metrology and, 88–91
nano-manipulator system of, 287
overview of, 284
Von Ehardt and, 321

