

## Index

### **a**

- acoustic phonons 305, 306
- Akhiezer model 318
- amorphous Si (a-Si) 169
- analytical model
  - dissolution rate of Mg, water 45
  - and experimental measurements 46
  - water concentration distribution 44
- arthropod eyes inspired digital camera 27
- atomic layer deposition 136

### **b**

- bio-integrated electronics 114
- Biotech therapeutics preparation 251, 252
- black silicon surface 232
- block copolymers 249
- Brillouin light scattering (BLS) 312, 313

### **c**

- cephalopod skins inspired optoelectronic camouflage systems 29
- chemical mechanical polishing (CMP) 61
- colloidal quantum dots (CQDs) 295
- complementary metal-oxide-semiconductor (CMOS) 169
- compressive buckling, deterministic assembly
  - bioinspired designs 13
  - circuit integration densities and operating speeds 11
  - complex, 3D architectures 18, 20, 21
  - mechanical modeling 14
  - sensory circuits, human organs 13
  - in stretchable electronics 13
  - synthesis and assembly techniques 13
  - 2D wavy geometries 15
  - for wavy layouts 13, 15, 16
  - wearable communication devices 13
- controlled delamination buckling 13

### controlled spalling

- biaxial tensile stress 102
- buried oxide (BOX) 98
- CMOS device integration 97
- flexible solar cells
  - III-V solar cells 104–106
  - (In)GaAs contact layer 105, 106
  - (In)GaP/(In)GaAs 104
- mechanical flexibility 98, 99
- n-FET vs p-FET device 101
- sophisticated system-on-chip (SoC) 96
- SRAM cell 101, 102
- UTB-SOI 96

### **d**

- device dissolution, layered-structures 47
- dispersion
  - Brillouin light scattering (BLS) 312, 313
  - confined phonons 310
  - plate waves 311

### **e**

- electromechanical properties, stretchable inverters 82
- epidermal electronic system (EES) 183

### **f**

- fabrication methods
  - etching process 61
  - scaling, Si industry 61
  - UVO oxidation 63
- fabrication process, series-shunt PIN diode RF switches 130
- Fano resonance photonic crystal devices
  - CQD integrated Si NM Fano filters 295
  - double layer Fano resonance filters 277–279

- Fano resonance photonic crystal devices  
(*contd.*)
- - controlled lattice displacement 279, 280, 282
  - electromagnetic field localization and enhancement 293, 294
  - infrared photodetectors 295
  - MR-VCSELs 286–289
  - epitaxial growth approach 289
  - transfer printing techniques 290, 292
  - wafer bonding and CMP techniques 290
  - principles 274, 275
  - reflectors
  - broadband reflector design 283, 284
  - different configurations and buffer layer design 284, 285
  - single layer filters 275, 276
- fast electronics
- carrier mobility 113
  - device DC and RF response characteristics 128
  - device fabrication, process flow 127
  - electrical and material properties 113
  - high carrier mobility 113
  - integrable on foreign substrates 113
  - lithographic techniques 136
  - manufacturing techniques 114
  - minimal degradation and transfer printing 136
  - neutral plane approach 137
  - organic semiconductors 113
  - performance enhancement 136
  - silicon-on-insulator (SOI) wafers 114
  - wireless communications 135
- finite difference time domain (FDTD) 221
- flexible sensor
- applications 182
  - device for mapping cardiac electrophysiology 191, 193
  - EES 183, 184
  - electro-tactile stimulation and tactile sensing 189
  - EMG 183, 185
  - mobility 182
  - multifunctional inflatable balloon catheters 191, 194, 198
  - Si NM strain gauges 189, 190
  - skin-attachable and finally implantable electronic devices 182
  - temperature sensors 184, 186
  - transient, biodegradable electronics 193, 195, 197
- flexible strained channel RF TFTs, fabrication 125, 126
- foldable electronics
- bending stiffness, substrate thickness 75, 76
  - dielectric layers and electrode materials 73
  - electromechanical properties 77
  - stiffness control 78
  - stretchable electronic devices 78, 79
- free-standing silicon membranes
- fabrication
  - - double-side polished (DSP) 307
  - - LPCVD 308
  - - SOI 306, 307
  - - strain control 309
  - - TMAH 307
- g**
- generic fabrication process 116, 118
- graphene-like 2D semiconducting materials 59
- h**
- hemodialysis 250, 251
- heterojunction bipolar transistor (HBT) 137
- high-electron mobility transistor (HEMT) 137
- high-performance flexible nanoelectronics 59
- high speed MOSFET
- doping process 114, 115
  - generic fabrication process 115, 117
  - strained Si NMs
  - - DC/RF characteristics 126, 129
  - - RF TFTs 125, 126
  - - strain techniques 121, 123
  - thermal instability 118
  - transconductance 119
- hydrolysis, Si NMs
- biological systems 40
  - chemical kinetics 39
  - dissolution kinetics 39
  - dissolution rates 39
  - types and concentrations of dopants 41
- i**
- injectable, cellular-scale optoelectronic devices 23, 25
- k**
- kinetically switchable adhesion 9
- l**
- Landau–Rumer model 318
- laser interferometric lithograph (LIL) 249

low-pressure chemical vapor deposition (LPCVD) 308  
low-temperature polysilicon (LTPS) 169

**m**

MALDI imaging 259  
mass spectrometer (MS) 257  
– biomarker discovery 258  
– field emission cooling 267, 268  
– field-emission mechanics 264–266  
– food safety 259  
– MALDI imaging 259, 261, 262  
– nanomembrane detector (NMD) 260  
– protein mass sensors 260  
– protein variation 258  
material-level dissolution  
– degradation of porous materials 41  
– distribution of water concentration 43  
– electrical properties 45  
– homogeneous boundary conditions 42  
– similar chemistry 45  
metal-semiconductor field effect transistor (MESFET) model 137  
metal strain gages 171  
microelectromechanical system (MEMS)  
monolithic microwave integrated circuit (MMIC) 137  
MR-VCSELs 286, 287, 289  
– epitaxial growth approach 289  
– transfer printing techniques 290–292  
– wafer bonding and CMP techniques 290  
multilayer optoelectronic devices 11

**n**

nanomembrane detector (NMD) 261, 262  
nanoporous silicon nitride (NPN) 248  
nanoposts (NPs) 221, 223, 227, 228  
nanoscience and nanotechnology 3  
neutral mechanical plane (NMP) 212  
NMs-based advanced functional device systems 3

**o**

on-board signal processing 172, 178  
optogenetics 23

**p**

patterned adhesion for controlled, large-scale  
– buckling 16–18  
Peltier effect 328  
phase-controlled beam steering 11  
phonon lifetime 315–318  
phonon mean free path 314, 315  
physically transient electronics 21, 23

polydimethylsiloxane (PDMS) 208  
polyethylene glycol (PEG) 246  
porous nanocrystalline silicon (pnc-Si) 248  
proteoforms 258

**r**

reactive diffusion models  
– analytical solutions 38  
– biofluids 53  
– dielectrics and encapsulation layers 53  
– experimental design 38  
– *in vivo* studies of transience 53  
– theoretical predictions 38  
resorbable electronics  
– applications 44  
– eigen equation 49  
– electric resistance 51  
– engineering efforts, materials and design 37  
– key materials and device structures 38  
– non-homogeneous boundary condition 49  
– orthogonality of eigenfunctions 50  
– physical disappearance 47  
– rate of dissolution 52  
– surface reactions 37  
– water concentration 52  
RF flexible capacitors and inductors, *see RF*  
flexible switches 129  
RF flexible switches  
– and diodes  
– – analytical modeling 134  
– – fabrication 129, 130  
– – RF characteristics 132, 134  
– mechanical bending 133  
– microwave frequency applications 129  
RF flexible transistors, *see RF* flexible switches 129

**s**

Seebeck effect 328  
semiconductor grade monocrystalline silicon 37  
semiconductor nanomembranes (NMs)  
– 1D nanostructures 3  
– silicon NMs, *see* silicon nanomembranes 4  
– thin-film growth and processing technologies 3  
separation science  
– bovine serum albumin (BSA) 245  
– flux of solute molecules (N) 241, 242  
– Hagen–Poiseuille equation 243  
– hydrophilic membranes 243  
– polarization 242  
– pores 245

- separation science (*contd.*)
  - tortuous path membranes 244
  - shallow trench isolation (STI) 96
  - SiGe based strain engineering 121, 123, 125
  - silicon nanomembrane (Si NMs) 246
    - anisotropic etching 6, 7
    - bending strain control 65
    - block copolymers 249
    - carrier-density changes, band structure 71
    - direct drilling 250
    - electronic system 59
    - electron mobility and outstanding optical transmittance 59
    - fabrication processes
      - LCP 150
    - flexible NW-based biomedical devices
      - NWFETs 147, 148
    - flexible organic biomedical devices
      - TFTs 144, 146
    - functional devices
      - arthropod eyes inspired digital camera 27
      - bioinspired devices 21
      - cephalopod skins inspired optoelectronic camouflage systems 29
      - close-range cellular stimuli and monitoring 21
      - injectable, cellular-scale optoelectronic devices, brain 23, 25
      - physically transient electronics 21, 23
      - three-dimensional integumentary membranes 25, 27
    - generic process 117
    - high-performance electronic and optoelectronic devices 4
    - human motion detectors
      - optical motion capture systems 150
      - PSRs 150
      - SiNM strain gauge 151, 152
    - integrated array configuration 155, 157
    - ion implantation and anneal processes 125
    - laser interferometric lithograph (LIL) 249
    - light transmission 68
    - mechanical flexibility and optical transparency 60
    - mechanical properties, bending and stretching 65, 67
    - micromachined 249
    - multiplexed electrophysiology 157
      - cardiac electrophysiology mapping 160, 161
      - ECeG 158, 159
      - neural activity monitoring 158
      - nanowires (NWs) 143
    - optoelectrical properties 69
    - organ motion detectors
      - strain gauge 152
    - oxidation and selective etching 63
    - of phosphorous doping profiles 116
    - piezoresistive effect 69, 70, 72
    - pnc-Si 247, 248
    - pressure-sensitive rubbers (PSRs) 143
    - purity and doping control 4
    - selective etching 4, 6
    - stretchable Si-based integrated circuits 79, 82
    - temperature sensors 154, 155
    - thermal oxidation 64
    - thickness control mechanism 63
    - track etch process 248
  - silicon-on-insulator (SOI) technology 61
  - silver-catalyzed etching 233
  - single-crystal silicon NMs 4
  - skin-patch-type device 152
  - sophisticated system-on-chip (SoC) 96
  - spalling-mode fracture
    - controlled spalling 94, 95
    - intrinsic stresses 94
    - thermal stress 93, 94
  - static random access memory (SRAM) 101, 102
  - steady-state substrate cracking
    - CTE 90, 91
    - delamination cracks 91
    - Dundurs parameters 91, 92
    - intrinsic stress 90
    - spalling 90
    - Stoney's equation 91
    - tensile stress 90
  - strained channel RF TFTs, DC/RF characteristics 126, 129
  - strain sharing principle 123

**t**

  - tactile sensor
    - addressing scheme 176
    - conventional CMOS micromachining processes 171, 178
    - design 172
    - domestic robot 170
    - doped Si-NM 178
    - dry transfer method 178
    - fabricated flexible strain sensor 172
    - flexible electronic skin 181
    - human fingertip 180
    - human-like electronic skin 181
    - human skin 171, 176
    - humidity sensing 175

- inorganic polysilicon 171
  - multimodal sensing capability 174
  - nose and ears 181
  - on-board signal processing 172, 178
  - piezoresistive strain sensors 172
  - polymer-based 171
  - pressure sensing polymer 171
  - pressure sensor 175
  - prosthetic hand, artificial electric skin 174
  - single crystal Si-NM 171
  - strain gauges 177
  - temperature sensing array 175
  - TFT switches 177, 179
  - thin and highly-doped inorganic single-crystal silicon ribbons 172
  - variations of 173
  - viscoelastic layers 180
  - Wheatstone bridge configuration 173
  - thermal conductivity
    - contactless techniques 318–320
  - thermoelectric (TE) 327, 328
  - electrical conductivity 329, 330
  - power factor (PF) 330
  - density of state (DOS) 337
  - field effect carrier doping 339, 340
  - quantum confinement 339
  - ZT enhancement 338
  - thermal conductivity 329–332
  - silicon nanowire system 333, 334
  - silicon thin film 334–337
  - thin film transistor (TFT) 177
  - 3D integumentary membranes for spatiotemporal cardiac measurements 25
  - time-of-flight (TOF) 260
  - top-down process
    - top-gated field effect transistors 74
  - transfer printing, deterministic assembly
    - device grade silicon 7
    - ink/donor interface 9
    - ink/receiver interface 9
    - low glass-transition temperature plastics/elastomers 7
    - nondestructive manipulation, silicon NMs 7
    - pressure-induced modulation 10
    - semiconductor devices 7
  - shear loading methods 9
  - for single- and multilayer 10, 11
  - thermal delamination, stamp/ink interface 9
  - van der Waals interactions 7
  - transferrable single-crystal Si nanomembranes (c-Si NMs) 60
  - transparent electronics
    - bending stiffness, substrate thickness 75, 76
    - electrical and optical properties 74, 76
    - folded U-TFT arrays 78
    - PET substrate 76
    - stretchable inverter 81
    - thinning process 72
    - transmittance spectra 76
  - two-dimensional photonic crystal slab (2D PCS) 274, 282, 283
  - two-laser Raman thermometry (2LRT) 319
- u**
- ultra-thin body silicon on insulator (UTB-SOI) 96
  - ultrathin monocrystalline silicon solar cells
    - compact size, high voltage outputs 217, 218
    - density-graded surface nanostructures 232, 233
    - fabrication 204–207
    - hexagonally periodic nanoposts
      - angular dependence 228
      - ARC 223, 225
      - BSR 225
      - diffraction effect 221
      - disadvantage 219
      - FDTD 221
      - light trapping 231
      - nanoposts (NPs) 221, 223, 227, 228
      - mechanical flexibility, high degrees of 212
      - microscale concentrator optics 216
      - optical transparency 215
      - PDMS 208, 210
      - photovoltaic performance 211
- w**
- wrinkling technique 13

