

Index

a

amperometric sensor 32
arch shaped configuration 79
atomic force microscope (AFM) 3

b

bipolar junction transistor (BJT) 99
Brunauer-Emmett-Teller adsorption
isotherm analysis (BET) 337
bubble-jet printing model 7, 209

c

calorimetric sensors 265–266
cantilever beams 80–85
carbonization 6
Carboxymethyl Cellulose (CMC) 7, 215
Casimir energy 5
Casimir force 141–142, 149
carbon nanotubes (CNT)-sheets 143
carbon nanotubes (CNT) tweezers
144
circular tweezers 143
Dirichlet and Neumann modes
148–149
proximity force approximation
144–148
rectangular beam plate 142
rectangular tweezers 143
wire plate 142
charge transfer band (CTB) 283
chemical bath deposition (CBD) 2
chemical sensors 318–319, 324

chemical vapor deposition (CVD) 29,
225, 340
chemiresistive sensing mechanism
261–262
CNT ink 225–228, 230
Co-precipitation 257
conductive nanomaterials 7, 8
controlled precipitation 67–68
Coulomb scattering 101–102, 114
limitation 4
current in plane (CIP) 306
current perpendicular to plane (CPP)
306

d

detachment length 149
differential mobility spectrometry (DMS)
261
direct sensors 318
Dirichlet and Neumann modes 148, 149
dodecylamine (DDA) 7
down-conversion photoluminescence
10, 11
down-conversion PL 279
drop-on-demand (DOD) printer 209

e

elastodielectric effects 301
electric arc discharge 225
electrochemical biosensors 35–36
electrochemical methods 251
electrohydrodynamic (EHD) Printing 7,
211

electron beam evaporation 264
 electron-electron scattering 97
 electrophoretic effect 10, 280
 electrospinning 6
 electrostatic forces
 carbon nanotubes (CNT) tweezers
 134–136
 carbon nanotubes (CNTs)-sheet
 132–133
 circular tweezers 133, 134
 Mejis-Fokkema model 136, 137
 Palmer's model 136
 rectangular beam-plate 131
 rectangular tweezers 132–134
 wire plate 131–132
 enzymatic electrochemical biosensors
 38, 40
 EPDQ 306

f

ferromagnetic (FM) electrodes 307
 fiber optic sensors 262–264
 field effect transistor (FET) 34–36
 flexographic printing 212
 fluorescence resonance energy transfer
 (FRET) 34
 fluorine-doped-tin-oxide (FTO) 30
 focused ion beam (FIB) 13, 331
 Fourier transform infrared spectroscopy
 (FTIR) 337
 freestanding phenomenon
 detachment length 149–150
 surface layer and size-dependent effects
 150–151
 full scan mode 258

g

Gas Chromatography-Mass Spectrometry
 (GC-MS) 258–261, 337
 gas sensors 318
 Gaussian distribution 108
 giant magnetoresistance (GMR) 302, 303
 glassy carbon electrode (GCE) 35
 graphene 25, 26
 -based biosensors 32–33

 based electrochemical biosensors
 35–36
 based fluorescent biosensors 46
 -based nano-electronics 30–32
 detection of acute myocardial infarction
 36–37
 detection of asthma 37
 detection of cholesterol 41–42
 detection of diabetes 38
 detection of hydrogen peroxide sensing
 42
 detection of lung cancer 37
 detection of nucleic acids 47
 detection of pathogens and food toxins
 47
 detection of small molecules 46
 detection of toxic heavy metal ions 47
 in electrochemical biosensing platforms
 33–34
 enzymes detection 44
 field effect transistors 34
 food toxin sensing 45
 fundamentals of 27–28
 history of 26–27
 heavy metal detection 45
 hydrogen peroxide detection 43
 nano-electronics biosensors 1, 2
 nucleic acid biosensor 43–44
 optical platform for bio-sensing 34
 pesticides detection 45–46
 properties of 27
 synthesis of 28–30
 thermal and electrical properties 25
 graphene ink 228, 234
 graphene nano-ribbons (GNR) 31
 graphene quantum dots (GQDs) 1, 27
 gravure printing 211, 212
 green chemistry synthesis 2
 green synthesis method 3, 68

h

Hänsch reliability model 105
 heterogeneous electron transfer (HET)
 33
 hexamethylenetetramine (HMT) 2

hot carrier degradation (HCD) 97
 creation process 104–108
 degradation of 108–118
 simulation framework of 102–103
 static analysis 118–119
 transient analysis 119–121
 hot carrier injection (HCI) 97
 Hummer's method 29
 hybrid nanogenerators 75, 76
 hydrothermal method 67

i

immunosensor 36
 impedometric methods 33
 indium-tin-oxide (ITO) 30
 Inelastic Electron Tunneling Spectroscopy (IETS) 307
 inkjet printing 209
 integrated electrode (IDE) 35
 inverse direct gravure printing 211

j

JLFET 98
 Judd-Ofelt analysis 281
 Julliere's model 304

k

Klaassen mobility model 102

l

laser ablation 225
 laser beam pulse 67
 Lennard-Jones potential 139
 li-ion battery 31
 line edge roughness (LER) 100
 liquid-phase synthesis 67
 lossy mode resonance (LMR) 263

m

magnetic dipole transition 284
 magnetic tunnel junction (MTJ) 12, 304
 magnetoelastic effects 301
 magnetoelectric (ME) effects 301
 magnetoelectric coupling 301, 305
 magnetoresistance 302

mammography 250
 mass-selected ion injected 258
 mechanochemistry method 66
 Mejis-Fokkema model 136, 137
 metal oxide semiconductors 8, 10
 metallic based inks 214–215
 micro-electromechanical systems (MEMS) 4
 microcantilever 319
 microfabricated tuning fork 13, 331
 Miller capacitance 121
 molecularly imprinted polymers (MIPs) 336
 MOSFET
 reliability-based analysis 3–4
 junctionless transistor 98–102
 creation process 104–108
 degradation of 108–118
 hot carrier degradation 102–103
 multiferroic materials 11–12
 magnetoelectric materials 301, 302
 spintronics 302
 multiferroic tunnel junctions (MFTJs) 307–309
 multiple electrospun wires 13, 340
 multiple ion monitoring mode 258

n

nano-electromechanical systems (NEMS) 4–5
 electrostatic forces 137
 Casimir forces 141–149
 electrostatic forces 131
 freestanding phenomenon 149–151
 van der Waals forces 137–141
 nano-electronics biosensors 1, 2
 nanoelectronics 30
 nanogenerator (NG) 3, 71
 hybrid 75–76
 piezoelectric nanogenerators 71–72
 pyroelectric 74–75
 triboelectric nanogenerators 73–74
 nanomaterials 5–6, 30
 based inks 213–215
 growth 255–257

needle–wire connections 69
 noise margin (NM) 118
 non-enzymatic glucose biosensor 40, 41

O

Ohnesorge number 209
 organic multiferroic tunnel junctions
 (OMFTJs) 308
 oxide trapping/detrapping process 105

P

Palmer's model 136
 piezoelectric nanogenerators (PENGs)
 71–72, 76–79
 piezoelectric printing model 7, 209
 piezomagnetic effects 301
 plasma electrolytic oxidation (PEO) 10,
 280
 polarized neutron reflectometry (PNR)
 11, 303
 polyacrylamide (PAM) 335
 polyacrylic acid 8
 polybutadiene 334
 polycrystalline graphene 1, 27–28
 polymer film bridges 338–342
 polymer wire bridges 331–338
 polymethyl methacrylate (PMMA) 340
 polystyrene (PS) 329
 polyvinylcinnamate (PVCN) 13
 polyvinylpyrrolidone (PVP) 338
 potentiometric methods 33
 printable nanomaterials 212
 printed electronics (PE) 207
 pristine graphene 1, 27
 proton transfer reaction mass
 spectrometry (PTR-MS) 258
 proximity force approximation (PFA)
 144–148
 pulsed laser deposition (PLD) 255
 pyroelectric nanogenerators 74, 75

Q

QR codes 338
 quantum confinement effect 101
 quantum mechanical effect 303

quartz crystal microbalance (QCM) 319
 quartz enhanced photo-thermal
 spectroscopy (QEPTS) 321
 quartz enhanced photoacoustic
 spectroscopy (QEPAS) 321
 quartz tuning fork (QTF) 12–13
 chemical sensors 318–324
 early development 324–325
 mass loaded sensor 328–331
 modified with polymer film bridges
 338–342
 modified with polymer wire bridges
 331–338
 sensor 325–329
 quick response (QR) codes 338

R

rectangular beam-sheets 138
 reduced graphene oxide (RGO)
 1, 27, 28
 resonant frequency 321
 roll-to-roll (R2R) printing 212

S

scanning electron microscope (SEM) 66,
 281, 337
 Schottky contact 3
 screen printed electrode (SPE) 35
 screen printing 7, 210
 selected ion flow tube-mass spectrometry
 (SIFT-MS) 257–258, 337
 semiconductor metal oxide (SMO) 252
 shaft tweezers models 130
 silver nanoparticles 215–222
 silver nanowire 222–226
 SiO₂, graphitization of 27
 slot die coating 210–211
 sol-gel synthesis 66–67
 spin-dependent tunneling (SDT) 304
 spin FET 309–311
 spin LED 311
 spin orbit coupling (SOC) 311
 spin valve 306–307
 spin-transfer torque (STT) 308

spin-orbit torque field effect transistor (SOTFET) 311

spintronics

- fundamental aspects of 302–303
- giant magnetoresistance 303
- multiferroic tunnel junction 307–309
- spin FET 309–311
- spin LED 311
- spin valve 306–307
- tunneling magnetoresistance 304

spray pyrolysis (SP) 255

Stokes shift 279

substrate carrier injection (SCI) 97

supercapacitors 30

surface plasmon resonance (SPR) sensor 264–265

t

Taylor series expansion 134

Tedlar sampling 337

thermally assisted switching (TAS) 308

thick film deposition 255

thin film deposition 252–254

threshold voltage 118

Tragacanth gum 68

transconductance 97, 110, 111

triboelectric nanogenerators (TENGs) 73–74

tunneling magnetoresistance (TMR) 304

u

ultrasonic irradiation 67

ultrasound 250

up-conversion PL 279

v

Van der Waals force 137

- carbon nanotubes (CNT) tweezers 140–141
- carbon nanotubes (CNT)-sheets 138–139
- circular tweezers 140

- rectangular beam-sheets 138
- rectangular tweezers 139–140
- wire plate 138

vapor transport synthesis 68–69

vapor-liquid solid (VLS) method 3, 70

volatile organic compound (VOC)

- body metabolism for 247–249
- evanescent wave fiber optic sensors 263
- lossy mode resonance fiber optic sensors 263–264
- breast cancer related 250
- components of human breath 249
- composite metal oxides for 252
- sensing, metal oxides for 252

voltage transfer characteristic (VTC) 118

voltammetric methods 33

w

wet-chemical method 2

wet spinning method 6

x

X-ray diffraction (XRD) 66, 281

X-ray energy dispersive spectroscopy (EDS) 281

z

zinc nitrate hexahydrate 2

zinc oxide (ZnO)

- controlled precipitation 67–68
- hydrothermal method 67
- liquid-phase synthesis 67
- mechanochemical method 66
- NPs crystal structure of 63–66
- piezoelectric effect 69–70
- piezoelectric nanogenerators 70–79
- structure of 63
- sol-gel synthesis 66–67
- vapor transport synthesis 68–69
- wurtzite-structure of 72

zinc oxide piezoelectric nanogenerators

ZrO₂

chemical and phase composition

281–283

Dy³⁺ 292–293Er³⁺ 286Eu³⁺ 283–285

experimental 280–281

films 283

Gd³⁺ 292Ho³⁺ 288Ln³⁺ 295

morphology

281–283

Pr³⁺ 290–292Sm³⁺ 286Tb³⁺ 287–288Tm³⁺ 288–290

undoped 283

