

Index

a

aggregation, of nanoparticles 19
 dispersion and transformation 22
 mineralization 24
 schematic representation of 21
 albumin 294–296
 alginate-BSA nanoparticles 296
 α -helix content of lysozyme 92
 alumina nanoparticles
 precipitation method 147
 sol-gel synthesis 145
 template method 146–147
 aluminum nanoparticles
 catalytic decomposition 130
 templated synthesis 132
 thermal decomposition 132
 antimony oxide
 biosynthesis 151
 bulk and nanoscale, properties of 13
 chemical reduction 151
 chemical synthesis 149
 Gibbs energy 148
 hydrothermal method 151
 microemulsion method 149–150
 antimony sulphide (Sb_2S_3)
 hydrothermal method 228
 laser ablation technique 228
 solvothermal method 227

b

biomolecules 69
 BSA-Acacia nanoparticles 297
 nucleic acid nanoparticles 313–314
 biosynthetic methods, for metal
 nanoparticle preparation 13

bismuth nanoparticles

 chemical reduction 129
 one pot synthesis 130
 polyol method 129
 solvothermal method 130
 thermal decomposition 128

bismuth sulphide

 protein mediated 231
 solvothermal synthesis 230
 sonochemical method 229
 template synthesis 230

blood-brain barrier (BBB) 9

Boltzmann entropy, characteristics of
 44

Boltzmann–Gibbs entropy formulae
 44

bottom-up approach, for nanostructures
 18–19

BSA–Acacia nanoparticles 297

c

cadmium sulphide

 carbon 28
 chemical synthesis 231, 236
 customized synthesis 237
 electrochemical method 232
 green synthesis 234–235, 237
 hot injection method 233
 thermal decomposition method
 233, 236

carbonyl decomposition 102

CdSe quantum dot-lysozyme interaction
 94

CdSe quantum dots 77, 78

cerium oxide

- Ceria nanoparticles 21
 hydrothermal and hydrolysis methods
 161
 microemulsions 161
 plant extract method 162–163
 precipitation method 159
 thermal decomposition method 161
 chemical equilibrium 51
 chemical potential difference 56
 chemical reactions, in nanosystems
 61–65
 chitosan 298
 circular dichroism (CD) spectroscopy
 74, 75, 84, 85, 92
 cobalt nanoparticles
 chemical reduction 121
 foam based synthesis 122
 laser ablation method 123
 polyol based 121
 thermal decomposition 122
 cobalt oxide nanoparticles
 facile method 154
 microemulsion method 154
 microwave synthesis 155
 plant extract method 155
 thermal decomposition 153
 colloidal iron oxides 166
 colloidal nanoclays 79
 copper nanoparticles
 chemical reduction 117
 one-pot synthesis 119–120
 polyol method 117
 reduction by plant extracts 119
 thermal decomposition and
 sonochemical synthesis 118
 copper oxide (CuO) nanoparticles
 chemical reduction procedure
 157
 equilibrium constant *vs.* reciprocal of
 size 64
 Gibbs free-energy *vs.* reciprocal of
 size 64
 hydrothermal decomposition 159
 microemulsion method 157
 molar enthalpy *vs.* reciprocal of size
 65
 molar entropy *vs.* reciprocal of size
 65
 plant extract method 159
 supramolecular method 158
 critical coagulation concentration 30
 cross flow filtration technique 9
- d**
 differential entropy production 43
 DLVO theory 28–30
 DNA 9
 DNA-chitosan nanoparticles 300–301
 DNA-nanoclay interaction
 circular dichroism 92
 differential binding studies 94
 effect on secondary structure
 89–90
 enzymatic activity effect 93
 FTIR spectroscopy 90–92
 relative viscosity 87–88
 surface tension 88
 UV-vis spectroscopy 87
- e**
 entropy 44–45
 equilibrium thermodynamics 7
 ethyl cellulose
 nanoprecipitation technique 280
 phase-inversion synthesis 278
 solvent diffusion method 280
- f**
 first law of thermodynamics 42–43
 fluorescence quenching 81–82
 free-radical miniemulsion
 polymerization 273
 FTIR spectroscopy 76–78, 90–92
- g**
 gelatin nano-and microparticles
 301–309
 gelatin nanoparticles, self-assembly of
 27
 gel filtration 9
 Gibbs–Duhem equation, for
 macroscopic system 46
 Gibbs equation 45–47

Gibbs free-energy 57
 Gibbs nucleation theory 55
 Gibbs–Thomson equation 6
 glutathione (GSH) 231
 gold nanoparticles
 chemical reduction 103
 green chemistry 104
 ligand free synthesis 104
 pulsed laser ablation method 103
 green chemistry methods 10

h

hard-sphere repulsion potential 31
 helicity value 90
 heparin 309
 heparin-chitosan nanoparticles 310
 heparin-deoxycholic acid nanoparticles 311
 heparin–poly(β -benzyl-L-aspartate) nanoparticles 311–312
 heteroaggregation 23–24
 homogeneous aggregation 23
 homogeneous nucleation 24–25
 Huggin's equation 87
 human serum albumin (HSA)
 nanoparticles 295–296
 hyaluronic acid nanoparticles 312–313
 hydration of complexes 76–78
 hydrogen bonding 31–32
 hydrophobic index, of protein molecule 72
 hydrophobic interactions 32–34

i

indium oxide ($In_2 O_3$)
 co-precipitation method 164
 hydrothermal synthesis 165
 laser ablation technique 164
 microemulsion method 164
 intrinsic protein fluorescence, feature of 71
 iron oxide nanoparticles
 aqueous method 167
 biocompatibility 166
 colloidal iron oxides 166
 coprecipitation 170
 ferrofluids 166

laser pyrolysis 169
 magnetite nanoparticles 166
 microemulsion 167
 microwave assisted synthesis 171
 pyrolysis 167
 sol–gel 167
 solution method 167
 thermal decomposition 168–169
 vapour deposition 167
 irreversible thermodynamics concept 41

k

Kubo gap 8

l

lanthanum oxide
 hydrothermal method 172
 sonochemical method 172
 thermolysis 172
 Laplace–Young equation 53, 55
 laponite–DNA solutions, FTIR spectra of 91
 laponite[®] 79, *see also* nanoclay–protein interaction
 lead nanoparticles
 hot injection method 133–135
 thermolysis in organic solvent 132
 lead sulphide
 facile method 238
 single-step synthesis 238
 synthesis of nanostructures with controlled dimensionality 240
 Lennard–Jones potential 30–31
 lithographic techniques 17
 lyophilization technique 9

m

magnesium oxide nanoparticles
 hydrothermal synthesis 175
 microemulsions 176
 optical properties 174
 precipitation method 174
 sol–gel based method 175
 thermal decomposition 175–176
 magnetic resonance force spectroscopy 52

- magnetite nanoparticles 166
 manganese sulphide
 hydrothermal method 241
 single step method 240
 thermal decomposition 241
 thermolysis 242
 mean residue ellipticity (MRE) 75, 84
 metastable phase formation, in
 nanoscale systems 52–58
 mineralization 24
 MMT-DNA solutions, FTIR spectra of
 91
 montmorillonite (MMT) 79, *see also*
 nanoclay–protein interaction
- n**
- nanobiotechnology 95
 nanoclay–protein interaction
 aspect ratio differential behaviour
 85
 binding constant 81–82
 circular dichroism spectroscopy 84,
 85
 fluorescence quenching 81–82
 stoichiometry 82
 synchronous fluorescence
 spectroscopy 82
 UV-vis absorption spectroscopy
 80–81
 nanomaterial–biomolecule/cell
 interaction 95
 nanomedicine 95
 nano *vs.* microscopic objects 5
 nanoparticles
 aggregation, *see* aggregation, of
 nanoparticles
 biological applications 5
 biopolymers for surface
 functionalization 11
 biosynthesis 10
 characterization 3
 gold 7
 vs. microparticles 5
 plant resources 12
 platinum 7
 nanoscience 3
 nanotechnology 3, 39, 49
 nanothermodynamics 41, 52
 neodymium oxide (Nd_2O_3)
 microemulsion method 179
 microwave assisted synthesis 179
 solution-coprecipitation synthesis
 179
 solventless method 178
 Nernst heat theorem 43
 nickel nanoparticles
 chemical reduction 124
 laser ablation 127
 microemulsion 126–127
 polyol based reduction 126
 nickel oxide nanoparticles
 alkoxide-based protocol 182
 heat treatment 183–184
 magnetic susceptibility 181
 sol–gel method 182
 thermal decomposition 181
 nickel sulphide
 chemical synthesis 244
 gamma irradiation 243
 solvothermal synthesis protocol 243
 thermolysis technique 243
 nonextensive thermodynamics 45
 non extensivity index 45
 nucleation and growth process 52
 nucleic acid nanoparticles 313–314
- p**
- palladium nanoparticles
 impregnation method 109
 Pluronic based synthesis 110
 polyol based synthesis 110–111
 reverse micelle 111
 thermal decomposition 111
 partition function, for ideal gas 48
 pectin–cisplatin nanoconjugate
 316–317
 pectin nanoparticles 315–316
 phase transitions 48
 physical stability, of nano size objects
 58–61
 platinum nanoparticles
 chemical reduction 114
 colloidal method 114
 polyol based synthesis 113

- reverse micellar synthesis 114
 solvothermal techniques 115
 synthesis using thiol-functionalized ionic liquid 112–113
- PNIPAM nanoparticles
 free radical polymerization 267
 one-pot synthesis 268
 poly(β -aminoester)s 268
- polyacrylamide
 free-radical microemulsion polymerization 281
 inverse heterophase polymerization 283
 inverse microemulsion polymerization 282
- poly(β -aminoesters) 268
- poly(ϵ -caprolacton)
 microemulsion method 284
 solvent displacement 284
- poly(ethylene glycol) (PEG) 261–262
- poly(lactic acid) (PLA)
 electrospraying 266–267
 one-pot synthesis 264
 plant extract synthesis 265
 solvent displacement technique 265
- poly(lactic-co-glycolic acid) (PLGA)
 emulsion solvent 270
 microfluidic nanoprecipitation 270
 nanoprecipitation 270
- poly(methyl methacrylate) (PMMA)
 “click” chemistry 272–273
 free-radical miniemulsion polymerization 273
 microemulsion polymerization 271–272
 surfactant-free emulsion polymerization 272
- Polymeric nanoparticles
 ethyl cellulose 278–281
 PLA 263–267
 PLGA 269–271
 PMMA 271–273
 PNIPAM nanoparticles 267–269
 polyacrylamide 282–283
 poly(ϵ -caprolacton) 284
 poly(ethylene glycol) 261–262
 polyurethanes 273–276
- poly(vinyl alcohol) 285–287
 poly(vinylpyrrolidone) 283–284
 reviews on 262
- polystyrene
 emulsion polymerization 276
 free-radical emulsion polymerization 277
 miniemulsion co-polymerization 278
 surfactant-free synthesis 277
- polyurethanes
 interfacial polycondensation 276
 mini emulsion synthesis 274
 oligodiol-polyurthane synthesis 275
- poly(vinyl alcohol)
 micromulsion and freezing/thawing cycle 285
 nanoprecipitation 285–287
- poly(vinylpyrrolidone) 283
- protein-CdSe complex quenching rate constant 70
 protein-quantum dot interaction
 circular dichroism spectroscopy 74, 75
 fluorescence quenching 70, 72
 FTIR spectroscopy 76
 hydration of complexes 76–77
 protein hydrophobicity effect 72–73
 stoichiometry 73
- q**
 quantum effects 5
 quantum size effects 12
- r**
 relative viscosity 87–88
 RNA 9
- s**
 samarium nanoparticles 115–117
 samarium oxide
 gate dielectric material 185
 hydrolysis 186
 hydrothermal method 186

- samarium oxide (*contd.*)
 microemulsion method 187
 microwave radiation 186
 thermal decomposition 185
 second law of thermodynamics
 43–44
 sedimentation 21–22
 semiconductor quantum dot, melting
 profile of 57
 silica nanoparticles
 bottom-up approach 188
 hydrothermal route 192
 microemulsion method 190–192
 sol-gel synthesis 190
 Stöber method 188–190
 top-down approach 188
 ultrasonication 192–193
 silk protein nanoparticles 317–318
 silver nanoparticles
 chitosan mediated synthesis 107
 Creighton method 106
 hydrophilic and hydrophobic NPs
 108
 laser ablation synthesis 108
 Lee–Meisel method 106
 Schneider method 106
 tea extract 107
 water soluble 107
 silver sulphide
 green synthesis 246–247
 single source precursor 245
 single-step method 246
 single Lander molecule, STM image of
 6
 siRNA-chitosan nanoparticles 300
 size-dependent structure-property
 relations 51
 Smoluchowski aggregation kinetics
 25–28
 solvothermal synthesis protocol 243
 statistical ensemble averaging
 techniques 47
 steric forces 34
 steric repulsion 34
 Stern–Volmer quenching constant
 70
 subdivision energy 53
 subdivision potential 46
 surface effects 5, 12
 surface etching 17
 surface patterning 17
 surfactant-free emulsion polymerization
 272
 synchronous fluorescence spectroscopy
 82
 synthesis of metal nanoparticles
 chemical reduction approach 101
 electrochemical discharges 103
 laser ablation 101
 lithography 102
 seed-mediated synthesis 101
 synthetic nanoclays 78
- t**
- thermodynamic equilibrium 42
 thermodynamic properties 47–49
 thermodynamics
 entropy 44–45
 Gibbs equation 45–47
 laws of 41–44
 at nanoscale 40–41
 thermodynamics reversibility 42
 tin oxide
 commercial graphite anodes
 200
 electric conductivity 200
 hydrothermal procedure 200
 precipitation method 203
 sol-gel method 202
 templated synthesis 201–202
 tin sulphide
 facile synthesis 247–248
 hydrothermal synthesis 249
 laser ablation 248
 solvothermal treatment 248
 titania nanoparticles
 biosynthesis 197–199
 hydrothermal method
 194–195
 microemulsion 196–197
 single-pot synthesis 197
 sol-gel method 195–196
 top-down approach, for
 nano-architectures 17

- tripolyphosphate-chitosan
nanoparticles 299–300
- tryptophan fluorescence 81
- U**
- ultracentrifugation technique 9
- UV-vis absorption spectroscopy
80–81
- UV-vis spectroscopy 87
- Z**
- zein nanoparticles 318–320
- zeroth law of thermodynamics 41
- zeta potential measurement 73, 82
- zinc oxide (ZnO)
plant extract method 207–211
precipitation method 205
- pulse laser ablation 204
- sol-gel method 206
- wet chemical method 206
- zinc oxide nanoparticles, MD simulation
of 32
- zinc sulphide
ambient condition and single
precursor 250
- chemical method 251
- facile synthesis 251
- single precursor thermolysis 252
- zirconium nanoparticles
biological method 213
- hydrothermal method 212
- laser ablation technique 213
- sol-gel protocol 212

