

Index

a

- acridine orange (AO) 411, 412
- adhesion
 - chemical adhesion 341
 - laser shock adhesion test 356–358
 - macro-bonding 341
 - mechanical anchorage 340–341
 - micro-bonding 341
 - modified peel test 343–346, 351–353
 - physical adhesion 341
 - scratch testing 346–349, 354–356
 - tensile pull test 342–344, 353–354
 - ultrasonic testing 349–351
- AlamarBlue® 141, 409–410
- alkaline phosphatase (ALP) activity 132, 255, 310, 405–406
- zirconia ceramics 83
- Almen test 363–365
- α-tricalcium phosphate (α-TCP) 99, 101
- alum 1
- alumina ceramics 1
 - mechanical properties 70, 71
 - nano-scaled powders 73
 - reinforcement mechanism 72, 73
 - wear resistance 74
- Weibull plot 70, 72
- alumina-toughened zirconia (ATZ) 82
- amorphous calcium phosphate (ACP) 313, 339
- SBFs 395–402
- anti-Stokes frequency 315
- atmospheric plasma spraying (APS)
 - Bassett–Boussinesq–Oseen equation 174
 - energy transfer process 174
 - hydroxyapatite coating
 - – characteristic surface features 175, 176

b – frozen-in-time traces 176

- sombrero-type morphology 177
- vs. low-pressure plasma spraying 313
- process types 173
- atomic force microscopy (AFM) 135, 169, 316
- b**
 - Basset–Boussinesq–Oseen equation 174
 - β-tricalcium phosphate (β-TCP) 15, 22, 59, 97, 99–102, 323
 - bioactive ceramics
 - bioglasses, *See* surface active bioglasses
 - hydroxyapatite, *See* hydroxyapatite
 - resorbable ceramics, *see also* resorbable calcium orthophosphate bioceramics
 - – calcium aluminates 104
 - – calcium carbonate 104
 - – gypsum and plaster of Paris 104
 - – transition metal-substituted calcium orthophosphates 95–98
 - bioactive glass coatings 61, 191, 197
 - bioactive materials 43, 84, 129
 - bioceramic/bone interface
 - cellular level
 - – cell adhesion 54
 - – hydroxyapatite nucleation 54
 - – matrix vesicles 54
 - interfacial loosening 50–52
 - moduli of elasticity 49, 50
 - tissue level
 - – dynamic behaviour 55
 - – electromagnetic field 58
 - – epitaxial crystal lattice matching 57, 58
 - – osseointegration 56
 - – osteoinduction 56
 - – osteostimulation 56

- bioceramic coatings
 - biological performance testing, *See* biological performance testing
 - cathodoluminescence 333–340
 - cell proliferation and viability tests
 - – AlamarBlue® 409–410
 - – alkaline phosphatase (ALP) activity 405–406
 - – fluorescence staining 411–414
 - – MTT assays 409–410
 - – non-collagenous proteins 406–409
 - chemical adhesion 341
 - EIS 389, 391, 392
 - FTIR spectroscopy 318–321
 - infrared spectroscopy 314
 - in vivo testing
 - – dog model 420–423
 - – goat model 429
 - – rabbit model 417–420
 - – rat model 416–417
 - RRR principles 415–416
 - sheep model, *See* in vivo testing
 - microhardness 382–387
 - modified peel test 343–346, 351–353
 - nuclear magnetic resonance spectroscopy 325–332
 - plasma-sprayed, *See* plasma-sprayed hydroxyapatite coatings
 - porosity 379–382
 - potentiodynamic polarisation testing
 - – corrosion protection 389–392
 - – Tafel slopes 388
 - Raman microscopy 316–318
 - Raman spectroscopy 315–316
 - Raman spectrum 321–325
 - residual stresses 358–377
 - scratch testing 346–349, 354–356
 - simulated body fluids
 - – ACP, *See* amorphous calcium phosphate (ACP)
 - – compositions 393–394
 - – EELS spectra 402–403
 - – extracellular and intracellular fluids 393
 - – PIXE 403–405
 - – surface roughness 377–379
 - tensile pull test 342–344, 353–354
 - ultrasonic testing 349–351
 - X-ray diffraction, *See* X-ray diffraction
 - bioceramic-polymer composites 446
 - bioceramics
 - biocompatibility 41
 - definition 41
 - calcium silicate 288
 - future developments 446, 449
 - medical devices 2
 - Bioglass® 16, 43, 84, 85, 88
 - bioinert ceramics
 - advantage 69
 - alumina, *See* alumina ceramics
 - zirconia, *See* zirconia ceramics
 - bioinert materials 43, 56, 69
 - biological performance testing
 - cell proliferation and viability tests
 - – AlamarBlue® 409
 - – alkaline phosphatase (ALP) activity 405–406
 - – fluorescence staining 411–414
 - – MTT assays 409–410
 - – non-collagenous proteins 406–409
 - in vivo testing
 - – dog model 420–423
 - – goat model 429
 - – rabbit model 417–420
 - – rat model 416–417
 - RRR principles 415–416
 - sheep model, *See* in vivo testing
 - SBFs, *See* simulated body fluids (SBFs)
 - Biolox® 2, 70, 73, 73
 - Biolox® delta 73, 74
 - biomaterials
 - average annual growth rate (AAGR) 17, 18
 - *vs.* biological materials 451
 - ceramic 11
 - classification 11–13, 16, 43
 - compound annual growth rate (CAGR) 18
 - corrosion control 450
 - definition 13, 42
 - in vitro and in vivo testing 16
 - metallic 11
 - osteolysis risk of, 450
 - osteoporotic bone fractures 16, 17
 - biomedical implants market for
 - dental implants 21
 - large-joint reconstructive implants 19–20
 - small joint replacement 20
 - spinal implants 21
 - biomimetic calcium phosphate coatings
 - adhesion strength 122
 - alumina scaffolds 123
 - apatite-forming solutions 122
 - glass ceramics 120
 - magnesium substrates
 - – corrosion protection 124, 125
 - – in vitro degradation behaviour 125

- octacalcium phosphate (OCP) 118, 119
- polymer scaffolds
 - - cholesterol 129
 - - PLGA/collagen fibres 132
 - - poly(etheretherketone) surfaces 129, 130
 - - poly(ethylene) surfaces 130
 - - poly(methylmethacrylate) 131
 - - starch/PCL-base scaffolds 131
- simulated body fluid (SBF) 116, 119, 127, 128
- solubility constants 117
- solubility isotherms *vs.* pH 118
- surface-induced mineralisation (SIM) 122
- titania films 124
- titanium substrates 125–128
 - - adhesion strength 127
 - - antibacterial effect, *Staphylococcus aureus* 128
 - - biocompatibility 126
 - - carbonated hydroxyapatite (CHAp) 128
 - - NaOH treatment 126
 - - surface roughness 126
- titanium surfaces
 - - NaOH activation 120, 121
- biomimetics
 - natural mineralisation pathways 116
 - simulated body fluids (SBFs) 116
- biomineralisation 52–53
- BIONIT® 2, 70
- biotolerant materials 18, 43, 447
- bonding osteogenesis 43, 51, 60, 84, 275, 277
- bone cement 19, 43, 50, 64, 75, 103, 402, 448
- bone morphogenetic proteins (BMPs) 59, 62, 63, 83, 288, 406
- bone-targeting drug delivery systems 11
- BONIT® 104
- bovine serum albumin (BSA) 54, 63

- c**
- calcium aluminates 104
- calcium carbonate 104, 116
- calcium phosphate coatings
 - arthroplastic devices 23
 - surface microstructure 451
- calcium phosphates 4–8, 22, 53
- solubility isotherms 99
- cancellous bone matter 47
- cathodoluminescence (CL)
 - colour and intensity 334
- electronic transitions 333
- plasma-sprayed hydroxyapatite coatings 334–340
- cell proliferation and viability tests
 - AlamarBlue® 409
 - alkaline phosphatase (ALP) activity 405–406
 - fluorescence staining 411–414
 - MTT assays 409–410
 - non-collagenous proteins 406–409
 - zirconia ceramics 83
- ceramic–ceramic composite coatings 447
- ceramic femoral ball heads
- diamond-like carbon (DLC) 25
- ionising radiation, *See* γ -irradiated medical-grade Y-TZP
- manufacturing process
 - - aseptic loosening 30
 - - laser-engraved identification 28
 - - mechanical performance 29
 - - process description 27
 - - quality control measures 29
 - - mechanical and functional properties 26–27
 - - reliability 27
 - - wear performance 27
- Ceraver-Osteal® 2
- CGDS, *See* cold gas dynamic spraying (CGDS)
- chemical adhesion 341
- chemical solution deposition, *See* sol–gel deposition
- chemical vapour deposition (CVD) 224–226
- coating deposition techniques
 - CVD 224–226
 - HVOF 222–224
 - ICPS 224
 - laser surface alloying 226
 - non-thermal methods, *See* non-thermal deposition methods
 - oxygen/acetylene flame spraying 222
 - phase inversion technique 226–227
 - thermal methods, *See* thermal deposition methods
- cold gas dynamic spraying (CGDS)
 - analytical equations 202
 - apparatus 201, 202
 - computational fluid dynamics (CFD) 205
 - critical particle velocity 203
 - hydroxyapatite coatings
 - - CoBlast microblast technique 207–208
 - - magnesium alloy substrate 206

- cold gas dynamic spraying (CGDS) (*contd.*)
 – – poly(etheretherketone) substrate 207
 – – ultrasonic powder feeding system 208
 – numerical simulation 202
 – stainless steel and CoCr alloys 208
 – statistical design of experimentation (SDE) 205
 – Ti/HAp composite coatings 204, 206
- combustion chemical vapour deposition (CCVD) 224
- contact osteogenesis 43, 69, 275, 417
- cortical bone 47
- curvature measurement 363–365, 374–376
- CVD, *See* chemical vapour deposition (CVD)
- cytokines 30, 55, 62–64, 447
- d**
- dental biomaterials 18
- dental implants 21
 – aesthetics 15
 – application 15, 16
 – biocompatibility 15
 – masticatory forces 14
 – physical properties 15
- dental restorations 449
- dentin 47–49, 92, 127, 408, 450
- diffusion-induced phase separation (DIPS) 226
- 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay 310, 409–410
- dip coating 125, 156
 – coating thickness 144
 – hydroxyapatite coatings 144, 145
 – process steps 144
 – *vs.* sol–gel deposition 144
- e**
- ECD, *See* electrochemical deposition (ECD)
- EIS, *See* electrochemical impedance spectra (EIS)
- elastic Rayleigh scattering 315
- electrochemical deposition (ECD)
 – advantages 146
 – calcium phosphate coating
 – – acid–base reactions 147–148
 – – electrochemical reactions 147
 – – precipitation reactions 148–152
 – pulsed current 148, 150
- electrochemical impedance spectra (EIS) 125, 137, 151, 200, 206, 207, 213, 389, 391, 392
- electron beam physical vapour deposition (EBPVD) 163
- electrophoretic deposition (EPD)
 – applications 154
 – Helmholtz double layer theory 152
 – hydroxyapatite coatings
 – – austenitic 316L stainless steel substrates 157
 – – TiO₂ nanotube arrays 158
 – – titanium alloy surfaces 155, 157
 – and PEO process 218
 – Smoluchowski equation 153
- emery 1
- enamel 48, 117, 222
- endoprosthetic implants 51, 61, 79, 208, 256, 367
 – dental implants, *See* dental implants
 – THR 14, 15
- ethidium bromide (EtBr) 411
- f**
- first-generation biomaterials 447
- flame-assisted chemical vapour deposition (FA-CVD) 225
- flame spraying
 – HVOF 222–224
 – oxygen/acetylene 222
- fluorapatite 5, 45, 92, 166, 182, 408
- fluorescence staining
 – acridine orange 411
 – ethidium bromide 411
 – MG63 osteoblast-like cells 412–414
- focused ion beam (FIB) sputtering 164, 291, 296, 297
- Fourier transform infrared (FTIR) spectroscopy 93, 94, 118, 145, 171, 182, 220, 267, 285, 314, 318–321, 325, 326, 332, 400
- Frialit® 2
- g**
- γ-tricalcium phosphate (γ-TCP) 101
- gypsum 98, 104
- h**
- highly soluble alkali-containing calcium orthophosphates 103–104
- high velocity oxyfuel spraying (HVOF) 194–197, 199, 201, 222–224, 269, 278, 413–414
- high velocity suspension flame spraying (HVSFS) 114, 186
 – alumina coatings 199
 – bioglass coatings 197–199

- vs. conventional plasma spraying 193–194
- hydroxyapatite coatings
- – surface and cross section of 195
- – Ti substrates 195
- numerical model 194
- TiO_2 coatings 196–197
- hole-drilling strain gauge method 365–367, 376–377
- human skeletal tissues
- hierarchical architecture 44, 45
- mechanical properties 47
- ordered and disordered motifs 46, 47
- osteons 46
- structural types 47
- HVOF, *See* high velocity oxyfuel spraying (HVOF)
- HVSFS, *See* high velocity suspension flame spraying (HVSFS)
- hydroprocessing, *See* thermal substrate deposition
- hydrothermal deposition method 162–163
- hydroxyapatite 6
 - biological apatite 92, 93
 - bone substance 91
 - calcium phosphate precipitation of, 94
 - carbonate substitutional defects 93, 94
 - hydroxyl ions behaviour 93, 94
 - inorganic *vs.* bioapatite 89
 - monoclinic form 91
 - Ca polyhedra 89, 90
 - orthohexagonal unit cell structure 90, 91
 - 6_3 screw axis arrangement 90, 91
- hydroxyapatite coatings 326–332
 - bond coats 24
 - cathodoluminescence 334–340
 - dental implants 24
 - dip coating 144, 145
 - EPD
 - austenitic 316L stainless steel substrates 157
 - TiO_2 nanotube arrays 158
 - – titanium alloy surfaces 155, 157
 - hip implants 24
 - hydrothermal deposition method 162, 163
 - IBAD
 - – α -alumina substrates 167
 - – silicon and glass substrates 164
 - – Ti-based alloy 165
 - in vivo resorption 446
 - laser shock adhesion test 356–358
 - laser surface alloying 226
 - LPPS
 - – adhesion strength 183–185
 - – electron diffraction (ED) spectroscopy 184
 - – microporosity 184
 - – optimised parameters 183
 - microhardness 386–387
 - modified peel test 351–353
 - phase inversion technique 226–227
 - plasma-sprayed, *See* plasma-sprayed hydroxyapatite coatings
 - radio-frequency magnetron sputtering 169, 170
 - spin coating 146
 - stress analysis
 - – curvature measurement 374–376
 - hole-drilling strain gauge method 376–377
 - – Raman piezospectroscopy 377
 - – X-ray diffraction 370–374
 - tensile test 353–354
 - thermal substrate deposition 158–162
 - X-ray diffraction 312–314
- i*
- IBAD, *See* ion beam-assisted deposition (IBAD)
- ICPS, *See* inductively coupled plasma spraying (ICPS)
- implantable biomimetic devices 129, 445
- inductively coupled plasma spraying (ICPS) 224
- infrared (IR) spectroscopy, *See* Fourier transform infrared (FTIR) spectroscopy
- in vivo testing
- dog model 420–423
- goat model 429
- rabbit model 417–420
- rat model 416–417
- RRR principles 415–416
- sheep model
 - – hydroxyapatite coatings 423–426
 - – orthophosphate coatings 426–429
- ion beam-assisted deposition (IBAD) 122
 - advantages 167
 - calcium phosphate coatings 164–166
 - hydroxyapatite coatings
 - – α -alumina substrates 167
 - – silicon and glass substrates 164
 - – Ti-based alloy 165
 - process 163, 164
- ion-beam sputtering deposition (IBSD) 165, 167

- γ -irradiated medical-grade Y-TZP**
 - colour changes 31, 32, 34
 - electron spin resonance (ESR) spectrum 34
 - Frenkel defects 31
 - residual optical absorption spectrum 32, 33
 - 3D-glow curve 34, 35

- k***
 - Keramed® 2

- I***
 - large-joint reconstructive implants 19–20
 - laser Raman spectroscopy (LRS), *See* Raman spectroscopy
 - laser shock adhesion test (LASAT) 356–358
 - laser surface alloying 226, 391
 - low-energy plasma spraying (LEPS) 180–182
 - low-pressure chemical vapour deposition (LPCVD) 226
 - low-pressure plasma spraying (LPPS) 182–185, 204, 269, 312, 380

- m***
 - macroscopic stresses 358–359
 - matrix-assisted pulsed laser evaporation (MAPLE) 220
 - mesenchymal stem cells 410
 - mesoscopic stresses 358
 - metallic biomaterials 11, 129, 208, 449, 450
 - microhardness 161, 164, 196, 206
 - Buckle's proposal 383–384
 - Burnett and Rickerby model 385–386
 - Chicot and Lesage expression 386
 - hydroxyapatite coatings 386–387
 - Jonsson–Hogmark model 384–385
 - Meyer's approach 383
 - pyramid-shaped diamond indenter 382
 - Thomas' approach 383
 - Vickers hardness 383
 - microplasma spraying (MPS) 179, 180
 - microscopic stresses 358
 - modified peel test 343–346, 351–353
 - MTT assay, *See* 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay

- n***
 - non-collagenous proteins 44, 54, 61, 91, 116, 276, 310, 406–409, 448

- nuclear magnetic resonance (NMR)
 - spectroscopy 93, 135, 320, 325–332, 399
 - hydroxyapatite Coatings 326–332

- o***
 - octacalcium phosphate (OCP) 94, 99, 119, 121–123, 148, 152, 221, 401
 - orthopaedic biomaterials 17, 18
 - osseocomductive ceramics, *See* bioactive ceramics
 - osseocomductive hydroxyapatite coatings
 - advantages 60
 - negative effects 61
 - positive effects 61
 - osteocalcin 44, 54, 83, 91, 118, 138, 171, 401, 406–410, 448
 - osteoclastogenesis 59, 64
 - osteocomductivity 56, 63, 92, 127, 419, 420
 - osteoinduction 56
 - osteonectin 91, 276, 286, 407–408, 448
 - osteopontin 44, 54, 91, 276, 286, 310, 407–409, 448
 - osteoporosis 16, 17, 407
 - osteostimulation 56
 - oxygen/acetylene flame spraying 222

- p***
 - PEO, *See* plasma electrolytic oxidation (PEO)
 - PerioGlas® 88
 - phase composition
 - cathodoluminescence, *See* cathodoluminescence (CL)
 - IR spectroscopy 314, 318–321
 - NMR spectra, *See* NMR spectra
 - Raman spectroscopy, *See* Raman spectroscopy
 - XRD pattern, 310–314
 - phase inversion technique 226–227
 - photoluminescence piezospectroscopy 367–370
 - physical adhesion 134, 341
 - plasma electrolytic oxidation (PEO) 124, 155, 389–391
 - alumina coating surface 212
 - current–voltage characteristics 209, 210
 - Mg alloys
 - – coating growth 214
 - – corrosion resistance 212, 213
 - – dual-layer coating 214
 - – hydroxyapatite nano-particles 213
 - – surface discharge process stages 210–212
 - TiO₂ coating
 - – Ca-P-based electrolyte 215

- - cp-titanium substrate 214
 - - direct current and pulse current 215
 - - hydroxyapatite coating 216, 217
 - - Sr-HAp coatings 217
 - - tantalum coatings 218–219
 - - ZrO₂/HAp coatings 218
 - plasma-enhanced chemical vapour deposition (PECVD) 226
 - plasma-sprayed hydroxyapatite coatings
 - biological responses
 - - advantages 276, 277
 - - interfacial bond strength *vs.* implantation time 277
 - bond coats role of, 284
 - calcium silicate bond coats
 - - adhesion strength 286
 - - coefficients of thermal expansion (CTE) 287
 - - resorption resistance 288
 - - vascularisation and osteogenesis 288
 - coating thickness 257, 258
 - crystallinity 255
 - mixed zirconia/titania bond coats 294–297
 - electron energy loss (EELS) maps 296, 297
 - optimised coating properties
 - - coating types 260, 261
 - - precipitation kinetics 260–263
 - - statistical design parameters 260
 - optimum adhesion strength 254–255
 - oxyapatite phase
 - - Ball-and-spoke model 273
 - - hypothetical structure 272, 273
 - - synchrotron X-ray diffraction profiles 274–276
 - performance criteria 259
 - performance profile 254
 - phase composition 255
 - porosity and roughness 256
 - residual stresses 256
 - - curvature measurement 374–376
 - - hole-drilling strain gauge method 376–377
 - - Raman piezospectroscopy 377
 - - XRD 370–374
 - surface nanotopography 256
 - thermal coating stress 257
 - thermal decomposition
 - - CaO-P₂O₅ system 264
 - - crystallinity *vs.* grain size 271, 272
 - - grain size *vs.* phase composition 271
 - - parametric optimisation strategies 270
 - - porosity *vs.* grain size 272
 - - schematic model 265, 266
 - - splat formation 266, 268
 - - ‘wipe’ test 267, 269
 - titania bond coats
 - - biocompatible behaviour 288
 - - laser-Raman spectra 285
 - - NaOH activation 289
 - - scanning transmission electron microscope (STEM) 291
 - - 2-dimensional secondary ion mass spectroscopy (2D-SIMS) imaging 289, 290
 - titania composite coatings 278
 - transition metal-substituted calcium orthophosphate 281–283
 - plasma spray parameters 281
 - - pore size distribution 282
 - - shear strength 283
 - - tensile adhesion strength 283
 - - thickness 281, 282
 - tricalcium phosphate coatings 280–281
 - XRD pattern 312–314
 - zirconia bond coats
 - - applications 292
 - - coating adhesion strength 293
 - - 2-dimensional secondary ion mass spectroscopy (2D-SIMS) imaging 292, 293
 - - zirconium cytotoxicity 293, 294
 - zirconia composite coatings 278–279
 - plaster of Paris 98, 104
 - PLD, *See* pulsed laser deposition (PLD)
 - porosity 379–382
 - Posner’s cluster 53, 120, 397–400
 - potentiodynamic polarisation testing
 - calcium phosphate coatings 150, 151
 - corrosion protection 156, 206, 389–392
 - Tafel slopes 388
 - pro-inflammatory cytokines 64
 - pulsed laser deposition (PLD) 419–420
 - double-layered HAp/TCP sheet 222
 - hydroxyapatite coatings 220, 221
 - *vs.* plasma-sprayed coatings 220
 - process 219
- r**
- radio-frequency magnetron sputtering
 - calcium phosphate thin films 169
 - hydroxyapatite thin coatings 169, 170
 - limitations 167
 - novel developments 167
 - *vs.* plasma-spraying process 167
 - process 168

- radio-frequency magnetron sputtering
(contd.)
- Pyro/TCP and HA_x coatings 171
 - Si-HA_x coatings 170
 - sputter-coated *vs.* non-coated titanium implants 168–169
 - titania coatings 172
- Raman piezospectroscopy 377
- Raman spectroscopy 93, 183, 191, 315–316
- plasma-sprayed hydroxyapatite coating 321–325
 - titania powder 316–318
- reaction-induced phase separation (RIPS) 226
- recombinant human bone morphogenetic proteins (rhBMPs) 22, 55, 63, 104, 448
- Replacement Reduction and Refinement (“RRR”) principles 415–416
- residual stresses
- curvature measurement 363–365
 - hole-drilling strain gauge method 365–367
 - hydroxyapatite coatings, *See* plasma-sprayed hydroxyapatite coatings
 - photoluminescence piezospectroscopy 367–370
 - $\sin^2 \psi$ method 361–363
- resorbable calcium orthophosphate bioceramics 98–105
- alkali-containing calcium orthophosphates 103–104
 - Ca–PO₄ sheet structures 103
 - tetracalcium phosphate 102–103
 - tricalcium phosphates
 - – α -TCP 59, 99, 101
 - – β -TCP 99, 100, 102
 - – γ -TCP 101
- roughness 377–379
- s**
- SBFs, *See* simulated body fluids (SBFs)
- scratch testing 139, 172, 190, 221, 346–349, 354–356
- second-generation biomaterials 447
- simulated body fluids (SBFs) 332
- ACP, *See* amorphous calcium phosphate (ACP)
 - compositions 393–394
 - EELS spectra 402–403
 - extracellular and intracellular fluids 393
 - PIXE 403–405
- small joint replacement 20
- Smoluchowski equation 153
- sol–gel deposition
- application 132
 - *vs.* dip coating 144–145
 - hydroxyapatite coatings
 - – alkoxide precursors 135, 136
 - – phosphorus and calcium precursors 135
- titania coatings 133–135
- solution precursor plasma spraying (SPPS) 224
- hydroxyapatite coatings 200
 - nanocrystalline hydroxyapatite coatings 201
 - solvent effects 200
 - titania coatings 200
 - Y₂O₃-stabilised ZrO₂ coatings 200
- spin coating 145–146, 278
- spinal implants 21
- Sponceram® 83
- SPS, *See* suspension plasma spraying (SPS)
- stabilised zirconia, *See* zirconia ceramics
- Stokes frequency 315
- supramolecular hydrogels 447
- surface active bioglasses
- apatite formation, mechanism of 86, 87
 - clinical applications 87
 - kinetic reaction stages 85, 86
 - pseudo-ternary system 84, 85
 - tissue scaffolds 88
- suspension plasma spraying (SPS) 224
- advantages 186
 - Al₂O₃–ZrO₂ composite coatings 193
 - bioactive glass coatings 191–192
 - composite Y₂O₃–MgO coatings 193
 - hydroxyapatite coatings 188–190
 - process steps 187
 - TiO₂ coatings 190–191
 - yttria-partially stabilized zirconia (YSZ) coatings 192–193
- t**
- Tafel slopes 151, 388
- temperature-induced phase separation (TIPS) 226
- tensile pull test (ASTM C633-13 2013), 342–344, 353–354
- tetracalcium phosphate (TTCP) 15–16, 102–103, 272
- thermal substrate deposition 158–162
- third generation biomaterials 448, 451
- THR, *See* total hip replacement (THR)
- 3D-printed scaffolds 448
- tissue engineering innovation tasks of, 449
- tooth structure 47–49

total hip replacement (THR) 14, 15,

23, 24

tricalcium phosphate (TCP) 2, 4

u

ultrasonic testing 342, 349–351

v

vacuum plasma spraying (VPS) 182–185

w

Weibull plot 70, 72, 78, 83, 196, 387

x

X-ray absorption near-edge structure

(XANES) spectroscopy 400

X-ray diffraction (XRD) 5, 127, 135, 137,

142, 169, 179, 185, 193, 204, 208, 271, 274,

399

– Bragg equation 311

– plasma-sprayed hydroxyapatite coatings
312–314

– Scherrer equation 311

– schematic representation 310

– stress analysis 361–363, 370–374

y

Y-TZP femoral heads 29, 31–35, 82, 123

z

zirconia ceramics 3–4

– bone replacement and repair applications
75

– cytocompatibility 82

– femoral ball heads, *See* ceramic femoral
ball heads

– hydrolytic stability 82

– mechanical properties 81

– Sponceram® 83

– transformation toughening

– – compressive surface layers 79, 80

– – Griffith–Orowan fracture mechanics
77, 78

– – martensitic phase transformation
75, 76

– – R-curve behaviour 79, 80

