

INDEX

- acetabular components 30–32, 42, 155, 156
- acid phosphate 232, 237
- Actifuse® 283, 424, 470, 473
- adolescent idiopathic scoliosis 81, 82, 152, 153, 162
- aerogels 24
- alkaline phosphatase 419
- allogenic 137, 197, 200
- allogenic bone grafts 138
- alloplastic 110, 137, 139, 141–144
- alumina 1, 3, 4, 6, 15, 16, 21, 27, 28, 30–34, 36, 42, 43, 52, 71, 110, 182, 191, 193–195, 215, 223, 351, 375, 377, 393, 439, 474, 528, 568, 581
- alveolar ridge 80, 109, 115–118, 120, 122, 130, 139, 141, 382, 568
- amino acids 511, 587
- amorphous calcium phosphate (ACP) 55, 59, 61, 236, 243, 280, 311, 335, 357, 411, 423, 457, 530, 531
- angiogenesis 87, 90–92, 159, 488, 585, 586, 590
- angiogenic 87, 90, 143, 588
- ankle 425
- ankle joints 34
- annealing 50, 335, 343, 399, 526
- anticoagulants 393
- antimicrobial 113, 128, 460
- aortic valve replacements (AVR) 390
- apatite 54, 55, 139, 172, 176, 177, 181, 183, 205, 215, 216, 218, 229, 230, 231, 232, 233, 234, 235, 237, 238, 239, 242, 243, 307, 311, 318, 351, 355, 412, 413, 414, 415, 418, 419, 421, 423, 424, 449, 452, 463, 466, 469, 470, 477, 495, 527, 530, 583
- apatite-wollastonite 162, 477, 501
- arthritis 39, 300, 393, 394, 586
- arthroplasty 37, 81, 152, 155, 156, 157, 393, 394
- artificial bone graft materials 464
- artificial vertebrae 172, 173, 477
- ASTM standard 386
- Auger electron spectroscopy (AES) 55, 58, 73, 342, 356, 533
- Augment™ Bone Graft 425
- autogenous 113, 137, 197
- autogenous bone 129, 137, 143, 154, 157, 160
- autogenous iliac crest 154
- A/W glass-ceramic 1, 7, 8, 16, 21, 71, 162, 171–180, 182, 184, 189, 190, 192–200, 201, 477, 495, 501, 525, 527
- bending strength 28, 35, 53, 141, 172–175, 218, 219, 296
- berlinite 218, 220
- beta-whitlockite 289, 307, 312, 313, 318
- beta-wollastonite 171
- bioactive borate glasses 488, 492
- bioactive materials 8, 9, 22, 71, 72, 74, 76, 109, 117, 125, 129, 132, 142, 184, 590
- bioactive titanate 355, 356, 363
- bioceramic HA 122
- biocompatible 11, 12, 36, 68, 215, 225, 295, 419, 431, 464, 487
- biodegradation 296, 297, 306, 307, 312, 318, 419

- Biogran® 466
bioinert 71, 75, 111, 397
biological fixation 6
biological growth factors 63, 465
biological HCA 59, 121
biomechanical properties 210, 292, 293, 296, 495, 584
BIOVERIT 499, 215–227
biphasic calcium phosphates 229
BonAlive® 162, 466
bonding zone 8, 68, 119, 122, 211
bone 1, 12, 13, 73, 110, 111, 144, 151, 167, 189, 193, 205, 209, 239, 279, 283, 287, 293, 298, 299, 305, 306, 393, 463, 567
 autogenous 96, 103, 104, 105, 163, 195, 196, 198, 199, 200, 201, 298, 299, 306, 409
 cancellous 12, 13, 15, 36, 119, 141, 194, 200, 287, 288, 291, 295, 298, 299, 300, 317, 476, 424, 480
 cortical 12, 13, 15, 36, 53, 73, 119, 141, 167, 171, 172, 189, 190, 287, 290, 293, 295, 298, 299, 300, 301, 317, 318, 400, 405, 423, 474, 495, 499, 501
 graft 80, 82, 129, 137–139, 140, 142, 143, 145, 151, 152, 157, 159, 160, 165, 167, 194, 199, 283, 287, 293, 306, 409, 425, 463–466, 482, 584
 grafting 553, 568
 lamellar 212, 295, 298, 325
 marrow 91, 212, 298, 425, 436, 437, 440, 465, 470, 483
 progenitor 72, 75, 119, 120, 141, 465, 483, 586
 stress shielding 501
 woven 194, 295, 298
bone analogue 403, 406
bone apposition 282, 306, 403, 405
bone cement 13, 195, 331, 349, 398, 404, 419
bone graft 103, 128, 147, 153, 555
bone morphogenic proteins 129, 342
breast implant 546
brittle fracture 293, 403
brushite cement 413–416, 419, 420, 424
CaF₂ 51, 52, 171
calcified tissues 235
calcium deficient hydroxyapatite (CDHA) 411, 412
calcium orthophosphates 410, 413
calcium phosphate cements 409, 410, 412, 416, 419, 423
calcium titanate 357–359, 360, 362
cancellous 138, 473
CarboMedic 390
carbon coating 331, 367, 370, 380, 386
carbon (glassy or vitreous) 372
cardiovascular 1, 10, 380, 381, 385, 586, 588
cartilage 110, 112, 113, 279
cell culture 89, 90, 152, 420, 470, 482, 586
CE mark 80, 130, 466, 551, 555, 556
Cementek® 417, 419
cementless hip prosthesis 331
Cerabone® 71, 172, 495, 496, 525
ceramics 6
Ceravital® 7, 16, 52, 110, 111, 178, 189, 191, 209, 210
characterization program 523, 524, 528, 530, 532, 536, 561
cholesteatoma 110
Class I devices 551, 553, 555
Class II devices 551, 553–555
Class III devices 524, 551, 553, 555, 557, 558
clinical trials 41, 42, 100, 105, 106, 112, 118, 140, 142, 297, 363, 482, 501, 549, 553, 559
coagulation 391, 392, 395
cobalt chrome alloy 42

- coefficient of friction 33
- collagen fibrils 9, 63, 64, 73, 109, 122, 282, 283, 584
- composites
- biodegradable 397
 - fiber/bioactive glass 397
 - fiber-reinforced composite
 - glass 399
 - HA/polyethylene 230
 - stainless steel fiber/bioactive glass 398
 - stainless steel fiber reinforced bioactive glass 399
 - steel fiber/bioactive glass 397
- compressive strength 28, 29, 35, 37, 167, 173, 218, 219, 293, 296, 306, 308, 418, 419, 421, 473, 423, 465, 477
- conductive hearing loss 96, 110, 111
- contact angle 33, 392
- contact microradiography 190, 194
- coralline HA 469
- corals 288, 289, 293, 469
- cordierite 216, 220, 221
- corrosion resistance 21, 27, 331
- cortical 138, 240, 403, 404
- crack growth 28, 36, 173, 174, 376–379, 385, 386
- crack propagation 293, 386
- crystal phase 19, 225, 216, 217, 218, 223, 449, 451, 496, 497, 499, 527, 535
- cystic cavities 142
- cytocompatibility 410, 421
- cytotoxic 343, 358
- cytotoxicity 558
- dahlite 234, 414
- defect structures 536
- degenerative disk disease 491
- degradation rate 92, 464, 469, 475, 478, 482
- demineralized freeze-dried bone (DFDB) 138
- density 13, 19, 21, 23, 24, 27, 307, 308, 332, 333, 342, 368, 370, 372, 373, 398, 439, 451, 530
- dental cementum 125, 126, 128
- dental implant 1, 27, 104, 105, 131, 331, 345, 346, 360, 382, 385, 524, 529, 531, 568
- dentin 125, 237, 455, 456, 457, 458, 460
- dental 81, 568
- dextran 505, 507, 508
- diabetes 125, 487, 489, 491, 588
- diametral tensile strengths 421
- dicalcium phosphate (DCP) 416
- Dicor® 216, 447–449
- differential scanning calorimetry (DSC) 417, 497
- dissolution rate 54, 74, 78, 312, 332, 340–342, 437, 438, 470, 512, 515
- Douek MED® 112
- drug delivery 184, 422, 423, 505
- elastic modulus 13, 31, 15, 36, 121, 122, 167, 183, 240, 292, 315, 358, 372, 385, 422, 495, 497–499, 501
- electrophoretic deposition 307, 332, 333, 335, 342
- emboli 95, 102
- enameling 210, 351
- endochondral bone 138
- endosseous ridge maintenance implant (ERMIs)® 117, 118, 122, 524, 568, 567
- epithelialization 488, 492
- epithelium 9, 126, 225
- ethical issues 573
- expansion coefficient 218, 219, 374, 380, 398, 439
- extracellular matrix (ECM) 71, 72, 76, 77, 79, 88, 210–212, 279
- failure loads 191, 194
- fatigue resistance 28

- FDA requirements 385
Federal Food, Drug and Cosmetics Act of 1938 542
femoral condyles 142
fibrin 139, 200, 201
fibroblasts 11, 109, 177, 585, 586
fibronectin 79, 282, 391
fibrous capsule 4, 6, 11, 61, 584
fibrous tissue 4, 5, 51, 63, 97, 126, 177, 194, 344, 400
finger 393
finite element analysis 315, 317
flame-spray coating 351
flame spraying 333
flap surgery 128
flexural strength 28, 29, 34, 374, 447, 448, 451, 498, 501
fluorapatite 56, 229, 313, 318, 319, 320
fluoride 52, 232, 235–237, 240, 243, 279, 459, 466
foraminotomy 153
Fourier transform infrared spectroscopy 417
four-point bend 292
fractographic 383
fracture toughness 8, 34, 53, 172, 173, 183, 218, 219, 355, 375, 376, 385, 397, 403, 418, 422, 451, 498, 499
gamma radiation 431
gelation 22, 23, 468, 471, 475
gel-cast foam 468, 473
gel-cast foaming 467, 471
giant cells 11
gingivae 125, 126, 128
gingivitis 127, 460, 568
glass-transition temperatures (T_g) 465, 497
glassy phases 216
good manufacturing practices (GMP) 525, 544, 550, 553
granulometry 413
growth factors 72, 76–79, 87, 103, 129, 301, 409, 423, 585, 588
HA cement 288, 290, 296, 297, 421
HA cones 116, 117, 120
HA-reinforced polylactide 404
Haversian systems 287, 301
head and neck surgery 112, 225, 226
heart valves 1, 375, 377, 381–383, 385, 389, 391–393, 395, 553
hematoma 167
high resolution electron microscopy 403
hip prostheses 153
hollow glass microspheres 505
hot isostatic pressing (HIP) 307, 332, 336
hot-pressing 20, 477
hydroxy-carbonate apatite (HCA) 9
iliac crest 80, 82, 103, 129, 138, 139, 143, 145, 152, 153, 159, 160, 199, 201, 204, 205, 477, 495
immunorejection 129, 137, 464
implants 346
incontinence 105, 579, 589
indentation fracture toughness 498, 499
index of bioactivity 68
inductively coupled plasma (ICP) 529
 chemical analysis 529
inflammation 7, 10, 42, 62, 125, 127, 128, 305, 584
infrared microscopy 532
infrared reflection spectroscopy (FTIR) 74, 176, 281, 511
Institute of Medicine (IOM) 570
Instron-type testing machine 190
interdental implant 298
interfacial attachment 8, 349
interfacial bond 4, 5, 68, 477, 585
interfacial bonding 6, 8, 73, 109, 119, 121, 162, 349, 352
interfacial stability 7, 8, 111, 120, 584

- International Standards Organization (ISO) 28
- interphalangeal (PIP) joints 393
- intervertebral space 160
- intervertebral spacers 172, 173, 202, 203
- intramedullary rod 154, 155
- intrauterine devices (IUD) 579
- investigational device exemption (IDE) 558
- ion assisted sputtering 307
- ISO 9001 557
- ISO standards 28, 31, 528, 557–559
- joints 1, 15, 154, 189, 394, 442, 577, 580, 581
- larynx 101
- leaching 54, 55, 160, 212, 213, 223, 282
- leucite 447–449, 450, 452
- lingual plates 118
- lithium disilicate 449–452
- lithium metasilicate 451
- liver 287, 431, 432, 439–445, 507, 508
- lumbar fusion 153, 154, 160, 162
- macrophages 5, 10, 11, 63, 213, 306
- macroporosity 312, 418, 467, 476
- mandible 103, 115, 119, 138, 142–144, 151, 297, 298, 346
- marine phosphorite 234
- marrow 211
- mastoid bone 110
- mastoiditis 110, 112
- matrix vesicles 210, 211
- maxilla 105, 115, 119, 297, 346
- maxillary 151
- maxillary sinus 99, 104, 105, 297, 400
- maxillary sinusitis 298
- maxillofacial 82, 98, 103, 132, 137, 142, 151, 297, 298
- mechanical valve 389–393
- Medical Device Amendments of 1976 543
- Medical Device Directives 552, 555, 558
- melt-derived glasses 24, 53, 471, 473, 474, 475
- mesenchymal stem cells 422, 506
- metal oxides 210, 213
- metals 6
- mica crystals 215–217, 220, 221, 224, 447
- microporosity 239, 297, 312, 418, 467
- middle ear 110, 111
- mineralization 77, 209, 210, 211, 512, 535, 585
- mitral valve replacements (MVR) 390
- molecular dynamics (MD) 513
- molecular orbital (MO) calculations 587
- monetite 243, 308, 415, 416, 419, 420, 423
- monocalcium phosphate monohydrate (MCPM) 415
- monocytes 10
- morphogenetic proteins 138, 143, 160
- multinucleated giant cells 294
- muscles 10, 13, 97, 138, 487
- nanocomposites 447, 478, 480
- nanoscale 475, 478
- National Institutes of Health (NIH) 570
- nerve 101, 125, 138, 145, 400, 455, 456
- nerve dysaesthesia 139
- network dissolution 54, 57, 457, 512
- neuropathy 489, 491
- Norian SRS® 414
- NovaBone® 72, 151, 155, 157, 466
- NovaMin® 72, 455, 457, 459, 460
- nuclear magnetic resonance (NMR) 281, 513
- octacalcium phosphate 243, 411, 419
- optical microscopy 497, 527, 532

- orbital floor 81, 99, 132, 145, 146, 147, 403
- orthopedic surgery 225, 297, 298
- Ossatura™ 468
- osseointegrative 279
- ossicles 96, 97, 109, 110, 144
- ossicular reconstruction prosthesis 111, 568
- ossicular replacement 81, 109, 111, 118
- osteoblasts 73, 77, 75, 78, 79, 130, 177, 279, 301, 476, 514, 585
- osteocalcin 419
- osteointegrative material 147
- osteocytes 287, 295, 400
- osteogenic 75, 77, 78, 91, 130, 159–161, 409, 422, 464, 470, 515
- osteoid 211
- osteoid induction 138, 400
- osteointegration 131, 404
- osteomyelitis 161, 165
- osteons 287, 300, 301
- osteopontin 419
- osteoporosis 157, 422, 423, 466, 586
- osteoproduction 75, 151, 568
- osteoprogenitor 143, 463
- osteostimulative 129, 132
- Oswestry disability index (ODI) 163
- oxyfluoroapatite 171

- pacemaker 382
- partially-crystallized glass-ceramics 497, 501
- periodontal disease 80, 100, 125, 127–130, 151, 466, 568
- periodontal ligament 101, 102, 109, 125–129
- periodontosis 127
- PerioGlas® 72, 75, 80, 100, 130–132, 141, 456, 466, 568
- phagocytes 10, 11

- pharmaceuticals 546
- piezoelectric properties 220
- plasma spray coating 19, 319
- platinum 182
- poly(acrylic acid) 421
- polycaprolactone 422
- polyether-ether-ketone (PEEK) 470
- polyethylene 30, 31, 39–41, 110, 145, 403–405
- poly- γ -glutamic acid 481
- polyglycolic acid (PGA) 90, 128, 398
- polystyrene 391
- polytetrafluoroethylene (PTFE) 128
- poly(vinyl alcohol) 421
- porosity 7, 11, 21, 92, 288, 290, 294, 307, 372–374, 418, 467, 473, 505, 528
- porous 6
- porous bead coatings 580
- porous ceramics 306
- porous hydroxyapatite 287
- porous metals 6
- potassium oxalate 456
- premarket approval application (PMA) 553
- premarket notification 510(k) 544
- prostheses
 - alumina 35
 - fingers 34
 - hip 27, 30–32, 34, 200, 201
 - iliac crest 199, 204
 - knee 30, 34
 - middle ear 209
 - shoulders 34
 - vertebral 194, 195, 201
 - wrists 34
- proteins 76, 77, 87, 279, 380, 391, 393, 418, 482, 511, 512, 535, 552, 585, 588
- pull-out tests 65
- pulp capping 81, 132

- push-out tests 223, 344
- pyrolytic carbon 367, 393
- radiation
 - alpha 36
 - beta 431, 441, 444
 - gamma 36, 434
- radiculopathy 159
- radioactive glasses 431
- radio-frequency glow discharge optical emission spectra 361
- radio frequency sputtering 336
- radiography 194, 398
- radiotherapy glasses 431
- Raman spectroscopy 339, 532
- rapid-immersion coating 351
- rapid prototyping 167, 473, 474
- rate of bonding 8, 49, 68, 524
- refractive index 438, 439
- regulation of medical devices 541, 549
- regulatory clearance 118, 549, 552
- remineralization 455, 460
- resorbable implants 8, 12
- risk-to-benefit ratios 541
- root planing 127, 128
- rutile 356, 359, 361, 362
- Safe Medical Devices Act (SMDA)
 - of 1990 544
- sapphire 1, 27
- scanning electron microscopy (SEM) 337, 372, 528, 532
- scratch testing 316
- secondary ion mass spectroscopy (SIMS) 534
- shearing stress 360, 392
- shear testing 295, 316
- silanols 24, 54–56, 59, 511, 514, 587
- silica-rich layer 55, 63, 68, 532, 533
- simulated body fluid (SBF) 59, 174, 355, 495, 536
- sinus obliteration 81, 132
- sodium hydrogen titanate 356, 359
- sodium phosphosilicate 455, 457
- soft tissues 1, 49, 63, 96, 109, 121, 183, 287, 487, 495, 584, 589
- sol-gel 16, 77, 78, 471, 474–476, 478, 480, 511, 587
- sol-gel glasses 475
- sol-gel processing 22, 77, 568, 586–589
- solid-state sintering 20, 21
- spinal repair 159, 477
- spine fusion 81, 152, 153, 162, 202
- spondylodesis 160, 161, 226
- spondylololsthesis 153, 159, 162, 196, 203
- sputter coating 307
- staffelite 234
- stenosis 113, 153, 159, 164, 166, 204
- sterilization 138, 342, 343, 557
- stiffness 122, 293
- St. Jude Medical heart valves 390
- stress shielding 15, 495
- stress transfer 121, 122
- StronBone® 466
- strontium 242, 414, 423, 456, 459, 466
- subcritical crack growth 378
- subcutaneous implantation 91
- subperiosteal implants 345, 346
- surface area 24, 52, 62, 74, 293, 296, 404, 418, 435, 472, 475
- surface charge 281–283, 457, 535, 536
- surface profiles 532
- surfactant 467, 468, 472, 473, 475
- technology transfer 80, 561
- teeth 1, 98, 115, 125, 132, 305, 447, 455, 590
- tetra-calcium phosphate 308
- tetra-ethyl orthosilicate (TEOS) 475
- thin film deposition techniques 336
- thromboembolism 390, 391, 395

- thromboresistance 3, 367, 380, 381
thrombosis 391
Ti-6Al-4V 358, 373
tibia 151, 189, 223, 287, 299
tissue ingrowth 27
tissue matrix 506
titanium alloys 374, 386, 465
titanium hydride 360, 362
titanium metal 182, 358
tooth replacement 116, 117, 447
tooth roots 116, 118, 125, 385
total knee replacement (TKR) 42
trabecular 12, 142, 143, 211, 212, 287,
295
transmission electron microscopy
(TEM) 282
transpedicular screw fixation 160
tri-calcium phosphate (TCP) 8, 289, 468
tricuspid valve replacement (TVR) 389
tri-ethyl phosphate (TEP) 475
tris-buffer solutions 63
- UK Healthcare Products Regulatory
Agency (MHRA) 482
ultralow-temperature isotropic (ULTI)
367
ureteral reflux 106
- vascular endothelial growth factor
(VEGF) 90, 129
vascularisation 87, 89, 90, 418, 422, 425,
464
- vertebroplasty 163, 165
Vickers hardness (HV) 141, 173
viscosity 19, 49, 352, 398, 417, 434,
468, 471, 475
vitrification 20, 21
vocal cords 101, 105
- wear debris 15, 30, 406, 584
wollastonite 171–173, 477
- xenogenic 137, 138
xenografts 129, 137–139
xerogels 24
X-ray diffraction (XRD) 59, 229, 281,
320, 337, 372, 526
X-ray fluorescence (XRF) 281, 524,
525
X-ray microtomography 473, 474, 476,
479
X-ray photoelectron spectroscopy (XPS)
342
- Young's modulus 34, 36, 173, 218, 219,
318, 403, 404, 480
yttrium aluminosilicate (YAS) glasses
431
- zeta-potential measurement 357, 361,
535
zirconia 4, 27, 71, 182, 398, 449, 452