

Index

a

- abbreviated new drug applications (ANDAs) 84
- abrasion 270, 392
- acetonitrile, ternary systems 120, 121
- acidity constants (pK_a) 32
- active pharmaceutical ingredient (API) 84, 134, 228, 329
 - amorphous API 464–466
 - and co-crystal formers 244
 - critical quality attributes (CQAs) 306
 - dosage forms
 - inhalation 36
 - transdermal route 36–37
 - drug products
 - injectables 34–35
 - solid dosage forms 35–36
 - good manufacturing practice (GMP) 84–85
 - needle-like morphology 243
 - nonstoichiometric hydrates 255
 - solid form control for low-dose drug 451–453
 - solid form selection 447
 - solid state properties 306
- adefovir dipivoxil (AD) 366
- agglomeration 292–295, 386–390
- allotropism 93
- amorphization
 - of α -glucose 334
 - dry milling of crystalline drugs 356
 - during freeze-drying 359–364
 - tolbutamide 343

amorphization methods

- high energy milling, crystalline materials 228
- mechanical path 227
- thermal quenching 228
- thermal route 227

amorphous compounds 192, 194, 464

- amorphous/crystalline solids
 - solid state, rheology 192
 - structural aspects 190
- amorphous indomethacin 356
- amorphous solid dispersions (ASD) 220, 228, 344

amorphous stability

- conventional glass formation 201
- liquid/crystal interface energy 203
- molecular mobility 202

amorphous stability, prediction

- confinement and size effect 204
- heterogeneous nucleation 204
- polymorphism 203

amorphous state

- amorphous stability
 - kinetic crystallization, nucleation and growth 200
 - metastability, crystallization 198
 - crystal melting *vs.* glass softening 192
 - fragile molecules, stabilization 190
 - glassy and amorphous compounds 194
 - negative aspects 189
 - order and disorder
 - crystallinity 193

- amorphous state (*contd.*)
 small or disordered perfect crystals 193
 poorly soluble compounds 190
 anti-plastification 223
 area under the curve (AUC) 68
 armodafinil 479–481
 Arrhenius diagrams ($\log(\tau)$) 219
 aspirin 470
 atomic force microscopy (AFM) 74
 atorvastatin calcium 351, 476
 automated direct nucleation control (ANDC) 315
- b**
 β -cyclodextrin 175
 β process 218
 binary systems, polymorphism
 mixed crystals
 one component 102–105
 one stable one metastable, full miscibility 111–112
 solid to solid transitions limitations 112–114
 two isostructural monotropic forms 113
 two stable one component, full miscibility 105–107
 two stable one component, limited miscibility 108–109
 no mixed crystals
 one component 98–100
 one stable, two form monotropism 100
 stoichiometric compound 100–102
 three enantiotropic 100
 two enantiotropic, one form monotropism 100
 bioavailability 11–14, 356–357
 biopharmaceutical classification system (BCS) 12
 biopharmaceutics 11–14
 biopharmaceutics risk assessment roadmap (BioRAM) 12
 bitopertin 453
 chemical structure 453
- energy-temperature diagram 453, 454
 solubility in ethanol 454, 455
 Bragg law 193, 416
 Bravais–Friedel–Donnay–Harker model 144
 brivaracetam (BRV) 64
 brucine dihydrate 166
- c**
 calorimetric signature, T_g 205, 206
 Cambridge Crystallographic Data Centre (CCDC) 134
 Cambridge Structural Database (CSD) 64, 65, 161
 carbamazepine (CBZ) 67
 DSC thermograms 433
 TG-FTIR 439
 carbamazepine polymorphs 401, 402, 405
 carboxylic acids, for co-crystal formation 244
 casopitant mesylate crystallization, statistical DoE
 control space 313
 design space 312, 313
 Design-Expert® software platform 310
 fractional factorial studies 310
 Fusion PRO® software platform 310
 power/volume values 310
 process parameters 308
 QbD approach 307
 response surface methodology 310
 scoping study 308
 ^{13}C CP/MAS ssNMR spectra 425
 center for drug evaluation and research (CDER) 14
 cimetidine 470
 clarithromycin 403
 classical nucleation theory (CNT) 264–266
 Clausius–Clapeyron equation 95
 clopidogrel bisulfate 408
 co-amorphization 365
 co-crystal eutectic constants (Keu) 66

- co-crystals 3, 61
 description 350
 EMA and FDA classification 460
 examples 350
 liquid-assisted/solvent-drop grinding 351
 cohesion/adhesion phenomena, in powders 388
 co-grinding 350–351
 combined liquid- and solid-state *in-situ* crystallization (CLASSIC) NMR 428
 co-milling 350–351
 compactibility 406
 compressibility 406
 compression 342–345
 contact methods 383
 conventional glass formation 201
 cooperative rearrangement regions (CRR) 213
 critical material attributes (CMA) 4
 critical process parameters (CPP) 4
 critical quality attributes (CQAs) 4, 306
 cross polarization (CP) 425
 crystal energy landscapes
 interpretation of 145
 tazofelone 146
 crystal form
 novelty of 472
 obviousness 472
 patent history 477
 patent litigations, arguments for and against obviousness in 478
 serendipity, role of 475
 crystal growth 290–291
 crystal melting *vs.* glass softening 192
 crystal structure
 comparison 141
 composition solvate/hydrate stoichiometry 439–443
 properties
 solubilities, morphologies,
 mechanical properties 143
 spectroscopic 143
 single-crystal X-ray diffraction 415
 solid-state nuclear magnetic resonance spectroscopy (ssNMR) 424–430
 vibrational spectroscopy 417–424
 crystalline hydrates, dehydration of 229
 crystalline mesophase formation 357–358
 crystallinity 54, 193
 crystallization
 behaviours 150
 during freeze-drying 359
 indomethacin 344
 mannitol 361, 364
 from melt method 249
 sorbitol 358
 trehalose 359
 crystallization process 20–21
 development and impurities 453–456
 modeling concepts for
 agglomeration 292–295
 crystal growth 290–291
 model-based optimization 290, 295
 parameter estimation 290
 population balance equations 286–289
 solvent-mediated polymorph transformation 291
 scale-up 305
 API critical quality attributes 306
 cooling method 325
 crystallization processes 318–324
 disappearing polymorphs 324
 heat transfer 325–326
 mass transfer 316–318
 metastable zone width, mixing impact of 324
 mixing optimization 316
 mixing process parameter 316
 polymorph control methods 324–325
 problems 305

- crystallization process (*contd.*)
 process analytical technology (PAT), for polymorph control 314–316
 statistical design of experiments 306–307
 VisiMix® calculations 316–322
- curcumin polymorphs 403
- d**
 dehydration 338–341
 raffinose pentahydrate 341
 trehalose dihydrate 341
- deliquescence 117–119
- density functional theory (DFT-D)
 calculations 177, 429
- design of experiments (DoE) 6
- desmotropy 93
- developability classification system (DCS) 12
- differential scanning calorimetry (DSC) 77, 431–436
- dihydrate polymorphs 177
- dispersion forces 137
- disproportionation 43–44
 microscopic solvation 44
 pH_{max} 43
 solid surface pH 44
- dissociation constant
 acids and bases 38
 equilibrium constant 38
 ionization constant 37
 pK_a 39–40
 weak electrolytes 37
- dissolution profile, of MBP 465
- distributed multipole (DMA) 137
- dosage forms
 inhalation 36
 transdermal route 36–37
- drug discovery 7
- drug product intermediate (DPI) 84
- drug products (DP) 10
 control strategy for 448
 injectables 34–35
 life cycle 52–53
 solid dosage forms 35–36
- drug research and development 471
- drug substance (DS) 3, 10–11
 drug product intermediate 34
 high soluble 35
- dry granulation 336
- dry powder inhalation (DPI) 36
- dynamic heterogeneity 213
- dynamic nuclear polarization (DNP) 429, 430
- dynamic vapor sorption (DVS) 431, 440–443
- e**
 efflorescence 115, 117–119
 enantiotropic polymorphs 100
 enantiotropy 96, 97
 energy balances 288
 energy landscape 208
 equilibrium constant 38
 equilibrium states 92
- f**
 failure mode effect analysis (FMEA) 5, 307
 famotidine, packing arrangement of 403
 felodipine 231
 fenoprofen calcium dihydrate 358
 fictive temperature 216
 fluid bed granulation 336
 fluid dynamics 288
 F3 mnemonic 10
 Focused Beam Reflectance Method (FBRM®) 314
 Fourier transform infrared spectroscopy (FT-IR) 70
 fracture 392
 fragile compounds 213
 fragile liquids 211, 213
 fragility 209
 freeze-drying 229, 347–349
 amorphization and crystallization 359
 freeze-dried formulations 347
 of indomethacin solution 349
myo-inositol phase transformations 347, 348

- of paracetamol 349
 freezing aqueous solutions 345–346
 fumaric acid co-crystal 460
- g**
 gabapentin, lactamization rates of 353, 355
 generally recognized as safe (GRAS) 61, 62, 243
 genotoxic impurities, sulfonic acid salt 459
 Gibbs free energy diagram 208
 Gibbs function 199
 Gibbs phase rule 93–94
 glass softening *vs.* crystal melting 192
 glass transition
 calorimetric signature, T_g 205, 206
 entropy crisis 207
 fragile and strong glass formers 207
 physical aging 206
 vibrations 206
 glassy amorphous state 208
 glassy compounds 194
 glutaric acid co-crystal 460
 good manufacturing practice (GMP) 84–85
 granulation process
 dry granulation 336
 fluid bed 336
 hydrate formation 337–338
 wet granulation 336, 341
 gravimetric vapor sorption (GVS) 160
- h**
 H_2 -antagonists 470
 Havriliak–Negami function 211
 heat transfer 325–326
 Helmholtz free energy 139
 heterogeneous equilibria 95
 heterogeneous nucleation 204, 268
 heterosolvates 115
 high shear granulators 336
 high-throughput screening (HTS) 48, 252, 253
 holistic solid form control strategy 448, 449
- drug product 450–451
 drug substance 449–450
 polymorph screening activities 464
 homogeneous nucleation 262–267
 hot melt extrusion (HME) 227, 229, 349–350
 hot-stage microscopy 74
 hydrate/anhydrate system, of drug substance 456–458
 hydrate crystallization 170
 hydrate dehydration 364–365
 hydrate formation 337–338, 364
 hydrate forming systems 183
 hydrates 115
 crystallization 170
 forming systems 183
 isostructural dehydrate 175
 statistics of 170
 structure and properties 174
 hydroxypropylmethylcellulose acetate succinate (HPMC-AS) 465
 hygroscopicity 54, 117–119
 behaviors, pharmaceutical solids 168
 classification 162
 moisture sorption analysis 166
 hygroscopic solids 115
- i**
 impurity 102, 279–280, 453–456
 indomethacine 225, 344, 406
 infrared absorption spectroscopy 422
 inhalation 36
 injectables 34–35
 in-process recrystallization 358
 minimizing amorphization 359
 intramolecular hydrogen bonding 177
 in vitro DP dissolution *in vivo*
 bioavailability correlation (IVIVC) 11
 inverse gas chromatography (IGC) 386
 capacity factor 387
 in food industry 387
 in pharmaceutical industry 387
 physicochemical parameters 387

- inverse gas chromatography (IGC)
(*contd.*)
- surface amorphous content and
agglomeration 387
 - ionic co-crystals (ICCs) 63–65
 - ionizable 31
 - ionization constant 37
 - ionization, pH 39
 - IR spectroscopy 77
 - selection rules 417
 - vs.* Raman spectroscopy 420
 - isomorphous desolvates 115
 - isothermal microcalorimetry (IMC)
436–438
- j**
- Johari–Goldstein process (JG) 218
- k**
- Kauzmann paradox 207
- kinetic crystallization, nucleation and
growth 200
- kinetic heterogeneities 214
- l**
- lattice disorder, creation of
altered particulate and bulk
properties 352–353
- chemical stability 353–356
- solubility and bioavailability
enhancement 356–357
- lattice energy 136
- liquid-assisted/solvent-drop grinding
351
- long range order (LRO) 191
- low-frequency Raman spectroscopy
423
- m**
- magic angle spinning (MAS) 78
- mannitol crystallization 345, 361, 362,
364
- manufacturing classification system
(MCS) 11
- mass transfer 316–318
- maximum absorbable dose (MAD) 13
- mechanical equilibrium 91
- mechanochemistry 31
- melting point 54, 69–70
- mesophases 3
- metastable crystal forms 472
- metastable equilibria 91, 107
- metered dose inhalation (MDI) 36
- methylene blue pentahydrate 434
- methyl paraben 72
- microcrystalline cellulose (MCC)
- DVS curve of 442
 - particles 353, 354
- micronized salbutamol sulfate powders
352
- microprecipitated bulk powder (MBP)
465
- microscopy, co-crystals 74
- millling 333–336
- purpose of 392
 - mixed solvates 115
 - model-based optimization, of
crystallization process 295
 - moisture sorption-desorption isotherms
166–168
 - molecular crystal powders 191
 - batch-to-batch variability 390–393
 - hydration–dehydration 393–395
 - millling-induced agglomeration
386–390
 - surface interactions and bulk
properties 395–399
- molecular crystals
- defects 400
 - hydration 401
 - mechanical properties 402–405
 - microstructural evolution 399
 - millling induced disorder 396
 - solid-state characterization 381
 - structural damage of 399
 - structure–property–response/
performance 385–386
 - surface characterization techniques
383
 - surface probing 386
- molecular dynamics 137
- molecular mobility
- and entropy 212

- fragile and strong glass formers 210, 211
and instability
 aging phenomenon 214
 non linearity 217
 secondary relaxations 218
 stability, assessment 216
- monotropy 96
- morphology 54
- multi-component amorphous systems
 crystalline *vs.* amorphous states 220
 mixing and stabilization 224
- multidimensional population balance model 299
- n**
- nano-crystalline drug particle generation 356
- new active substance (NAS) 83
- new drug applications (NDAs) 84
- N*-hydroxyethylpyrrolidine (HEP) 37
- noncontact methods 383
- nonobvious invention 470
- nonsteroid anti-inflammatory drugs (NSAIDs) 82, 177
- nonstoichiometric compounds 100
- nonstoichiometric solvates 115
- Norvir® 477
- novel invention 470
- nucleation 204
 characterization of 270–274
 description 261
 deterministic nucleation rates 270–272
 examples 261
 heterogeneous 268
 homogeneous 262–267
 secondary 261, 268–270
 stochastic nucleation rates 272–274
 of unstable polymorph 276
- Nuvigil® 478
- o**
- office for pharmaceutical quality (OPQ) 14
- Ostwald's rule of stages (OSR) 246, 247, 275–277
- p**
- paracetamol 397
 DSC thermogram 432, 435
 XRPD patterns 417
- Pareto optimal solutions 297
- paroxetine hydrochloride hemihydrate 476
- particle adhesion 390
- Particle Vision Measurement (PVM®) 314
- patent systems 470
 description 469
 obviousness inquiry 471
 requirements for obtaining 470
 role in pharmaceutical industry 470
 in United States 469
- penicillin 470
- perfect crystals 190
- pharmaceutical co-crystals (PCCs)
 analytical tools
 microscopy 74
 patent literature review 79
 regulatory aspects 83–85
 solid-state NMR 78–79
 thermal methods 77
 vibrational spectroscopy 77–78
 X-ray diffraction 75–77
 definition of 61
 properties
 bioavailability 69
 dissolution rate 67–68
 melting point 69–70
 solubility 66–67
 stability 70–71
 undesired effect of 71–73
 types
 ionic co-crystals 63–65
 polymorphism 65
 salts *vs.* co-crystals 62–63
- pharmaceutical crystal forms 471
- pharmaceutical development
 bioavailability 11–14
 biopharmaceutics 11–14

- pharmaceutical development (*contd.*)
 crystallization process 20–21
 drug discovery 7–10
 drug substance and product 10–11
 formulation of 10, 21–22
 physical purity determination 22–23
 polymorphism 17–20
 process of 8, 9
 quality assessment 14–15
 salt/co-crystal 16–17
 solid state discovery 16
 pharmaceutical glasses 227
 pharmaceutical hydrates 174
 pharmaceutical ionic co-crystals (PICCs) 63
 pharmaceutical processes
 intended phase transformations 346–351
 unintended phase transformations 333–346
 phase-appropriate approach 447
 phase field dislocation dynamics (PFDD)
 theory 399
 phase transformations
 of amlodipine besylate 338
 amorphization 352–357
 chemical composition, changes in 364
 co-amorphization 365
 co-crystal formation 366
 crystalline mesophase formation 357–358
 hydrate formation and dehydration 364–365
 in-process recrystallization 358
 intended 346–351
 salt formation and disproportionation 366–368
 on stress-relaxation concept 332
 unintended 333–346
 pH_{\max} 42, 43
 pH –solubility 40
 physiology based pharmacokinetic (PBPK) modeling 12
 piracetam (PIR) 64
 $\text{p}K_a$ values 32
 plastification 223
 poly(L-lactic acid) polymorphic structure 409
 polymorphism 2, 3, 245
 access to 97–98
 equilibrium 91
 mechanisms 98
 mixed crystals
 one component 102–105
 one stable one metastable, full miscibility 110
 solid to solid transitions limitations 112
 two isostructural monotropic forms 113
 two stable one component, full miscibility 105–107
 two stable one component, limited miscibility 108–109
 pharmaceutical co-crystals 65
 powder compaction properties 406–409
 powder flow, impact of 401–402
 salt formation 31–33
 size reduction by milling 405–406
 with unary system 95–98
 without unary system 94–95
 polymorph prediction
 crystal energy landscapes
 interpretation of 145
 tazofelone 146
 crystal structure 140
 comparison 141
 properties 144
 pharmaceutical industry
 crystal structure prediction 134
 thermodynamic prediction 134
 relative energies, crystals
 free energy 139
 lattice energy 136
 polymorphs 245, 248
 characterization and selection 253–254
 crystallization method, selection of 248
 Ostwald's rule of stages 246, 247

- solvent selection 250
 surface free energy 247
 thermodynamic stability,
 non-solvated forms 248
 polymorph screen 251, 255
 economic criteria 251
 elements required 252
 ICH guidelines 251
 polymorph transformation 291–292
 population balance equations 286–288
 solution of 288–289
 powder activation 387
 powder compaction properties
 compactibility 406
 compressibility 406
 dense cluster packing 406
 polymorphism impact on 408
 slip planes and defects 406
 tabletability 406
 preferential orientation 416
 pressure-induced polymorphic
 transformations 343
 primary heterogeneous nucleation 261
 primary homogeneous nucleation 261
 process analytical technology (PAT) 6,
 289, 418
 chord length distribution 315
 data collection methodology 315
 design via control strategy 315
 FBRM® probe 314, 315
 Particle Vision Measurement probe
 315
 for polymorph control 314
 Raman spectroscopy 315
 processing-induced phase transitions
 330, 331
 propyphenazone 79
 pseudopolymorphs 2
 pyrithyldione 79
- q**
- quadrupolar nuclei 428
 quality by design (QbD) 3–6
 design of experiments 6
 DP CQA 4
 failure mode effect analysis 5
 risk assessment 4, 5
 quality target product profile (QTPP)
 4
- r**
- Raman fiber-optic probe 424
 Raman microscopy 421
 Raman spectroscopy 77
 advantages 419, 420
 carbamazepine 418, 419
 co-crystal former 421
 disadvantages 420
 low-frequency 423
 selection rules 417
 sensitivity 421
 transmission 422
 two-dimensional mapping technique
 420
- ranitidine hydrochloride (Zantac®)
 408, 475
- relative energies, crystals
 free energy 139
 lattice energy 136
- risk assessment 4, 5
- ritonavir 476
- s**
- salt formation
 active substances 33–37
 basics of 37–44
 characterization
 initial data 45
 salt formers 45–46
 disproportionation 43–44,
 366
 dissociation constant
 acids and bases 38
 equilibrium constant 38
 ionization constant 37
 p K_a 39–40
 weak electrolytes 37
 drug candidates 51
 drug development 32, 33
 drug's life cycle 52–53
 drug substance 49
 ionization and pH 39
 pH-solubility 40

- salt formation (*contd.*)
 polymorphism 31–33
 salt preparation
 crystallization 48, 49
 drug substance 47
 HTS 48
 procedures 46–49
 solid materials 46
 XRPD 48
 salt selection process 53
 sulfonic acids 53
 salt&co-crystal screening 16–17, 244
 salt formers 45–46
 salts *vs.* co-crystals 62–63
 salts, screening for 242, 243
 Schroeder–Van – Laar equation 99
 secondary nucleation 261, 268–270
 seeded crystallization process
 impurity control 279–280
 process control 277–279
 polymorphism control 279
 seletracetam (SEL) 64
 short range order (SRO) 197
 single-crystal X-ray diffraction
 (SCXRD) 75, 416
 slip planes
 description 402
 in indomethacin crystals 407
 in paracetamol 400
 sodium naproxen, hydration of 339
 sodium salts, solid forms of 451, 453
 solid dosage forms 35–36
 solid forms
 attribute control 448
 co-crystal, quality by design
 458–460
 dalcetrapib 466
 holistic control strategy 448, 449
 hydrate/anhydrate system, of drug
 substance 456
 intrinsic control 448
 parametric control 448
 polymorph screening activities 460
 procedural control 448
 quality by design principle 448
 screening and selection 241, 242,
 447
 solid– liquid monovariant 95
 solid-state development 1–3, 15–23
 solid-state nuclear magnetic resonance
 (ssNMR) spectroscopy 78–79,
 424–430
 advantages 425
 crystallization of polymorphs 427
 disadvantages 426
 dynamic nuclear polarization 429,
 430
 homonuclear and heteronuclear
 correlation experiments 427
in-situ experiments 427
vs. solution-state NMR 424
 spectral editing approach 425
 solid-state, rheology 191
 solubility 54, 66–67
 solubility limited absorbable dose
 (SLAD) 12
 solution calorimetry (SolCal) 438–439
 solvates 245, 247
 chiral discrimination formation
 121–123
 formation and stability 248
 hygroscopicity, deliquescence,
 efflorescence 117
 identification of 245
 isomorphous, formation of 253
 stoichiometric *vs.* non-stoichiometric
 116–117
 solvent-based crystallization processes
 170
 solvent-mediated polymorph
 transformation 291
 sorption coefficient 388
 sorption isotherms 168
 sorption kinetics, microcrystalline
 cellulose 163
 spray-drying 229, 346–347
 statistical design of experiments
 306–307
 failure mode and effects analysis
 307
 response surface methodology 307
 scale-independent parameters 306
 screening matrixes 307

- Kepner-Tregoe 307
 stoichiometric solvates 114
 vs. non-stoichiometric solvates 116–117
 strong liquids 210
 Structure Activity Relationship (SAR) 7
 sulfamerazine 408
 sulfathiazole 405
 supersaturation control (SSC) 315
 surface characterization techniques
 practical applications and information 383
 size scales 384
 surface energetics 390
- t**
 tablet formation, compression pressure for 342
 tabletability 406
 terahertz (THz) spectroscopy 422, 423
 terahertz pulse spectroscopy (TPS) 422
 ternary systems
 chiral discrimination formation 121–123
 thermal equilibrium 91
 thermal methods 77
 thermal quenching 228
 thermodynamical stable polymorph 17
 thermodynamic properties
 differential scanning calorimetry 431–436
 dynamic water vapor sorption experiments 431
 isothermal microcalorimetry (IMC) 436–438
 solid forms 431
 solution calorimetry (SolCal) 438–439
 thermodynamics
 allotropism 93
 chemical purity 92
 chirality 93
 components 93
 desmotropy 93
 Gibbs phase rule 93–94
 isotopic purity 92
 structural purity 92–93
 unary system/section
 with polymorphism 95–98
 without polymorphism 94–95
 water solid interactions 160
 thermogravimetric analysis (TGA) 46, 77, 182, 439–440
 thermogravimetry-Fourier transform IR (TG-FTIR) 440
 thermogravimetry mass spectrometry (TG-MS) 252, 440
 time-temperature-transformation (TTT) 200, 201
 Tool, Narayanaswamy, Moynihan (TNM) expression 218
 tosylate salts 459
 transdermal route 36–37
 transmission Raman spectroscopy 422
 triethanolammonium modafinate (TMM) 122
 two-step nucleation theory (2-SNT) 263, 264, 266–267
- u**
 unary system/section
 with polymorphism 95–98
 polymorphs access 97–98
 polymorphs mechanisms 98
 without polymorphism 94–95
- v**
 van der Waals interaction 137
 vapor–liquid equilibria 94
 vemurafenib 356, 357
 chemical structure 464
 transformation scheme 465
 USP4 dissolution profiles 466
 validated XRPD method 466
 vibrational spectroscopy 77–78, 417–424
 VisiMix® calculations 316–322

Vogel–Fulcher–Tamman equation
(VFT) 212

W

water–solid interactions 160
weak electrolytes 37
wet bead-milling 356
wet drying 182
wet granulation 336, 341

X

xemilofiban 352
X-ray crystallographic methods 75
X-ray diffraction (XRD) 75–77, 195,
416–417
X-ray powder diffraction (XRPD) 46,
71, 75, 76, 78, 416