

Index

a

- ab initio* approach 82, 102, 382, 393
- acoustic levitation 2, 322
- activation energy 21, 23, 45, 143, 235, 273, 277
- aerodynamic levitation (ADL) 2, 72
- Ag–Ge alloy microstructure 538
- Al–Cu–Ag alloy
 - coupled Al–Al₂Cu growth structures in 488
 - DTA traces for different compositions in 489
 - predictions of three-phase coupled growth 494
- Al–Cu alloys 460, 465, 467
- Al–Cu droplets, processed in terrestrial electromagnetic levitator 473
- Al–Cu–Fe system 529
 - estimate of thermal field in laser clad of 536
 - liquidus surface projection of 530, 531
 - peritectic reactions in quasicrystal forming 529, 530
 - undercooling studies of ordered phases 103
- Al–Cu–Si system
 - eutectic cells form during Al–Al₂Cu univariant growth in 489
- Al(fcc)–Al₂Cu eutectic structures 490
- Al–Fe powders
 - mass median diameter 457
 - nitrogen and helium 457
- alloy melts, structure of 77–83
 - atomic scattering factors 79
 - Bhatia–Thornton formalism 78, 81, 82
 - Faber–Ziman formalism 79, 81, 82
 - measured and simulated S_{NN} of liquid Zr₆₄Ni₃₆ at 82
 - neutron diffraction experiment on 78
- alloy structures solidified, quantitative analysis 451
 - IA droplets
 - description of 454, 455
 - microstructure solidification 469
 - modeling 469
 - cooling rate 469–473
 - eutectic undercooling 473–477
 - peritectic systems 477–480
- Al₈₀Mn₂₀ alloy 70
- Al₈₈Mn₁₂ alloy 4, 5, 7, 8
- Al₈₀Ni₂₀ alloy 70
- Al–Ni alloys
 - phase fractions in 418
 - solidification 403
- Al-rich Al–Cu–Fe alloy system 530
- anisotropy 130, 239, 378, 427, 445, 487
- athermal behavior 233, 234
- atomic packing, in metallic glasses 71
- atomic radii 70, 77, 83, 168
- atomistic simulations 106, 381, 382, 486
- Avizo™ software 465, 466

b

- Babbage's tables 33
- bending rigidity 387
- binary systems 51, 70, 219, 376, 454, 530
 - nonisothermal 355
- blooming 42
- Boussinesq approximation 34
- Brownian dynamics simulations 113

c

- capacitance proximity sensor (CPS) technique 248, 252
- capillary wave spectrum 385
- capillary wave theory (CWT) 382–384, 387, 388, 398

- cell spacing 461, 462
 - CGM. *See* continuous growth model (CGM)
 - chill cooling 255
 - experiments on levitated samples 256
 - classical nucleation theory (CNT) 88, 143
 - homogeneous steady-state nucleation 88–90
 - nucleation rate 218
 - cluster formation 219
 - CMOS sensors 43
 - colloidal systems 381
 - competitive nucleation 148
 - computer algorithms 41, 44
 - computer-based 3D visualization 41
 - computer simulations 113, 382
 - confocal microscopy 381
 - contact angle 52, 114
 - containerless processing
 - of melts 72
 - through levitation 8
 - containerless processing through levitation
 - electromagnetic levitation 9–16
 - in reduced gravity 23–26
 - electrostatic levitation 16–23
 - continuous growth model (CGM) 364, 365, 367, 373, 374
 - convection 309
 - delay time as a function of 152, 153
 - effect on nucleation and solidification 313
 - growth velocity of dendrite 317–319
 - nucleation undercooling 313, 314
 - solidification structure 314–317
 - influence of 306, 307
 - cooling rates 64, 146, 471
 - effect of radiation 148
 - particle size, cooling gas 461
 - scales 537
 - Coulomb force 16, 34
 - coupling of ordering, in liquid
 - to nucleation barrier 101
 - coupling of ordering
 - and nucleation barrier 102–106
 - icosahedral ordering 101, 102
 - crack nucleation 227
 - crevice geometry 231–234
 - critical nucleus development
 - mechanisms 235, 236
 - critical undercooling 14, 144, 154, 194–196, 198, 203, 214, 215, 289, 306, 317
 - as function of drop size 151, 152
 - crystal growth 393–398
 - averaged temporal profile of layers of growing Ni crystal 396
 - concentration and order parameter as function of time for Ni and Al layers 398
 - determining kinetic growth coefficients 393
 - growth velocities as function of undercooling for Ni and $\text{Al}_{50}\text{Ni}_{50}$ 394
 - number density profile of growing Ni crystal 395
 - regular density oscillations of crystal decay in 394
 - simulation procedure 393
 - time evolution of single layers 397
 - velocities in glass-fluxed melts under static magnetic fields
 - advanced facility for measurements 297
 - crystallization 12, 14, 21, 113, 398
 - containerless crystallization of Si 270
 - of Fe_2Tb phase 169
 - Gibbs free energy 143
 - of intermetallic phase 200
 - 1M-PFC model 122, 124
 - needle 15
 - into undercooled melts 268
 - crystal–melt interfaces 262, 363, 376
 - crystal nucleation 113
 - barrier 105
 - catalysis of 90, 108
 - heterogeneous, solutions of the Euler–Lagrange equation 131
 - in mixed single-mode – two-mode PFC system 120
 - thermodynamics of 298
 - Cu–Ag alloy systems 528
 - Cu–base alloys 51
 - Cu–based metallic systems 51
 - cubic crystal structure 239
 - cubic interpolation, of edge profile 43
 - $\text{Cu}_{50}\text{Co}_{50}$ alloys 63, 65
 - Cu–Co melts, spinodal decomposition in 62–64
 - Cu powder, atomizing 458
 - Cu–6Sn powders, microstructure of 460
 - Cu solubility 468
- d**
- DAS. *See* dendrite arm spacing (DAS)
 - data reduction 41
 - demixing 52–54
 - experiments in drop tube 56–62
 - experiments in terrestrial EML, and in low gravity 54–56
 - mechanism 52–54
 - dendrite arm spacing (DAS) 405, 415
 - dendrite fragmentation 225

- dendrite growth 3, 204, 239, 460
 - in binary stagnant system 356
 - implications for 376–379
 - in pure (one-component) system 355
 - rates 376, 466
 - dendrites 247, 250, 281
 - during rapid solidification 240
 - dendritic grain 251
 - dendritic growth velocities 282
 - categories of techniques 282
 - in electromagnetically levitated Ni melts 252
 - of glass-fluxed Ni samples 189–191
 - metallic systems 26
 - in Ni_3Sn_2 compound 291
 - novel data of growth velocities 291, 292
 - peculiarities of intermetallic compounds 291
 - in pure Ni melts 286
 - CPS data 287
 - with predictions of modified LKT model and 300
 - recalescence characteristic 287, 288
 - with and without imposition of static magnetic field 299
 - and tip radius 357
 - and undercooling 318
 - dendritic microstructure 14, 15, 63, 261, 519
 - dendritic ribbon-shaped Ge crystal 262
 - dendritic solidification
 - in cross section of droplet processed by EML 351
 - evolution of convective patterns, and solidifying structures 351
 - partitionless 204
 - TEMHD in 339–345
 - density, noncontact measurement of 42
 - δ -Fe solid solution 510
 - differential scanning calorimetry (DSC) 51, 489, 516
 - differential thermal analysis (DTA) 51, 52, 178, 180, 181
 - diffusion 485
 - of atomic species 536
 - controlled reaction 526
 - localization of 509
 - disorder trapping 531
 - droplets
 - dispersion 516
 - emulsion technique 516
 - metal 454
 - nonmetallic 454
 - drop tube processing 3, 161
 - advantages 161
 - alloy composition 457
 - containerless crystallization 275, 276
 - cooling rate of droplet during 163–165
 - Cu solubility 468
 - electromagnetic levitation 451
 - experiments 65, 140, 162
 - facility at ISAS/JAXA 162
 - gas boundary layer 469
 - instrumented, need for 451–454
 - microgravity environment 452
 - rapid cooling, containerless solidification 452
 - recalescence boundaries 464
 - spherical samples produced by 163
 - undercooling level 163–165
 - DTA. *See* differential thermal analysis (DTA)
 - dynamic density functional theory (DDFT) 382
- e**
- EBSD. *See* electron backscatter diffraction (EBSD)
 - eddy current 2, 9, 72, 307, 308, 350, 404
 - EDX analysis 64
 - electrical conductivity 9, 10, 298, 306, 323, 333, 342, 426, 428, 429, 431, 436, 443–447
 - electromagnetic force 55, 306, 307, 325, 326, 333, 335, 452
 - electromagnetic interference 41
 - electromagnetic levitation 2, 9, 72, 404, 519, 529, 537
 - apparatus 404
 - chamber for containerless undercooling and 13
 - convective flow in droplets processed in 350, 351
 - diamagnetic repulsion force 9
 - of droplets 451
 - electromagnetic levitation force F_{em} 11
 - experiments, cooling rates in 147
 - heat transfer by radiation 12
 - mean force 10
 - mean power absorption P 11
 - in reduced gravity 23–26
 - sample 413–418
 - to evaluate heat transfer coefficient 415
 - radius 10
 - simulation predictions 415–418
 - solidified $\text{Al}_{75}\text{Ni}_{25}$ droplet, image analyses 414
 - skin depth 10
 - temperature–time ($T-t$) profile 14
 - electromagnetic levitator 3, 21, 23, 26, 51, 52, 255, 261, 270, 296, 305, 306, 429, 473

- electromagnetic stirring on droplet
 - growth 65
 - electromotive force 307
 - electron backscatter diffraction (EBSD) 315, 406, 418, 475, 476
 - characterization 475, 476
 - electrostatic force 73, 105
 - electrostatic levitation (ESL) 2, 16–23, 34, 72, 98, 509, 515
 - advantage 19
 - elucidating dendritic solidification 486
 - embedded atom method (EAM) 371, 373
 - EML droplet, solidification 479
 - energy barrier 235
 - enthalpy 21, 242
 - equivalent flux 35
 - ESL. *See* electrostatic levitation (ESL)
 - Euler–Lagrange equation 117
 - European Synchrotron Radiation Facility (ERSF) 16, 464, 520
 - eutectic alloys 514
 - directional growth microstructures 483, 484
 - eutectic growth, univariant 489
 - eutectic reaction 519
 - eutectic scaling constant 487
 - eutectic solidification 483
 - basic theory of 490–493
 - competitive growth considerations 496–499
 - quantitative simulations of 487
 - research & developments 499–503
 - solidification paths 496–499
 - for ternary systems 493–496
 - univariant and invariant 483
 - eutectic undercooling 474
- f**
- faceted dendrite, in semiconductive material 262
 - crystal growth with a single twin 263
 - dendrites growth 264
 - 2D nucleation 263, 270
 - EBSP orientation map 266
 - isothermal DLG model 262
 - parameters for low index interfaces 263
 - rate-determining process for crystallization 268–270
 - transition 267, 268
 - twin free
 - continuous growth 264
 - EBSP analysis 266
 - SEM images 267
 - twin-related growth 263
 - lateral growth 264
 - types of 265
 - Fe-25 atom
 - microstructures of 520
 - Fe–C system 510, 528
 - Fe–Ge system, binary alloy phase diagram of 515, 516
 - Fe₉₅Mo₅ alloy 15
 - Fe–Ni alloys 16, 316
 - Fe–Ni–Cr steel alloy 25
 - Fe–rare earth (RE) magnetostriction alloys 165–173
 - γ-Fe solid solution 510
 - Ficks law 366
 - flow dynamics, for droplet 311
 - fluid flow
 - calculated 36, 37
 - external and internal 145
 - model for effect on diffusion fields around subcritical nuclei 34
 - on phase selection 37–40
 - residual 296
 - and temperature distribution 37
 - time-dependent 145
 - unsteady 142
 - viscous 349
 - Fourier transform 74, 80, 81, 116, 383, 385, 500
 - Frank–Kasper like polyhedra, of coordination number 83
 - Frank’s prediction 70
 - free energy 88, 94, 95, 100, 115, 118, 119, 129, 367, 371, 376, 377, 389
 - freezing 88, 90, 92, 106, 107, 114, 288, 473, 485, 488, 511
- g**
- gas atomization 452
 - gas nozzle 72, 452
 - Ge alloy 515, 519–521
 - droplets samples, microstructures of 520
 - Ge and Si crystals 264
 - Gibbs–Duhem relation, application of 488
 - Gibbs framework, for thermodynamics 485
 - Gibbs free energy 21, 62, 76, 88, 94, 143, 154, 155, 188, 189, 218, 219, 221, 229, 230, 240
 - Gibbs–Thomson effect 239, 242, 354
 - Gibb–Thomson equation 492
 - glass fluxing technique 282
 - data processing 283, 284
 - experimental setup and procedures 284, 285
 - *in-situ* observations 283
 - HSC technique 283

- to undercool samples 282
- globular proteins 113
- grain-refined microstructures 4
- grain refiners 510
- gravitational force 2, 9, 11, 17, 23, 350, 404
- growth rate analysis 522
- growth velocities 215, 243, 247, 270
 - experimental methods for undercooled melts 241
 - as a function of kinetic undercoolings 270
 - measurements 216, 244
 - apparatus for 245
 - of dendrite growth velocities 246, 248
 - experimental setup for 246
 - on pure Ni 248
 - temperature profile, dendrite tip of pure metal 242
 - in undercooled Ni melts 252
 - by CPS and photodiode method, data comparison 249, 250

h

- heat flux 35, 143, 150, 218, 440
- heating power 72
- heat transfer 140, 146
 - across growing interface 218
 - effective heat transfer coefficient 469
 - hot spherical body in stagnant fluid 452
 - inside drop 143
 - numerical 536
 - solution of turbulent momentum and 326
 - by radiation 12
 - unsteady, under convection in molten drops 146
- heterogeneous nucleation 7, 19, 20, 21, 23, 51, 71, 72, 87–90, 114
 - on container walls 1
 - within crevice 230–235
 - ω crystallites precipitate on quasicrystals by 533, 536
 - of Cu sample, thermodynamic aspects 297
 - effect of mismatch between
 - crystal and substrate lattices 133
 - Euler–Lagrange equation, solutions of 131, 132
 - extended model of nonstationary 154–157
 - with faceted interfaces on a square-lattice substrate 130
 - foreign particle induced nucleation in 3D on 133, 134
 - Greer’s free-growth-limited nucleation 131
 - PFC modeling of 129–134

- EOF-PFC model of Fe 129
- reduction of 240
- of spherical cap on a flat surface 221–224
- heterogeneous nucleation sites (HNSs) 140
- heterophase fluctuations 113
- high magnetic fields, opportunities with 295
 - motivation 295, 296
- homogeneous nucleation 87, 114, 118
 - equation of motion, solution of 120–129
 - characterization of amorphous phases 128
 - EOF-PFC model of Fe 129
 - 1M-PFC model 121–125
 - 2M-PFC model 121, 126–129
 - Euler–Lagrange equation, solution of 118–120
 - for fcc and bcc clusters 119, 120
 - in nickel 389–392
 - in framework of CNT 389
 - free energy for formation of cluster of size 390, 391
 - Monte Carlo (MC) simulations 390
 - probability distribution of deformation parameter 392
 - of spherical cluster 219–221
- hypoperitectic alloys 511

i

- icosahedral clusters 70, 75
- icosahedral quasicrystalline (IQC)
 - grain 531, 532
 - phase 530
- icosahedral symmetry 69, 71
- image sensor 42
- impulse atomization (IA) technique 405, 406
 - Al–Ni alloys
 - characterization 418
 - decrease in primary Al_3Ni_2 fraction 421
 - impulse-atomized in helium with particle radius 420
 - microstructures, study using 418
 - model prediction, comments on results 421, 422
 - simulating solidification of 419, 420
 - copper powder, SEM image of 458
 - droplets
 - Al–Cu alloys 467
 - breakup mechanism 455
 - description of 454, 455
 - iron alloys 456
 - microstructure solidification 469
 - tube, mass flow rate 456
 - drop tube 480
 - helium

- CuAl₂, volume fraction of 460
 - IAP atomized 459
 - porosity, visualization 467
 - nitrogen
 - atmosphere 458
 - CuAl₂, volume fraction of 460
 - IAP atomized 459
 - porosity, visualization 467
 - phosphorous bronze powder 460
 - etched cross-section of 462
 - incubation time 218, 219, 235, 236
 - Indian Space Research Organization (ISRO), initiatives 538
 - inhomogeneous Ni systems 383, 384
 - integrated computational materials engineering (ICME) 47
 - interface energy 8, 23, 62, 90, 106, 157, 190, 205, 239, 526, 528, 537
 - internal flow velocity 145
 - International Space Station (ISS) 3, 26, 33, 510
 - iron-based alloys 469
 - isothermal annealing 526
 - isothermal diffusion-limited growth (DLG) model 262
- j**
- JH theory 486, 487
 - jump frequency 219
- l**
- lamellar structure 491
 - Landau–Lifshitz model 66
 - Landau theory 64
 - laser flux 35
 - laser processing 533
 - L1-droplet distributions in drops 65
 - Lennard-Jones potentials 69, 70, 113
 - Lennard-Jones (LJ) system 364
 - Lenz rule 9, 72
 - levitated melt, convection in 305
 - levitation
 - electromagnetic and electrostatic 509, 510
 - force 10, 55, 72, 428
 - determined by 11
 - on solid phase 436
 - levitation thermofluid dynamics
 - mathematical models for 322–326
 - DC field stabilization 330–332
 - droplet levitation, simulations of 327–330
 - impurity separation 335, 336
 - levitating large masses 332–334
 - thermofluid equations 326, 327
 - levitator setup 309
 - ligaments 455, 456
 - Lipton–Kurz–Trivedi (LKT) model 194, 201, 248, 274, 276, 277, 287, 300, 319
 - liquid–liquid demixing 52, 65
 - liquid metal undercooling studies 97
 - experimental techniques 97, 98
 - selected experimental results 98
 - maximum-undercooling data 98, 99
 - nucleation rate measurements 99–101
 - liquid Pb on Si (001) substrate 71
 - liquid–solid reaction 528
 - liquid–solid–substrate tri-junction 114
 - liquid-solid transformation 526, 536
 - long drop tubes 5–8
 - Lorentz force 15, 296, 297, 305, 308, 336, 341, 350, 404, 428
- m**
- magnetic flux density 307
 - magnetohydrodynamic (MHD) 35
 - magnetostrictive C15 Laves phase 161
 - Marangoni convection 34
 - Marangoni number 35
 - mass transfer
 - calculation, coupled to phase transformation 143
 - effect on nucleation and crystal growth 145, 146
 - Maxwell’s equations 17, 35
 - measured growth velocities of pure Ni 298–300
 - melt atomization 452, 453
 - complexity of 469
 - melting point 41, 71, 74, 76, 92, 217, 244, 285, 397, 452
 - melting temperature 7, 12, 21, 34, 70, 71, 91, 98, 150, 193, 240, 273, 383, 404, 499
 - metallic alloys 1, 139, 145, 191, 378, 381, 510, 537
 - metal oxides 2, 282
 - metastable phase 178–183, 187
 - binary peritectic Fe–Co soft-magnetic materials 216
 - formation from undercooled melts, alloy systems 190
 - amorphous phases 206, 207
 - bcc phase formation in Fe-based alloys 193–197
 - formation in eutectic systems with 203, 204
 - formation in peritectic systems 198–203
 - phase formation for refractory metals 192, 193

- quasicrystalline phases 204–206
 - supersaturated solid solution phases 190–192
 - magnetic property of 177
 - mechanism of transformation 178–183
 - nucleation of 188–190
 - thermodynamic aspects 188–190
 - metastable solidification 187, 188
 - of magnetic materials 161
 - microsegregation models 471, 472
 - microstructures 239, 241
 - Al-36wt%Ni particle 479
 - as dropped samples processed using 275
 - for eutectic alloys 484
 - Fe₆₇Dy₃₃ samples 171
 - of Fe₇₅Ge₂₅ samples solidified at 519
 - of Fe₆₇Nd_{16.5}Tb_{16.5} samples 172
 - of Fe₆₇Tb₃₃ samples 170
 - of glass-fluxed Ni–Sn eutectic alloy samples solidified at 295
 - Nd-Fe-B alloys 174, 176
 - quantification of 459–466
 - neutron diffraction 467, 468
 - secondary dendrite arm spacing 459, 460
 - x-ray microtomography 461–467
 - of steel alloy 217
 - Ti₄₆Al₄₆Nb₈ alloy quenched onto 192
 - model equations 351–355
 - modeling, for solidification 406, 407
 - assumptions for 407
 - diffusion lengths 409
 - growth kinetics 411, 412
 - heat balance 410
 - mass conservations 407, 408
 - nucleation 410
 - numerical solution 412, 413
 - one-dimensional model 406, 407
 - secondary dendrite arm spacing, for each zone 407
 - specific surfaces 408
 - thermodynamics data 410, 411
 - molecular dynamics (MD) simulations 113, 364, 368, 381, 383
 - implications for dendrite growth 376–379
 - LJ system 369–372
 - Ni–Cu system 371, 373–376
 - molten drops, analyze solidification of 140
 - coupling of models and experiment data 144, 145
 - equations 141–143
 - crystal growth 143, 144
 - fluid flow 141, 143
 - heat transfer 141–143
 - Navier–Stokes equation (NSE) 141, 142
 - nucleation kinetics 143, 144
 - time-dependent motion 141
 - models 140
 - Gibbs–Thomson contributions 144
 - LKT–BCT model 144
 - scaling expressions and units defined in 141
 - monatomic melts, structure of 73–77
 - charged colloidal suspensions 76, 77
 - Debye–Waller factor 74
 - dodecahedron and icosahedral symmetry 74
 - fcc/hcp-type aggregates 75
 - intercluster distances 74
 - liquid phase 76
 - simulations 75
 - structure factor S 73, 75
 - Monte Carlo (MC) simulations 104, 114, 369, 371, 381, 390
 - motion of inclusions, floating on surface of melt 311
 - sequential images 312
 - motion of levitated droplet 307
 - multiphase nucleation 140
 - mushy-zone region 486
- n**
- Navier–Stokes equations 34
 - Nd-Fe-B magnet alloys 161, 537
 - phase selection, and microstructural evolution 537
 - undercooling solidification 173, 174
 - mechanism of transformation, metastable phase 178–183
 - metastable phase, magnetic property of 177
 - microstructure evolution 174–177
 - phase selection 174–177
 - Nd₂Fe₁₇B_x metastable phase 161
 - needle-shaped crystal
 - diffusion-controlled axial growth 485
 - negentropic model 21, 23, 190, 193, 198
 - neutron diffraction 406, 475
 - neutron scattering 16, 72–74, 78–80, 205
 - nickel
 - density 416
 - homogeneous nucleation in 389
 - solid–liquid interfaces 383
 - three-dimensional modeling of a nickel dendrite 358
 - into undercooled melt 359
 - triggered solidification image 254
 - viscosity of 328
 - Ni–Cu binary alloy 364, 368

- Ni–Sn eutectic alloys
 - cooperative/uncoupled dendritic growth 293
 - crystal growth dynamics in 293
 - growth velocities 293
 - at high undercoolings, types of growth 293
 - HSC images, morphology of recalescence front 294
 - optical micrographs, illustrating microstructures 295
 - plot of measured dendritic growth velocities 294
 - recalescence behavior 293
 - solidification of 293
- Ni–V alloys 16
- nonconductive materials 72
- noncontact measurement, of creep 45–47
- nondestructive technique
 - 3D microtomography, advantage of 464
- nonlinear behavior 146
- nonmetallic droplets 454
- nonrotating drop, velocity 36
- nonstationary heterogeneous nucleation
 - extended model 154–157
 - factors governing 155
 - modeling, based on CNT 154
 - random Poisson variables 154
 - stable nucleus with a critical radius 156
- nucleation 4, 15, 509
 - barrier 87
 - and droplet growth 51
 - heterogeneous (*See* heterogeneous nucleation)
 - homogeneous (*See* homogeneous nucleation)
 - of liquid phases 52
 - oscillation and convection affecting 305
 - of phases in undercooled samples 140
 - rate 5, 87, 88, 90, 100, 139, 150, 153, 154, 218, 229
 - depends on 146
 - of γ -Fe and ϕ phases as a function of 152
 - of solid phase in parent liquid state 71
 - spontaneous 15, 16, 21, 144, 154, 157, 252–254, 433
 - thermodynamic barrier of 114
 - undercooling 19, 20, 306, 313, 314, 316, 422, 471, 474, 515, 517
- nucleation models, to take account of ordering 93
 - density-functional models 95–97
 - diffuse-interface model 94, 95
- nucleation theory 88
 - classical nucleation theory 88–90
 - homogeneous steady-state nucleation 88–90
 - heterogeneous nucleation 90–93
- numerical methods 47
- Nusselt number 419, 469
- o**
- orifice diameter, atomizing
 - log-normal standard deviation 457
 - mass mean (D_{50}) particle size 456
- oscillations 52, 305, 307, 309, 310, 334, 394
 - of composite drop 52
- oxidation
 - rate 156
 - of surface 155
- oxygen sensor 455
- p**
- particle-based computer simulations 381
- Pb-based peritectic alloys 526
- Péclet numbers 147, 378, 485, 525
- Percus–Yevick equation 71
- peritectic alloys 510, 516, 529
 - nucleation 509
 - solidification of 509
- peritectic phase
 - diagrams 509, 511, 512
 - growth 522
 - nucleation 516, 518
- peritectic reactions 512, 513
 - diffusion, schematic diagram 524
 - phase diagram 517
 - in ternary systems 529–536
- peritectic systems
 - β -phase nucleation, undercooling levels for 517
 - nucleation, different situations of 514
- peritectic temperature 53, 54, 60, 150, 167, 170, 200, 511, 517, 526, 529
- peritectic transformation 411, 415, 421, 511, 526, 528, 535
- phase-field approach (PFA) 381
- phase-field crystal (PFC) models 114, 115
 - equation of motion 117, 118
 - Euler–Lagrange equation 117
 - free energy functionals 115–117
- phase-field method (PFM) 139
- phase formation 5, 140, 188
 - metastable 187, 188, 190, 191, 195, 198, 199, 203, 537
 - thermodynamics of 140, 189, 208, 223, 235
- phase selection 215, 218
 - in Nd–Fe–B droplets 148
 - in undercooled metallic melts 139

- phase transformation 139
- photodiodes 242, 244
- photo-sensitive detector 17
- plate-like facet crystals 261
- Poisson distribution 22
- polytetrahedral aggregates 70, 75
- postsolidification cooling rates 188
- potency factor 156
 - influence on delay time in 224
- powder characteristics 455–458
- predictions of model 355
 - dendrite growth
 - in binary stagnant system 356
 - in pure (one-component) system 355
- pyrometers 242, 255

- q**
- quantitative evaluations
 - dendrite growth velocity, and tip radius 357–360
 - modified Ivantsov function 356, 357
- quantitative metallography 461
- quantitative metallurgical characterization 405, 406
- quartz tubes 243
- quasicontainerless undercooling techniques 72
- quasicrystal 71
 - forming Al–Pd–Mn- and Al–Mn–Cr-melts 71
- quasiperitectic reaction 513
- quasi-steady approximation (QSA) 145

- r**
- radiation heat transfer mechanisms 469
- Ranz–Marshall equations 470
- Rappaz–Thevoz microsegregation model 470
- Rayleigh instability 453, 455
- recalescence
 - double 213–216
 - spontaneous of $\text{Fe}_{99.3}\text{Co}_{0.2}\text{Si}_{0.5}$ alloy melt, images 253
- Reynolds number 35, 419
 - for ESL and microgravity EML 40
- Rietveld analysis 467
- rotating drop, velocity 36

- s**
- scanning electron microscopy (SEM) 53, 178, 264, 267, 405, 406, 413, 439, 459, 463, 467, 520
- Scheil–Gulliver model 467, 471, 474
- Scheil’s equation 528
- secondary dendrite arm spacing (SDAS)
 - measurement 477, 478
- Seebeck coefficient 446, 447
- selected-area diffraction (SAD) 523, 532, 535
 - analysis of 532
- short drop tubes 4, 5
- Si crystallization, containerless 270–274
- Si–Ge alloy semiconductors 425
 - Si–Ge alloy preparation 429, 430
 - solidified sample, evaluation 431, 432
 - crystalline orientation of solidified product 436–439
 - figure of merit 446, 447
 - microstructure and Si and Ge distributions 439–442
 - Seebeck coefficient 446
 - temperature and solidification behavior 432–436
 - thermoelectrical properties 442–446
- static and alternating magnetic fields, simultaneous imposition of 427–429
- surface contacted with Cu chill block 426
- thermoelectrical material solidified from undercooled melt
 - properties of 425–427
- simulations 43, 114. *See also* molecular dynamics (MD) simulations; Monte Carlo (MC) simulations
 - computational 44, 113, 382
 - finite element 46
- single dendritic crystal, sketches of 485
- single-fluid atomization technique 454
- sixth-order Legendre polynomial 43
- Skipov model 23
- Sn–Sb phase diagram
 - nucleation temperatures 518
- solar cell 261
- solidification
 - behavior 432–436
 - dendritic 485
 - direction 441–448
 - by enthalpy method 338, 339
 - eutectic 483, 485, 487, 488, 493
 - of externally cooled droplet 345, 346
 - of L1-phase and 53
 - of metallic liquids 97
 - modeling (*See* modeling, for solidification)
 - morphologies 483
 - under nonequilibrium conditions 147
 - path 217, 218
 - peritectic 536
 - process (*See* solidification process)
 - shrinkage 413
 - simulated 421

- speed of 393, 452, 479
- spontaneous 151
- time 472
- triggering 15
- solidification processing
 - Ag–Sn alloys 528
 - of atomized droplets 461
 - convection, effect of 510
 - effect of gravity 536
 - growth, for peritectic phase 522–524
 - peritectic phase 528, 529
 - peritectic reaction 524–526
 - peritectic transformation 526–528
 - isothermal annealing time 527
 - kinetics of 529
 - microgravity experiments 536
 - nucleation studies 509, 514
 - peritectic alloys 509, 512–522
 - peritectic equilibrium 510–512
 - peritectic phase diagrams, classification 527
 - ternary alloy systems
 - peritectic reactions 512–514
 - transformation 510–512
 - solid–liquid interfaces 368, 376, 381, 383, 483, 491
 - behavior
 - atomistic simulation of 486
 - continuum and atomistic simulation of 486
 - energy 21, 23, 239
 - in nickel, analyzed in framework of CWT 383–389
 - solid–liquid phase transformation 66
 - solid–solid peritectic transformation 528
 - solid-state diffusion 161
 - solute drag 367, 368, 375–377
 - solute trapping 377
 - models of 364–367
 - solubility theory 239
 - space recovery capsule (SRE) 539
 - spectroscopy 40, 46
 - sphere-like geometry, of droplets 1
 - spherical cluster
 - heterogeneous nucleation, on a flat surface 221–224
 - homogeneous nucleation 219–221
 - spherical cap geometry 222
 - spinodal decomposition 64
 - in $\text{Cu}_{50}\text{Co}_{50}$ melt 50
 - splat-quenching experiments 64
 - static levitation 307
 - static magnetic field 307, 308, 309, 310, 427
 - on flow velocity, effect of 312, 313
 - influence on trace 310
 - relative velocities as a function of 312
 - on undercooling behavior 297, 298
 - substrate–solid interfaces 114
 - supercooled liquid 113
 - surface angle, influence of crevice geometry on 233
 - surface contour of solidification 253
 - modeling 253
 - surface wetting, influencing shape of crevice cluster 234
 - synchrotron cycle, time-temperature profile of 521
 - synchrotron spectra 521
- t**
- temperature-dependent surface energy 139
- temperature distribution 146
 - inside a drop and positions of temperature 147
 - maximum temperature difference 148
- temperature–time profile 140
 - calculation of 148–151
 - during melting 240
 - during undercooling 240
- temperature–time–transformation (TTT) 4, 5, 8
- TEMPUS 3, 24–26, 55, 59, 60, 65, 250, 253
- ternary peritectic system, on cooling 513
- thermal conductivity 4, 141, 164, 218, 338, 425, 442, 443, 445, 447, 448
- thermal expansion, noncontact measurement of 42
- thermal models 471
- thermal radiation 26, 35
- thermodynamic equilibrium 240
- thermoelectric magnetohydrodynamics, in levitated droplets 336, 337
 - solidification by enthalpy method 338, 339
 - solidification of externally cooled droplet 345, 346
 - TEMHD in dendritic solidification 339–345
 - thermoelectricity 337, 338
- thermophysical properties 51
- three-dimensional data 41
- time-of-flight spectrometer 72
- tip selection behavior 485
- tomography. *See* x-ray tomography
- transient development, of heterogeneous sites 224, 225
 - crack formation 225–227

- dendrite collision 227, 228
- dendrite fragmentation 225
- heterogeneous nucleation within a crevice 230–235
- internal grain boundary formation 229, 230
- transient heat, effect of 145
- transients in internal flow 145, 146
- transient temperature distribution 146
- transmission electron microscopy 53, 64, 106, 107, 205, 406, 418, 475, 532
- of Fe-25 523
- transport phenomena, in multiphase systems 139
- TTT. *See* temperature-time-transformation (TTT)
- turbo-molecular pumps (TMPs) 163
- Turnbull's coefficients 119
- twin-related lateral growth 261, 264

u

ultrahigh vacuum (UHV) technique 4

v

video-based data acquisition 41
virtual sensor 41
visualization, of 3D structures 47

w

weight percent eutectic, comparison of 474, 475
wetting angle 223, 227, 234
Whitaker correlation 470
Whitaker equations 470
Wilson–Frenkel model 277, 278
worm-like structures 64, 66

x

x-ray absorption spectroscopy 72, 76, 463
x-ray diffraction (XRD) 406, 467, 520
x-ray microtomography 462, 463, 466
x-ray tomography 464

z

ZrB₂-based ceramic composites 46

