CAMBRIDGE

Cambridge University Press
0521423163 - Stability of Microstructure in Metallic Systems, Second Edition
J. W. Martin, R. D. Doherty and B. Cantor
Index
More information

Index

activation enthalpy 5–6
activation free energy, 5
Alnico decomposition, 389–90
aluminium
  grain boundary energy (T) 226
  grain growth, 325
  hypercooling limit (T), 91
  recovery of deformed (polygonisation), 176–7
  recovery of quench-hardened, 171
  recrystallisation, 186–7; 191–2
  surface energy (T), 226
aluminium alloys,
  Al–Ag alloys, 25–6, 80, 249–50; effect of fatigue, 394–5; particle coarsening, 288–9
  Al–Cu alloys 44–6, 60–3; effect of fatigue, 395–6; effect of strain, 393; eutectic spacing, 114–15; eutectic stability, 300 *et seq.*; extended solubility (T), 113; grain boundary mobility 199; interfacial free energy (T), 243; liquid phase effects, 364–5; precipitate coarsening, 75, 249, 256, 287–90, 296; precipitate dissolution, 78, 81; recrystallisation, 204–5, 218
  Al–Cu–Mg, growth of S-phase, 74–6
  Al–Fe, 117–21, 295–6, extended solubility (T), 113
  Al–Fe–Si, grain sizes (T), 352
  Al–Al_3Li, particle coarsening, 275, 279–80
  Al–Mg, extended solubility (T), 113
  Al–Mg_2Si, 25, 351
  Al–Mn, 117-18, 256, 348
  Al–Ni, 138–40; eutectic stability, 298 *et seq.*
  Al–Si recrystallisation, 210; extended solubility (T), 113
  Al–Sn, 37, 99
  Al–Ti, 99, 102
  Al–Zn alloys, 34–5, 54; interfacial free energy (T), 243
  Al–Zn–Mg, effect of fatigue on structure, 394
  Al–Zr, 98, 100
amorphous alloys, 121 *et seq.*; (T), 124; coordination (T), 130; crystallisation, 138 *et seq.*
Arrhenius equation, 6, 133, 200
Avrami exponents (for crystallisation of amorphous alloys) (T) 144

banded structures, 50
Bernal holes, 131–32
boundary migration by 'step' or 'ledge' migration, 24–7
brass, α/β, *see* copper alloys, Cu–Zn

Cd–Zn, interfacial free energy (T), 243
chemical free energy, 28 *et seq.*
coarsening of precipitates
  coarsening-resistant systems, 295–7
  fibrous eutectic systems, 298–300, 302–3
  lamellar eutectic systems, 300–1, 303–4
  non-spherical, 287–90
  spherical, or near-spherical 272–83
cobalt, electromigration, 386
cobalt alloys
  Co–Cu, particle coarsening, 281–2
  Co–Si eutectoid stability, 307–8
Coble creep effects, 224
coherent interfaces, 17–18
coherency loss by precipitates, 72–6
cold work, stored energy, 147 *et seq.*

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521423163 - Stability of Microstructure in Metallic Systems, Second Edition
J. W. Martin, R. D. Doherty and B. Cantor
Index
More information

computer simulation
  grain growth, 316–22
  particle coarsening, 283–6
condensation (rapid solidification), 91
copper
  deformation mechanisms, 154–5
  effects of fatigue, 397
  grain boundary energy (T), 226
  helium bubble migration, 378–80
  hypercooling limit (T), 91
  recovery of deformed structure 172
recovery of quench-hardened structure, 170–1
  recrystallisation, 192
  stored energy, 160
  surface energy (T), 226
copper alloys
  Cu–Ag, 85
  Cu–Be, particle stability, effect of strain, 393
  Cu-Co, 57; dislocation distributions, 155, 164–5; interfacial free energy (T), 242; particle coarsening, 74–5, 250, 275, 279, 281–2, 297; recovery, 177–9; recrystallisation, 207–8; 215
  Cu–MgO, 74
  Cu–Ni–Fe, 54–5, 396
  Cu-oxide systems, grain growth, 364; particle mobilities, 362–4; stored energy of deformation, 160
  Cu–SiO_2: dislocation distributions, 162–3, 167; particle coarsening, 286–7; particle dragging, 362; recovery, 177–80; recrystallisation, 204–6
  CuTi, precipitate dissolution by strain, 392
  Cu–Zn, α/β 72; eutectic stability, 305; interfacial free energy (T), 242; particle coarsening, 293, 346; recrystallisation, 212–13; -silica, dislocation distributions, 163–4; stored strain energy, 158
  Cu–Zn–Sn, interfacial free energy (T), 242
coring, 39 *et seq.*
creep deformation, effect on stability, 399–401
crystallisation of amorphous alloys, 138 *et seq.*; (T), 144

decagonal compounds, 117
deformation: bands, 155–6
dendrite arm coarsening, 366
dendritic structures, 40 *et seq.*
dental amalgams, 46
diffusion creep, 224
  and precipitate distribution, 399–401
diffusion-limited dissolution, 78–80
diffusion thermodynamics, 28–35
dislocation distributions in cold-worked metals, 153–5
dissolution of precipitates, 77–82
dodecagonal compounds, 118
driving forces for microstructural change, 6 *et seq.*

electromigration, 385–7
eutectics, 113–14
  degradation of, 298–307

faceting, 237–9
fatigue loading effects, stability, 391–7
ferrite, pro-eutectoid, growth, 69–70
fibrous microstructures, stability, 298–300
Fick's laws of diffusion, 132

gas atomising, 85–6
gas bubble migration in solids, 378–80
Gibbs–Duhem equation, 33
Gibbs–Thompson equation, 246 *et seq.*, 266–70, 395–7
Gibbs–Wulff theorem, 231 *et seq.*
glass forming alloys (T), 124
  critical cooling rates (T), 127
glass transition temperature, 99 *et seq.*
gold
  grain boundary and surface energies (T), 226
  recovery of quench-hardened, 169–70
  recrystallisation, 201
gold–silver alloys, stored energy of cold work, 152; 158–9
grain boundary energies of pure metals, 192; (T), 226
grain boundary mobility,
  electric field effects, 386–7
  pure metals, 192–5
  solute effects, 196–202
grain boundary phase growth, 69–71
  ripening, 260–2; (T), 261
grain growth, normal, 307 *et seq.*, 322–6
  abnormal, 309, 346–362;
  influence of dispersed phases, 326 *et seq.*; coupled grain- and particle-coarsening, 345–6; dragging of particles by grain boundaries, 362–5
gravitational field causing migration, 384–5
growth of precipitates in solids, 64–77
  diffusion-controlled, 65–9

Harper–Dorn creep, 225–6
helium bubble migration, 379
heterogeneous nucleation of precipitates in solids, 57–60
homogeneous nucleation of precipitates in solids, 55–7
homogenisation of segregation, 41–5
  effect of deformation, 46
Hume–Rothery phases, 115
hypercooling limit, 90; (T), 91

ice–salt system, temperature gradient zone melting, 368–70
icosahedral compounds, 117
incoherent interfaces, 18–19
interdendritic segregation, 39–41
interface
  control of particle coarsening, 259–60
  dislocation formation, 72–6
  reaction kinetics, 80–1
interfacial free energy, 227–30, 241–3
  values (T), 242–3

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521423163 - Stability of Microstructure in Metallic Systems, Second Edition
J. W. Martin, R. D. Doherty and B. Cantor
Index
More information

iron
αFe/γFe interfacial free energy (T), 242
γ–α transformation, 11; Widmanstätten plate growth, 71–2
grain boundary diffusion (T), 261; energy (T), 226
hypercooling limit (T), 91
recovery, 179–80, 183
surface energy (T), 226
iron alloys
Fe–Au particle coarsening, 274
Fe–B, 139–42
Fe–C: carbide allotriomorph growth, 69–70; carbide coarsening, 270–1, 273, 290–1; carbide dissolution, 82–3; eutectoid stability, 305–7; grain growth, 348; interfacial free energy (T), 242
Fe–Cr, 54
Fe–Cu, interfacial free energy (T); 242; precipitate coarsening, 248, 271, 281
Fe–Ni melt spun microstructures, 96
Fe–Ni–B 136–7
Fe–Si: grain growth, 350; particle coarsening, 273
Fe–Ti–Ni, particle coarsening, 291–3
irradiation and precipitate stability, 401–2

Johnson–Mehl–Avrami kinetics 143, 184–7

Kirkendall effect, 35–9

lamellar structures, stability, 300–4
discontinuous coarsening, 306–7; effect of stress and strain on stability, 304–6
lead, grain growth, 202–3
lead alloys
grain boundary mobilities, 195; grain growth, 323
'ledge' mechanism of growth, 17, 24–7, 249, 287–8
liquid inclusions
migration, 371 *et seq.*
lithium fluoride, recovery, 174–5

magnesium, hypercooling limit (T), 91
magnesium–zinc alloys, effect of diffusion creep, 400–1
magnetic field effects, 387–91
magnetocrystalline anisotropy, 391
mechanical disruption (manufacturing method), 91, 93–4
melt extraction, 85
melt spinning, 85–6
metallic glasses (amorphous alloys), 121 *et seq.*
metastability, 2–3, 94 *et seq.*, 106 *et seq.*
crystalline compounds, 114 *et seq.*, (T), 116
microcrystalline alloys, 106–8
migration of phases in solids, 368 *et seq.*
in a gravitational field, 384–5
in an electric field, 385–7
of gas bubbles, 378–80
of liquid phases, 371–8
of liquid plus vapour, 380–3
of solid phases, 368–70
misfit dislocation formation, 72–7

Nabarro–Herring creep effects, 224
nanocrystalline alloys, 106–8
nickel, stored energy of cold work, 152
hypercooling limit (T), 91
nickel alloys
Ni–Al, melt-spinning 86–7; segregation 112; interfacial free energy (T), 242
Ni–Al–Cr eutectic stability, 301
Ni-based superalloys, recrystallisation 211; stress annealing, 397–8
Ni–Cu, Kirkendall effect, 37–9
Ni–Ni_3Al particle coarsening, 272, 275–9, (T), 277–8, 282–3; grain growth, 328
Ni–Si interfacial free energy (T), 242
Ni–ThO_2: grain growth, 347; interfacial free energy (T), 242; stability, 294–5
Ni–Ti interfacial free energy (T), 242
non-uniform solute distribution, 28 *et seq.*
nucleation of
precipitates in solids, 51 *et seq.*
recrystallisation, 188 *et seq.*

octagonal compounds, 117
Ostwald ripening (*see* precipitate coarsening)

palladium–silicon glasses (T), 124
particle mobilities in copper, 362–4
Penrose tiling 119–21
planar flow casting, 85
platinum, grain boundary and surface energies (T), 226
point defects, 153
recovery, 168–72
polygonisation, 175–7, 179–80
potassium chloride, migration of inclusions in, 372–5
precipitate arrays, 82
precipitate coarsening, 239 *et seq.*
controlled by: lattice diffusion, 251–9; interface kinetics, 259–60
effect of precipitate volume fraction, 263–6
in ternary and higher order alloys, 270–1, 286–7
Ni_3X in nickel alloys, 293–4
of grain boundary precipitates, 260–2
of non-spherical precipitates, 287–90
of precipitates on low-angle boundaries, 260–3
oxide dispersions, 294–5
precipitate movement during, 286
resistant systems, 295–7
precipitate dissolution, 77 *et seq.*
precipitate growth, 64 *et seq.*
precipitate nucleation in solids, 51 *et seq.*
precipitation during recrystallisation, 214–18
pro-eutectoid ferrite growth, 69–70

quantitative microscopy, 27
quasicrystalline compounds, 114 *et seq.*, (T), 117

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
0521423163 - Stability of Microstructure in Metallic Systems, Second Edition
J. W. Martin, R. D. Doherty and B. Cantor
Index
More information

radioactive waste disposal, 382–3
rapid solidification, 85 *et seq.*
rate controlling steps in microstructural change, 12 *et seq.*
Rayleigh instability, 299–300, 302–3
reciprocal σ plot, 238–9
recovery, 166 *et seq.*
  enhancement by fatigue, 397
  kinetics, 166–8
  mechanisms, 168–83
recrystallisation, 183 *et seq.*
  coarse dispersions, 212–14
  growth of new grains, 192 *et seq.*
  kinetics, 183–7
  nucleation, 188–92; particle-stimulated nucleation, 204, 210–11
  precipitation during recrystallisation, 214–18
  retardation, 206–10
  solute effects , 196–202
  two-phase alloys, 202–18; deformable particles, 211–12; bimodal dispersions, 212
ripening of precipitates, 243 *et seq.*
  effects of volume fraction, 263–6
  on grain boundaries, 260–2
  on low-angle (dislocation) boundaries, 262–3

second phase dissolution, 77 *et seq.*
segregation, 108 *et seq.*
semi-coherent interfaces, 19–20
sigma plot, 231–9
Si–Ag, 108–9
silver
  electromigration, 386
  grain boundary diffusion (T), 261
  recovery of quench-hardened, 172–3
  recrystallisation of two-phase alloys, 206–7
  stored grain energy, 158–9
silver alloys, 164
  Ag–Ge, 85
  Ag–Ni, recrystallisation, 213–14; particle coarsening, 293
  Ag–Pb, interfacial free energy (T), 243
sintered alloys, homogenisation, 48–9
solubility extensions (Al and Ti alloys) (T), 113
Soret effect, 383–4
spinodal decomposition, 28, 33–4, 51–5
'splat' quenching, 85
spray forming, 85
steel
  austenitic, recrystallisation, 211
  carbides in cast, 43
  cast, 43
  hypoeutectoid, recrystallisation, 212
  particle coarsening, 290–1
  phase transformation in magnetic field, 390–1
  rolled, banding, 50–1
  vanadium carbide, 82–3
stored energy of cold work, 147 *et seq.*
strain-induced boundary migration, 189–92
stress, effect on eutectic stability, 304–6
stress annealing, 397–9
structural relaxation in amorphous alloys, 132 *et seq.*
subgrain growth, 188–9
subgrain reorientation, 180–3, 191
submerged phases, 95–9
surface energies of pure metals (T), 226
surface entropy, 230
surface free energy, 220–8
  anisotropy, 231–9
surface tension, *see* surface free energy

T_0 temperature, 94–5
temperature gradient effects, 368–84
  gas bubble migration, 378–80
  liquid inclusion migration, 371–6; shape stability, 377–8
  liquid–vapour inclusion migration, 380–3
  solid-phase migration, 383
  Soret effect, 383–4
thermal evaporation, 91–2
Ti alloys, extended solubility (T), 113
topological short range order (TSRO), 136
trace element effects on precipitation, 63–4
transition bands, 156
transition phase formation, 60–3
TTT diagram, 125–6, 143–5, 215–17
tungsten
  doped-wire recrystallisation, 206–7
  grain boundary and surface energies (T), 226
  -particle coarsening in liquid Ni–Fe, 257–9

Udimet 700, stress annealing, 397–8
undercooling, 87–90
uranium, swelling, 378–80
uranium–aluminium alloys, particle coarsening, 290
uranium dioxide fuel rods, porosity, 380

vanadium carbide in steel, 82–3, 273–4
Voronoi construction, 131–2

Widmanstätten plate dissolution, 78
Widmanstätten plate growth, 71–2
Wulff construction, 234–7
Wulff theorem, 234, 247

Zener pinning of boundaries, 209–10
'zero creep' method for surface tension, 221–4; 226
zinc
  hypercooling limit (T), 91
  polygonisation, 176
  recrystallisation, 192
zirconium, recovery in, 182–3

© Cambridge University Press www.cambridge.org