

## Index

- acoustic detection of cracks, 99, 103, 196, 341–2
- activated crack propagation, 107–8, 128–32, 138–9, 157–62, 165–72, 183
- activated failure, 266–8, 285, 294–5, 330–1
- activation area, 130–1, 160–1, 168, 171
- activation energy (*see under energy*)
- adhesion, contact (*see under contact adhesion*)
- adhesion zone (*see Barenblatt cohesion zone*)
- adsorption, 107–12, 128–31, 134–5, 169–75, 178, 180, 182
- aging  
   of flaws, 286–7, 307, 321, 325, 346, 350  
   of zirconia, 122–7
- alumina (*see under materials*)
- anisotropy, in crack systems, 28, 41, 50, 98, 255–6
- atomic aspects of fracture, 12, 15, 53–4, 143–93
- atomic bond (*see cohesive bond*)
- Auerbach's law, 249, 285–6
- Barenblatt cohesion zone, 59–66, 69–73, 80–2, 112, 117, 129, 143, 165, 176, 179, 180–4
- bathub curve, 335–6
- bi-material interfacial-crack specimen (*see under fracture test specimens*)
- blunt crack (*see under crack-tip*)
- blunt indenter (*see under indenter*)
- bond (*see cohesive bond*)
- bond-rupture concept of fracture, 12, 41, 51, 54, 105–7, 113, 117, 128–9, 137–8, 144–62, 165–8, 169–74, 317
- branching, crack, 93, 95–9, 206
- bridging, crack-interface, 80–2, 194, 202, 205, 209–10, 225, 227, 230–48, 274–6, 278, 282, 325–6, 332–3, 350–4, 356, 361
- brittleness, 14–15, 187, 188, 291–3
- capillary, crack-interface, 112, 132, 136, 141
- ceramics (*see also under materials*), 51, 55–6, 99, 125–6, 194–248, 261–2, 271–6, 292–3, 302–4, 307–8, 314–18, 321, 324–7, 332–3, 335–62
- chemistry, in fracture, 11, 106–42, 165–85, 320, 343–4
- cleavage, 49–50, 55, 93, 98–9, 183, 196–9, 207–8, 255–6  
   of mica, 10–12, 23, 50, 140–1, 163–4, 176–9, 182–3
- closure, crack (*see under crack*)
- coating, protective, 14, 103, 314, 348–9
- cohesion zone (*see Barenblatt cohesion zone*)
- cohesive bond, 6, 12, 15, 40, 53–4, 143–92
- cohesive energy- and force-separation function, 53–4, 59–66, 69, 110, 144–7, 149–57, 161–3, 166–9, 175–6, 178–81, 185
- cohesive strength (*see theoretical cohesive strength*)
- compaction, 261, 272, 288
- compliance, crack specimen, 20–3, 30, 70, 82, 89, 91, 361
- composites, ceramic-matrix, 55–6, 202, 210, 242–8, 299–300, 337, 353–5, 361
- computer simulation, crack-tip (*see under crack-tip*)
- cone crack (*see Hertzian cone crack*)
- contact  
   adhesion, 304–6  
   damage, 300–4, 309–12  
   elastic field, 249–50, 251–6, 283–7, 309–12  
   elastic-plastic field, 247–50, 259–61, 288–90, 309  
   residual field (*see under residual stress*)

- continuum descriptions of cracks, 16–85  
controlled flaws (*see under* flaws;  
  indentation fracture)  
covalent–ionic solids (*see also under*  
  materials), 50, 103–4, 163–5, 174,  
  185–92, 200, 211–12, 215, 249, 287,  
  307, 314–15, 355  
crack  
  arrest, 42, 79, 91–2, 99, 196, 259, 290,  
  323, 325, 358  
  closure, 19, 28–9, 39–40, 178–80, 253  
  healing (*see* healing, crack-interface;  
  hysteresis)  
  initiation (*see* initiation, crack)  
  irreversibility (*see* irreversibility, crack)  
  propagation (*see* propagation, crack)  
  reversibility (*see* reversibility, crack)  
crack-extension force, or ‘motive’, 41, 58,  
  76, 114, 154  
crack-interface bridging (*see* bridging,  
  crack-interface)  
crack-opening displacement, 27–8, 64, 80,  
  134–5, 143, 152, 235–6, 240, 353  
crack path, 17, 44–50, 95–7, 196–206, 252  
crack-resistance energy (*see also* *R*-curve),  
  52, 55–8, 72–85, 194–248  
crack stability (*see also* crack path), 17, 23,  
  37, 41–4, 78–9, 99, 187, 233, 240–1,  
  249–50, 257–8, 266, 277, 283–5, 290,  
  296, 307–9, 328–34, 350–2, 356–7  
  neutral, 37–8  
  quasi-, 107, 113–16, 132, 155–6  
  stable, 10–11, 37, 42–3, 78–9, 249, 251,  
  253–4, 265–70, 275, 284–5, 290, 341,  
  355–6, 358, 361  
  unstable, 9, 37, 42–3, 78–9, 86–99, 155,  
  253, 265–6, 277, 290, 299  
crack-tip  
  blunting, 136–8, 185, 187–8, 192, 296–7,  
  362  
  chemistry (*see* chemistry, in fracture)  
  cohesion, 52–4, 144–7, 185–6  
  computer simulation, 144, 162–5, 185  
  corrosion, 128, 133, 136–8, 141, 188  
  deflection (*see* deflection, crack-front)  
  deformation (*see* plasticity, *this entry*)  
  field, 4, 18–19, 23–8, 44–5, 48, 51, 59–64,  
  72–7, 89–90, 95–8, 117–18, 162–5,  
  181–2, 195, 210, 212–17, 228  
  kink, 45, 157–62, 165, 171, 188  
  plasticity, 56–8, 132–3, 136–8, 162,  
  185–93, 211–16, 229, 361  
  profile (*see* structure, *this entry*)  
  radius, 3–5, 12, 137–8, 147, 164–5,  
  181–2, 188  
  reaction, 128–31, 138–9, 165–9, 172–4,  
  183  
  sharpness, 137, 188–93, 195, 296–7  
  shielding (*see* shielding)  
  singularity, 26–8, 41, 51–4, 59–66, 129,  
  164  
  stress field (*see* field, *this entry*)  
  structure, 2–5, 14–15, 28, 52, 59–66, 128,  
  163–5, 173, 180–3, 305–6  
crack velocity (*see* velocity, crack)  
creep, 321, 361–2  
cyclic fatigue (*see under* fatigue)  
damage accumulation, 361–2  
dead-weight (constant-force) loading, 20–3,  
  89–92  
deflection, crack-front (*see also* branching,  
  crack), 44–50, 99, 194–208, 223, 227,  
  235–6, 244  
diamond-structure crystals (*see under*  
  materials)  
diffusion, crack-interface, 128–9, 131–6,  
  182–4, 321  
discreteness, in brittle-crack models, 54, 65,  
  72, 143–95, 209, 233, 288, 355–6  
dislocation, 23, 185, 187–92, 194, 211–16  
  cloud, 195, 211–16  
  emission, 211  
  friction, or Peierls stress, 141, 213  
  network, 189–92, 200  
  pile-up, 314–18, 328  
  source, 190, 211, 213–15, 315  
double-cantilever beam test specimen (*see*  
  *under* fracture test specimens)  
double-torsion test specimen (*see under*  
  fracture test specimens)  
ductile–brittle transition, 190, 215, 291, 315  
Dugdale model, 59, 188  
Dupré work of adhesion (*see* work of  
  adhesion)  
dynamic fracture, 86–105  
dynamical loading, 99–102  
elastic contact field (*see under* contact)  
elastic–plastic contact field (*see under*  
  contact)  
electron microscopy, of crack tips, 188–92,  
  212  
Elliot crack, 65–6, 143–4, 165, 176  
elliptical  
  cavity, 2–5, 7, 14–15, 320, 326  
  crack front, 32–3  
energy-balance concept (*see* Griffith  
  energy-balance concept)  
energy, of crack system, 5–11, 13, 17–23,  
  39–42, 45, 51–8, 86–8, 112–16, 150–62,  
  304–6  
  activation, 113, 116, 130–1, 158–60,  
  130–1, 139, 154, 157, 160, 165, 267

374 *Index*

- crack-resistance (*see* crack-resistance energy)
- dissipative, 76–7, 83, 118, 132–3, 157, 196, 206, 211, 213, 220, 236, 238, 243, 247–8
- kinetic, 86–92, 95, 105
- mechanical, 6, 8, 10–11, 18–23, 29, 37, 57, 67–8, 70, 154, 163
- surface, 6, 8, 10–11, 40, 50, 54–5, 58, 107–12, 132, 141, 145–7, 151, 154–7, 163, 170, 179, 184, 200, 203, 211
- entropy production rate, in crack growth, 113–15
- environment, influence on fracture, 1, 11, 106–42, 165–85, 276–82, 296, 320, 343–7, 352
- equilibrium crack systems (*see also* crack stability), 2–12, 16–19, 39–44, 51–66, 70–2, 73–9, 86, 106–16, 139, 143–85, 209
- erosion (*see* wear and erosion)
- fatigue, and time-dependent failure, 108, 276–82, 295, 343–6, 348
- cyclic 361
- lifetime, 280–2, 335, 343–6, 352, 361–2
- limit, 280–2, 344–5, 351–2, 355
- static, 280–2, 343–5
- fibres, 13–14, 55, 210, 242–7, 299–300, 307, 346–8
- field (*see under* contact; crack-tip)
- fixed-grips (constant-displacement) loading, 21–3, 89–92
- flaw characteristics, in relation to design
- detection, 307, 312–14, 336–47
- elimination, 321, 327, 336–7, 340, 344, 347–50
- tolerance, 79, 230, 273, 275–8, 303, 332–3, 337, 350–7, 360
- flaws, 2, 49, 95, 118, 253, 301, 307–34, 335–62, 358
- chemically-induced, 318, 320
- controlled, 249, 263–98, 309–12, 341–2
- critical, 16, 308, 338
- Griffith, 13–14, 16, 79, 102, 115, 307–9, 319, 335–6, 343
- microstructural (and processing), 206, 216–18, 233, 235, 240, 323–7, 348–50
- radiation-induced, 321–5
- stability of, 79, 283, 328–34, 350–4
- thermally-induced, 319–22
- fluid, at crack interface, 9, 107–11, 114–16, 128–9, 133–6, 144, 176–80
- force-separation function, for bond
- rupture, 12, 145, 149–51, 164, 166–8
- fracto-emission, 103–5, 157
- fracture mechanics, linear, 16–50
- fracture mechanics, nonlinear, 51–85
- fracture steps, 4–5, 49–50, 198–9, 206–8
- fracture surface energy (*see* crack-resistance energy)
- fracture test specimens
- bi-material interfacial-crack, 38–9
- double-cantilever beam, 36–7
- double-torsion, 38
- flexure, 35–6, 267
- indentation-strength (*see under* indentation-strength test)
- tensile, 30–3
- free molecular flow, of gas along crack interface, 128–9, 133–6
- friction, in fracture systems, 101, 129, 132–3, 213, 215, 231, 234–7, 241, 244–5, 255–6, 286, 289, 299–300, 309, 315, 352–3
- frontal zone, 57, 75, 80, 83–5, 194–5, 209–30, 239, 243, 248, 361
- glass, silica (*see under* materials)
- grains and grain boundaries (*see also under* size effects, in fracture; strength), 194–5, 196–202, 216–19, 225, 230, 232–41, 262, 275–6, 302–4, 315–16, 320, 323, 325–6, 332–4, 353, 358–61
- Griffith energy-balance concept, 1–19, 39–41, 51–2, 54, 56–8, 64, 70–2, 86–9, 106–13, 125, 130, 132, 139, 147, 153–7, 160, 195
- Griffith flaws (*see under* flaws)
- hackle (*see* mirror, mist and hackle)
- hardness, 137, 250–1, 257, 259–60, 271–3, 292–3, 303–4
- healing, crack-interface, 12, 19, 29, 40, 106, 111, 115–16, 139–42, 152–3, 170, 175, 180–4, 189–93, 306, 319, 321
- Hertzian cone crack, 249, 253–7, 64–5, 283–7, 301, 304–5, 309–13
- hydrolysis, of silicon-oxygen bonds, 172–4, 178
- hysteresis, in fracture processes, 83–4, 106, 116, 139–42, 144, 175, 178–80, 183–5, 221, 223, 237, 242, 342
- impact loading, 86, 99–102, 300–4, 309–12, 354, 361
- indentation fracture (*see also* Hertzian cone crack, radial crack, lateral crack), 233, 249–306, 309
- as controlled flaws, 263–82, 293–5
- postthreshold, and crack propagation, 253–82
- special applications, 296–300
- subthreshold, and crack initiation, 282–93
- threshold, 282–93

- indentation-strength test, 263–82, 293–5, 301–3, 331, 352–4, 356
- indenter  
blunt, 250–1, 253–7, 264–5, 282–7, 309  
sharp, 250–1, 257–63, 287–95, 341–2
- Inglis analysis, of elliptical cavity, 2–5, 7–8, 12, 14, 18–19, 320
- initiation, of crack, 14, 95, 98, 138, 216–17, 249–50, 265, 282–93, 307–34, 323, 328–32, 337, 358
- integral, path-independent (*see* J-integral)
- interatomic bond (*see* cohesive bond)
- interatomic potential and force function (*see* cohesive energy– and force–separation function)
- interface energy (*see* surface or interface energy)
- interfaces (*see* grains and grain boundaries; weak interfaces; *see also under* microstructure)
- intergranular fracture, 196, 199–202, 204, 211, 216, 233, 235, 262, 279
- interphase boundaries (*see under* microstructure)
- ionic bonding (*see* covalent–ionic bonding)
- irreversibility, crack, 12, 15, 51–8, 70, 72–86, 88, 91, 95, 112–17, 132–3, 137, 141, 157, 194, 196, 207, 216, 229, 236, 239, 242–3, 245, 247–8, 251, 257, 341–2, 361
- Irwin–Orowan small-scale zone model, 56–8, 72, 77, 86
- J-integral, 66–71, 74–6, 80–4, 248
- Joffe effect, 320
- kinetic energy, of crack system (*see under* energy, of crack system)
- kinetic fracture, 106–42, 157–62, 169–74, 184, 276–82, 296–7, 343–5
- kink, crack-front (*see under* crack-tip)
- Knoop indenter, 257, 259, 266–7, 269, 341–2
- lateral crack, 257–9, 261, 274, 296–7, 303
- lattice trapping, 144, 149–72
- lifetime (*see under* fatigue)
- limit, fatigue (*see under* fatigue)
- linear elastic fracture mechanics (*see* fracture mechanics)
- materials (*see also* ceramics; composites, ceramic-matrix; polycrystalline ceramics; two-phase ceramics)  
alumina, 55, 126–7, 199, 219, 221, 230, 232–4, 239–40, 242–3, 247–8, 262, 272–6, 278–82, 302, 323–6, 332–3, 338, 340, 344–5, 349, 351–4, 356–61  
body-centred cubic metals, 162, 185–6, 188  
cement, 243, 246–7, 349  
concrete, 55, 210–11, 230, 307, 355  
diamond-structure crystals, 50, 55, 162–5, 185–6, 255–6, 292, 310, 312  
face-centred cubic metals, 186, 188  
glass (*see* silica glass, *this entry*)  
glass-ceramics, 242–3, 271–2  
hexagonal-close-packed metals, 188  
ionic solids (potassium chloride, sodium chloride), 200, 318, 320  
lithium fluoride, 55, 198, 213, 321–2  
magnesium oxide, 55, 190, 192, 212, 292, 315–16  
mica, 10–12, 50, 55, 103–4, 119, 121, 123, 133, 136, 139, 140–1, 176–8, 181–4, 213, 304–6  
sapphire, 55, 120–1, 139, 142, 183, 190–1, 233, 262, 271–4, 292, 307, 319, 321  
silica glass, quartz, 1, 7–9, 12–14, 50, 55, 93, 95–8, 102–3, 108, 119–25, 128, 133, 137–42, 161, 171–4, 183, 204–5, 242–3, 249, 253–6, 258–60, 262–5, 268–73, 277–81, 285–8, 292, 294–305, 307–8, 311–12, 314, 319–23, 338, 340, 346–8  
silicon, 55, 162–5, 174, 189–90, 208, 272, 292, 307  
silicon carbide, 55, 190, 243, 255–6, 272, 292, 299–300  
silicon nitride, 55, 266–7, 268, 272, 292, 300, 302, 339–40, 341–2  
steel (and iron), 15, 55, 162, 185, 292  
tungsten carbide, 55, 247, 272, 292  
zirconia, 55, 195, 221–30, 242–3, 272, 292, 349, 361
- mechanical energy, of crack system (*see under* energy, of crack system)
- mechanical-energy-release rate, definition, 17, 20–3, 29–41
- metallic solids (*see also under* materials), 1, 23, 55–6, 58, 117, 119, 127–8, 185–8, 211, 215–16, 247–8, 291–3, 315, 318, 361
- metastable interfacial states, 144, 170, 175–85, 192
- mica (*see under* materials)
- microcrack (*see also* frontal zone), 13–14, 210–11, 216, 232–3, 246, 289, 304, 308, 315–32, 360–1  
cloud, activation, 216–18  
cloud, and toughness, 217–21  
microstructure, 194–248, 323–7  
dislocations (*see* dislocation)

376 *Index*

- grain boundaries (*see*  
grains and grain boundaries)  
interfaces (*see* weak interface)  
interphase boundaries, 23, 50, 203, 216,  
235–6, 243, 325  
pores (and voids), 194, 205, 318, 323–4,  
326–7, 349, 356  
second-phase particles (and inclusions,  
precipitates), 194, 202–6, 210, 221,  
242, 315, 321, 326–7, 332, 353–4  
slip bands, 315–16  
twins, 194, 227, 230, 315  
mirror, mist and hackle, on fracture  
surface, 95–8  
mist (*see* mirror, mist and hackle)  
modes of fracture, 23–4, 26–7, 29, 31–2, 39,  
44–50  
I, opening, 23–4, 25–8, 31–2, 39, 41, 43,  
46–50, 203, 213  
II, sliding, 23–4, 25, 27–8, 31–2, 38, 39,  
47–8, 196, 199, 201, 203, 300  
III, tearing, 23–4, 27–8, 31–2, 47–50,  
196, 199, 201, 203, 206  
moisture (*see* water)  
molecular theory of strength (*see*  
theoretical cohesive strength)  
motive (*see* crack-extension force)  
Mott dynamic crack, 86–92
- neutral crack (*see under* crack stability)  
notch, 2–5, 35–6, 39, 78–9, 97, 138, 211,  
223–4, 231, 235–6, 247, 356–7  
nucleation, crack, 16, 307, 309–12, 314–18,  
325–6, 328
- Obreimoff's experiment, 9–12, 37, 103  
opening mode of fracture (*see under* modes  
of fracture)  
Orowan generalisation of Griffith concept,  
108–12
- path, crack (*see* crack path)  
path-independent integral (*see* *J*-integral)  
Peierls barrier (*see under* dislocation)  
penny cracks, 31–3, 35–6, 217–18, 236–7,  
239–41, 254, 258–61, 321, 329–30, 341,  
350–2, 356  
Petch relation, 317, 332–4  
phase transformation, in zirconia  
cloud initiation, 225–8  
and toughness, 195, 210, 220–30, 328,  
349  
pile-up model of crack nucleation (*see*  
*under* dislocation)  
pinning and bowing, 205–6  
plane strain and plane stress, 8–9, 25, 29,  
46–8, 61, 186
- plasticity (*see under* crack-tip)  
polycrystalline ceramics (*see also under*  
materials), 50, 55–6, 121, 125–7, 194,  
196–202, 216, 230, 233–5, 262, 271–4,  
276, 292, 302, 304, 307, 321, 323, 325,  
332  
pop-in, 42, 79, 233, 240, 253, 257, 275, 284,  
285–6, 290–1, 295, 309, 312, 319, 327,  
330, 358  
pores (*see under* microstructure)  
postthreshold indentations (*see under*  
indentation fracture)  
proof test, 336, 339–41, 344–7, 355  
propagation, crack, 16–193
- quartz (*see under* materials)  
quasi-equilibrium crack (*see under* crack  
stability)
- radial–median crack, 249–50, 255, 257–63,  
265–73, 279, 287–93, 296–8, 301, 321,  
326–9, 331–2  
*R*-curve (*see also* *T*-curve), 55, 72–85,  
117–19, 195, 209, 216, 229, 230–3, 246,  
248–9, 337, 346, 350, 356–7  
reaction, crack-tip (*see under* crack-tip)  
reliability, 307, 335–62  
residual stress (or strain)  
mismatch, 73, 83, 190–4, 195, 202,  
204–5, 211, 213, 216–17, 219, 221, 223,  
232, 235–7, 240–1, 244–5, 248,  
298–300, 304, 308, 318, 320–3, 325–32,  
346–7, 353, 355–6, 359  
contact, 258–66, 268, 273, 278, 280,  
288–91, 296–7, 308, 312, 341  
reversibility, crack, 5–7, 11, 17–19, 29, 40,  
54, 67, 70, 106, 109–16, 139–42, 170,  
178–80  
Rice integral (*see* *J*-integral)  
Rice thermodynamical generalisation of  
Griffith concept, 107, 112–16, 132,  
139, 155, 175, 184
- sapphire (*see under* materials)  
second-phase particles (and inclusions,  
precipitates) (*see under* microstructure;  
*see also* two-phase ceramics)  
sharp crack (*see under* crack-tip; *see also*  
slit crack)  
sharp indenter (*see under* indenter)  
shielding (*see also* bridging, crack-  
interface; frontal zone), 52, 54–6,  
72–85, 117–19, 126–7, 132–3, 194–5,  
208–48, 350–4  
silica glass (*see under* materials)  
silicon (*see under* materials)  
silicon carbide (*see under* materials)

- silicon nitride (*see under materials*)  
size effects, in fracture, 13, 227, 293  
crack-initiation threshold, 219, 250, 282, 293, 328–32  
grain-, 237, 332–4  
indenter radius (and Auerbach's law), 286  
molecular, 143  
sliding mode of fracture (*see under modes of fracture*)  
slit crack, 17–28, 52, 59–66, 143, 148–50, 164, 173, 181  
slip band (*see under microstructure*)  
slow crack growth (*see velocity, crack*)  
source-sink, in crack field, 56, 72–3, 79, 118, 209, 212  
spontaneous fracture, 9, 217–18, 241, 265, 268, 273, 285, 290, 294, 327, 330–1, 332, 338, 357, 360  
stability, crack (*see crack stability*)  
stable crack (*see under crack stability*)  
static fatigue (*see under fatigue*)  
statistical distribution of flaws (*see under flaw characteristics; see also Weibull statistics*)  
steady-state  
crack velocity, 92, 95, 102, 106–7, 111, 113–15, 132, 134, 215  
*R*-curve or *T*-curve, 57, 81–2, 84, 209–10, 214–15, 219, 223, 226, 228–30, 239, 246, 248  
steel (*see under materials*)  
steps, on fracture surface (*see fracture steps*)  
straight cracks, 22, 31–6, 40, 42–3, 67, 78, 89, 154, 156, 238–40, 357  
strain-energy-release rate (*see also mechanical-energy-release rate*), 22, 29  
strength (*see also indentation-strength test; theoretical cohesive strength*), 1, 7–9, 15, 78–9, 226, 245, 249–50, 263–82, 293–5, 298–9, 314–18, 326, 328–34, 335–62  
and flaw size, 9, 13–14, 79, 248, 307–9, 336  
and grain (microstructure) size, 275–6, 315–17, 328–34  
degradation, 250, 265, 301–3  
inert, 106, 263–76, 295, 296–301, 337–42, 352  
fatigue, 108–9, 276–82, 343–7  
specimens, 35–6  
variability, 335–48  
stress concentrators (*see notches*)  
stress-intensity factor, definition, 17, 23–44  
subcritical crack growth (*see under velocity, crack*)  
subthreshold indentations (*see under indentation fracture*)  
superposability, 17, 41–4  
of *G*-fields, 29  
of *K*-fields, 27–8, 43–4, 237, 246  
surface or interface energy, 6–12, 39–41, 50, 55–6, 63, 106, 108–10, 119, 123, 132, 145–7, 150–1, 155–6, 163, 170, 180–4  
periodicity in, 154–6  
surface forces, 40, 53, 109, 112, 175–85, 304–6  
surface stresses, 298–300  
*T*-curve (*see also R*-curve), 55, 72–85, 117, 126–7, 195, 209, 223–4, 232–5, 237, 239–41, 246–8, 249, 263–4, 269–70, 274–6, 278–9, 282, 304, 332–3, 337, 350–6, 358–60  
tearing mode of fracture (*see under modes of fracture*)  
temperature, effect on fracture, 106, 113–14, 121–3, 125, 127–8, 131, 138–9, 141–2, 189–90, 215, 285–7, 291, 296, 319–22, 357–9, 361–2  
tensile test (*see under fracture test specimens*)  
terminal velocity, 86, 89, 92–8  
theoretical cohesive strength, 12, 144–7, 185–6, 287, 347  
thermally-activated crack propagation (*see activated crack propagation*)  
thermal expansion mismatch (*see under residual stress*)  
thermodynamic basis of fracture  
first law (Griffith), 2, 5–7, 16–20, 29, 39–41, 44, 51, 56–8, 66, 70–1, 106, 108–10  
second law (Rice), 107, 112–16, 157, 180, 183  
threshold (*see under indentation fracture; size effects, in fracture; velocity, crack*)  
time-dependent failure (*see fatigue*)  
toughness (*see also T*-curve), 52, 55–6, 61, 72–85, 194–248, 271–6  
transformation toughening (*see under phase transformation, in zirconia*)  
transgranular fracture, 195–9, 201, 211, 234  
transition, ductile–brittle (*see ductile–brittle transition*)  
twins (*see under microstructure*)  
two-phase ceramics (*see also under materials*), 202–6, 210, 221, 353–4, 361  
unstable crack (*see under crack stability*)  
van der Waals forces, 176–7

378 *Index*

- velocity, crack (*see also* terminal velocity;  
*see also under* steady-state)  
‘fast’ (dynamic), 86–102  
‘slow’, or ‘subcritical’ (kinetic), 106–8,  
112–42, 157–62, 171, 174–5, 184, 215,  
276–82, 295, 343, 352, 362  
threshold, 106–8, 115–17, 123–5, 130,  
137–42, 170, 175, 181, 184, 262, 278–9,  
282, 296, 362  
Vickers indenter, 190, 255, 257–9, 262–4,  
269–73, 275–82, 288–9, 291, 293–300,  
354  
virgin crack interface, 40, 110, 115–16, 121,  
140–2, 179–84  
viscosity, of crack-interface fluid, 128–9,  
132–3  
Wallner lines, on fracture surface, 99  
water, effect on crack propagation, 108,  
120–7, 134–6, 139, 140–2, 171–4,  
177–8, 181–3, 192, 262, 277–82, 295–7,  
306, 346–7, 320  
weak interface, 23, 49, 194–6, 200–1, 211,  
203, 231, 235, 242, 245  
wear, and erosion, 250, 302–4, 314, 358–60  
Weibull statistics, and Weibull modulus,  
335, 337–41, 343–9, 355  
work of adhesion (*see also* surface or  
interface energy), 40, 54, 107, 108–12,  
141, 170, 179–80, 200–1, 203–4, 304  
yield stress, 59, 188, 248, 315, 361  
Yoffe hypothesis, for dynamic crack, 95–8  
zirconia (*see under* materials)  
zone models of cracks (*see* Barenblatt  
cohesion zone; bridging, crack-  
interface; frontal zone; Irwin–Orowan  
small-scale zone model)