

Index

- a**
acoustic emission (AE) based approach 250
- b**
Budiansky–Hutchinson–Evans shear-lag model 5, 251
- c**
ceramic-matrix composites (CMC)
 thermomechanical fatigue (TMF)
 loading 309
chemical vapor deposition (CVD) 3, 4, 104, 118–121
chemical vapor infiltration (CVI) 3, 47, 48, 104, 118–120
crack densities 3, 4
creep mismatch ratio (CMR) 301
cross-ply ceramic-matrix composites
 C/SiC composite at 800°C in air atmosphere 156–158
 C/SiC composite at room temperature 155–156
 SiC/CAS composite at room temperature 152–155, 159
 SiC/MAS-L composite at 800°C and 1000°C in inert atmosphere 158
cross-ply C/SiC composites 118–119
C/SiC composites 3, 24, 33, 105, 117–119, 135, 147, 230–233, 235–245, 252, 309
C/Si₃N₄ and SiC/Si₃N₄ composites 3, 4
C/Si₃N₄ composite 4, 30, 41
cyclic fatigue behaviour, of CMC
 comparisons analysis 238–245
 cross-ply CMCs 152
 cross-ply C/SiC composites 118–119
 at elevated temperature 233–238
 fatigue damage evolution
 fatigue peak stress 125–127
 fatigue stress ratio 127–128
 fiber volume fraction 123–125
 matrix crack spacing, effect of 128–129
 woven structure 133–135
 fiber/matrix interface shear stress vs. applied cycle number curve 123
 hysteresis-based damage parameters 121–122
 at room temperature 229–233, 235
 stress–strain hysteresis loops 122
3D SiC/SiC composite at 1300°C 121
3D braided CMCs 226–229
2D SiC/SiC composite at 1000°C 119–120
2D SiC/SiC composite at 1200°C 120
2D SiC/SiC composite at 1300°C 120–121
unidirectional CMCs
 C/SiC composite at elevated temperature 147–152

cyclic fatigue behaviour, of CMC
(*contd.*)

- C/SiC composite at room temperature 143–147
- SiC/1723 composite at room temperature 140–142
- SiC/CAS composite at room temperature 135–137
- SiC/CAS-II composite at room temperature 137–140
- unidirectional C/SiC composite 117–118
- cyclic loading/unloading hysteresis behaviour, of CMCs
 - global load sharing criterion 2
 - interface debonding and fiber Poisson contraction 1
 - interface shear stress and interface frictional coefficient 2
 - matrix cracks 1
 - two-parameter Weibull model 2
 - unidirectional CMCs
 - C/SiC composite 3, 24–30
 - C/Si₃N₄ and SiC/Si₃N₄ composites 3–4
 - C/Si₃N₄ composite 30–33, 41
 - fiber failure 8–9, 22–24
 - fiber/matrix interface debonded energy 20–22
 - fiber/matrix interface shear stress 16–20
 - fiber volume fraction 13–15
 - hysteresis loops and hysteresis-based parameters 12–13
 - hysteresis theories 9–10
 - interface completely debonding 11–12
 - interface debonding 7–8
 - interface partially debonding 10–11
 - matrix cracking 6–7
 - matrix cracking density 15–16
 - SiC/CAS composite 4, 38–43
 - SiC/Si₃N₄ composite 33–38
 - stress analysis 4–6

d

- digital image correlation (DIC) technique 250
- dwell fatigue behaviour, of CMC
 - acoustic emission (AE) based approach 250
 - cross-ply SiC/MAS composite
 - 1093°C in air atmosphere 288–296
 - 566°C in air atmosphere 280–288
 - comparison analysis 296–301
 - damage evolution model 253–256
 - digital image correlation approaches 250
 - fiber volume fraction 272–276
 - fiber/matrix interface oxidation region 257
 - fiber/matrix interface shear stress degradation rate 252
 - hold time, effect of 258–263
 - lifetime prediction model 256–258
 - matrix crack spacing, effect of 268–272
 - matrix cracking and interface debonding 256
 - oxidation effects 252
 - oxidation temperature, effect of 276
 - periodic loading and unloading cycles 249
 - SiC/SiC minicomposite 250
 - stress level, effect of 263–267
 - 3-parameter curve fitting approach 250
 - 3D KD-1TM-SiC/SiC composite 250
 - time-dependent strain 249
 - 2D NextelTM 720/Alumina composite 303–304
 - 2D SiC/SiC and C/[Si-B-C] composites 252
 - 2D SiC/SiC composite 301–303

e

- energy balance approach 6, 58, 59, 309

experimental fatigue hysteresis 30, 33,
35, 135–137, 141–143, 146–149,
151–153, 161–165, 176, 184,
186–191, 196, 200, 210, 220,
240–242, 246, 372, 445

f

fatigue damage evolution, of CMC
cross-ply CMCs 152–158
fatigue peak stress 125–127
fatigue stress ratio 127–128
fiber volume fraction 123–125
matrix crack mode 129–133
matrix crack spacing 128–129
3D braided CMC 226–229
unidirectional CMCs 135–152
woven structure on 133–135
fatigue hysteresis loops models 134,
135, 143, 146, 149, 151, 437, 449,
451, 453, 455
fatigue peak stress, in-phase
thermomechanical fatigue
354–357
fiber/matrix interface shear stress
16–20
fiber volume fraction 348–354

g

Global Load Sharing (GLS)
assumption 256
criterion 8, 295

h

hysteresis theories 9–13

i

in-phase thermomechanical fatigue
damage
fatigue hysteresis dissipated energy vs.
cycle number curves 371
fatigue hysteresis modulus vs. cycle
number curves 371
fatigue peak stress 354–357
fiber/matrix interface debonded
length vs. cycle number curves of
cross-ply SiC/MAS composite
371

fiber volume fraction 348–354
interface properties 361–365
vs. isothermal fatigue loading
372–373
matrix stochastic cracking 357–361
thermal cyclic temperature range
365–368

in-phase thermomechanical fatigue
loading 323, 325
in situ X-ray microtomography method
309
interface debonding, theoretical analysis
7–8
interface debonded energy 20, 328
interface degradation models
hysteresis loops and hysteresis based
damage parameters 441
interface slip cases 438
interface properties 361
isothermal fatigue hysteresis loops 336
isothermal fatigue loading 368, 372

l

liquid polyvinylcarbosilane (LPVS) 121
local load sharing criterions (LLS) 8

m

matrix crack spacing,
thermomechanical fatigue
hysteresis loop 321–324
matrix cracking 1, 3, 6
density 15–16
modes 129–133
matrix stochastic cracking 1, 357–361
Melt Infiltrated (MI) 2D Hi-Nicalon™–
SiC/SiC composite 249

n

nondestructive testing (NDT) methods
309

o

1D fatigue hysteresis loops models
134, 135
out-of-phase thermomechanical fatigue
hysteresis loops 344–345

- out-of-phase thermomechanical fatigue loading 323, 397–398
 - out-phase thermomechanical fatigue damage
 - fatigue peak stress 379–383
 - interface frictional coefficient 386–390
 - vs. in-phase thermomechanical fatigue damage and isothermal fatigue loading 393–397
 - isothermal fatigue loading at 566°C 399–401
 - matrix crack spacing 383–386
 - temperature range of 566°C and 1093°C 397–398
 - thermal cyclic temperature range 390–393
 - oxidation effects 252
- p**
- polymer infiltration pyrolysis (PIP) method 119, 121
- q**
- quasi-static tests 4
- s**
- servo-hydraulic testing system 121
 - SiC/CAS composite 4
 - fatigue hysteresis loops 38, 54, 55, 57
 - fiber/matrix interface debonding length vs. applied stress 38, 53
 - interface slip lengths vs. applied stress of unidirectional composites 54–57
 - matrix cracking density 38
 - matrix cracking density vs. applied stress curves 53
 - SiC/MAS-L composites 158
 - SiC/SiC composites 158–164
 - SiC/Si₃N₄ composite
 - experimental fatigue hysteresis dissipated energy vs. peak stress curve 35
 - fatigue hysteresis dissipated energy 33
 - vs. applied stress curve 42, 47
 - fatigue hysteresis loops 44, 45, 49, 50
 - fatigue peak stress 35
 - interface slip lengths
 - vs. applied stress curves of type A 45, 50
 - vs. applied stress curves of type B 49, 51
 - matrix cracking density
 - vs. applied stress curve 47
 - vs. applied stress curve of type A 42
 - weak interface bonding at room temperature 35
 - stress-rupture time, PyC interface 301
 - stress-strain hysteresis loops 1, 25, 62, 89, 93, 105, 122, 309, 313, 442
- t**
- theoretical fatigue hysteresis, dissipated energy 152, 156
 - thermal cyclic temperature range 332–336, 365–368
 - thermomechanical damage parameters 312–313
 - thermomechanical fatigue (TMF) loading
 - cyclic thermal and applied stress 309
 - electrical resistivity measurement 309
 - fatigue hysteresis loops
 - fatigue peak stress 317–321
 - fiber/matrix interface frictional coefficient 325–328
 - fiber volume fraction 313–317
 - in-phase thermomechanical fatigue hysteresis loops 341–344
 - interface debonded energy 328–332
 - isothermal fatigue hysteresis loops 336–341
 - matrix crack spacing 321–324
 - out-of-phase thermomechanical fatigue hysteresis loops 344–345

- thermal cyclic temperature range 332–336
- hysteresis parameters 309
- in-phase thermomechanical fatigue damage
 - fatigue hysteresis dissipated energy vs. cycle number curves 371
 - fatigue hysteresis modulus vs. cycle number curves 371
 - fatigue peak stress 354–357
 - fiber/matrix interface debonded length vs. cycle number curves of cross-ply SiC/MAS composite 371
 - fiber volume fraction 348–354
 - interface properties 361–365
 - isothermal fatigue loading 368, 372–373
 - matrix stochastic cracking 357–361
 - thermal cyclic temperature range 365–368
- in situ* X-ray microtomography method 309
- out-of-phase thermomechanical fatigue damage
 - fatigue peak stress 379–383
 - fiber volume fraction 374
 - interface frictional coefficient 386–390
 - vs. in-phase thermomechanical fatigue damage, isothermal fatigue loading 393–397
 - isothermal fatigue loading at 566°C 399–401
 - matrix crack spacing 383–386 temperature range of 566°C and 1093°C 397–398
 - thermal cyclic temperature range 390–393
- phase angles 404
 - fatigue hysteresis dissipated energy vs. cycle number curve 406
 - fatigue hysteresis loops 406, 409, 412, 415
 - fatigue peak strain vs. cycle number curve 406
 - fatigue peak stress 416–426
 - fiber volume fraction 408–416
 - in-phase thermomechanical fatigue 433–434
 - interface debonded length vs. cycle number curve 406
 - interface slip length vs. cycle number curve for 2D SiC/SiC composite 406
 - matrix crack spacing 426–432
 - out-of-phase thermomechanical fatigue 433–434
 - stress/strain hysteresis loops 309
 - stress-strain hysteresis models 309
 - thermomechanical damage parameters 312–313
 - thermomechanical stress analysis 310–312
 - thermomechanical fatigue hysteresis loops 341–344
 - thermomechanical stress analysis 310–312
 - 3D braided ceramic-matrix composites 226
 - 3D KD-ITM-SiC/SiC composite 250
 - 3-parameter curve fitting approach 250
 - 2D Hi-NicalonTM-SiC/SiC composite 250
 - 2D NicalonTM-SiC/SiC composite 249
 - 2D SiC/SiC composite 119–120
 - 2D SylramicTM-SiC/[SiC+Si₃N₄] composite 250
 - SiC/SiC composite at 1000°C in air and steam atmospheres 164–192
 - SiC/SiC composite at 1200°C in air and steam atmospheres 191–209
 - SiC/SiC composite at 1300°C in air atmospheres 209–226
 - SiC/SiC composite at 600°C, 800°C and 1000°C in inert atmosphere 158–164, 169
 - two-parameter Weibull model 8

U

unidirectional C/SiC composites
room temperature
 experimental and analytical model
 fatigue hysteresis dissipated
 energy vs. fiber/matrix interface
 frictional coefficient 446, 448,
 450
 experimental and analytical model
 fatigue hysteresis loops 449
 experimental and analytical model
 predicted fatigue hysteresis loops
 451
 experimental and predicted fatigue
 hysteresis loops 447

fatigue hysteresis dissipated energy
445, 447, 449

fiber/matrix interface frictional
coefficient 446, 448, 450

unidirectional CMCs

C/SiC composite at elevated
temperature 156

C/SiC composite at room
temperature 143–147, 150

V

Vagaggini's hysteresis loops models
122