

A

absorbing media, 8, 22
 absorptance, 55, 80, 83, 85, 86, 89–97, 101, 102, 106, 108, 124, 128, 129, 131, 134, 135, 154, 155, 169, 184, 186, 218, 219, 290, 356, 360, 403, 404, 406
 absorption, 3, 4, 6–8, 10, 17, 18, 25–28, 47–50, 52, 53, 57, 58, 60–63, 71–74, 76–87, 89, 90, 92, 93, 95, 98–109, 111–117, 119–127, 129–139, 143, 148, 151, 153–155, 158–160, 165, 180–188, 191, 195, 198–202, 204, 210, 213, 214, 216, 219, 221, 226, 228–235, 238, 241, 242, 244–246, 248, 250, 254, 257, 258, 267–270, 272, 275, 276, 279–281, 285–287, 289, 290, 294, 296, 297, 300, 303–305, 307, 310, 312, 331, 333, 334, 339, 350–352, 354–357, 359, 360, 363, 365, 367–374, 376, 378, 379, 384, 386, 387, 389, 390, 392–394, 397, 398, 399, 401–406, 413, 421–424, 437, 439, 441, 443
 absorption coefficient, 10, 18, 26–28, 47, 53, 57, 60, 61, 63, 78–84, 87, 89, 90, 92, 95, 98–105, 109, 121, 122, 126, 127, 129–132, 134–138, 151, 153, 154, 158, 159, 165, 180, 181, 182, 184–188, 191, 199, 202, 204, 214, 226, 229, 231–234, 241, 242, 257, 258, 267–270, 275, 279, 281, 286, 287, 289, 290, 294, 296, 300, 303, 305, 307, 310, 312, 331, 334, 339, 351, 354, 356, 357, 363, 369–371, 376, 386, 392, 399, 402, 403
 effective, 103, 105, 131, 187
 integrated, 78, 79
 line-integrated, 79
 mean effective, 131, 191
 mean soot, 131
 Patch mean, 105
 Planck mean, 61, 104, 105, 209, 212–214, 228, 233, 238, 244, 245, 254, 259, 275–277, 297, 298
 Rosseland mean, 63, 104, 130, 259, 369, 371, 372
 soot, 126, 127, 129, 131, 132, 188, 275, 356, 357, 363, 409
 absorption cross section, 112

absorption efficiency factor, 117, 120, 354, 356, 373
 absorptivity
 spectral directional, 21, 28, 30
 spectral hemispherical, 21, 30
 total hemispherical, 30
 acetylene, 120, 125, 264, 265, 275, 276, 280, 282, 315, 317
 ADF model, 100, 101, 185
 ADFFG model, 101, 184
 adiabatic flame temperature, 231, 277, 430, 437, 440, 441
 adiabatic temperature, 206, 288, 416
 advection, 66, 199, 203, 210, 236, 276, 288, 289, 331, 344, 390, 397, 399, 420
 angle of incidence, 13
 anomalous diffraction limit, 372
 applications to furnaces, 217
 Arrhenius equation, 198, 211, 237
 Arrhenius law, 203, 213, 398, 408
 ash, 119, 122, 352, 368, 369, 372, 373, 375–379, 381–383
 asymmetry factor, 119, 172, 371, 444
 attenuation of external radiation, 198
 azimuthal angle, 53, 129, 142, 152, 176, 295

B

back-scattering fraction, 134
 band center, 234
 band radiation
 infrared, 71
 band width, 89, 93, 155
 binary diffusion coefficient, 406
 black smoke, 385
 black surface, 27, 29, 31
 blackbody
 emitted flux, 36, 38–40, 150, 179
 fractional function, 39, 99
 function, 34, 38, 39, 312, 357
 Planck's function, 36, 204
 radiation physics, 16
 spectral intensity, 35, 41, 54, 63
 blackbody emitted flux
 spectral, 38, 41
 blackbody fractional

- function, 36, 38, 39
- blackbody radiation
 - laws, 33
- bluff-body burner, 311, 312
- Bohr's frequency condition, 72
- Boltzmann constant, 34, 64
- Boltzmann formula, 77
- Boltzmann number, 288
- boundary layer approximations, 201, 240
- broadened line
 - collision, 79
 - Doppler, 79
- broadening
 - collision, 79
 - Doppler, 79
 - Voigt, 79
- buoyancy, 68, 69, 198, 200, 201, 203, 206–208, 235, 237, 242, 261, 387, 413, 414, 432

C

- carbon dioxide, 71, 91, 97, 102, 106, 108, 132, 138, 213, 265
- carbon monoxide, 71, 91, 106, 256, 264, 281, 282, 367
- cellular materials, 421
- chemical reaction
 - one-step, 201
- chemically reacting flow
 - turbulent, 343
- chemically reacting flows
 - RTE, 256
- CK model, 87, 88, 151, 184, 185, 189, 191, 275, 351, 352
 - extensions, 185
- CKFG model, 88
- Clausius-Clapeyron equation, 219, 359, 390
- combustible solid
 - burning, 207
- combustion
 - thermally stabilized, 424, 427
- combustion chamber, 2, 94, 119, 120, 138, 140, 151, 169, 173, 178, 179, 187, 190, 191, 285, 286, 288–291, 293, 294, 296–300, 309, 312, 313–315, 317, 320, 322, 325, 330, 331, 338, 343–345, 353, 360, 362, 364, 378, 380, 432
 - axisymmetric, 300, 306, 310
 - radiative transfer, 285
- combustion in furnaces, 367
- combustion region, 418, 419, 434, 435
- combustion-stabilization principle, 429
- compartment fires, 395, 398–400, 406, 410, 412, 413
- concentration
 - radiating species, 140, 145, 147, 148, 159, 164, 169, 186, 191, 257, 285, 304, 305, 319, 338
- conservation equations, 63–67, 201, 204, 207, 210, 211, 213, 233–235, 239, 242, 290, 291, 298, 308, 310, 317, 320, 331, 332, 335, 336, 360, 361, 373, 375, 388, 389, 397, 408, 419,

- 420, 425, 438
- conserved scalar, 272, 294
- continuous flame, 391
- cross section
 - absorption, 112
 - extinction, 112
 - scattering, 112, 113, 121
- cumulative k-distribution, 88

D

- delta-Eddington approximation, 119, 137, 172, 179, 188
- differential approximation, 134, 168, 169, 171, 172, 188, 305, 337, 374, 376, 377, 381
- diffraction
 - anomalous, 114, 137, 354, 368, 370, 371, 372
- diffuse emitter, 144, 364, 426
- diffuse reflector, 55, 295
- diffuse walls, 148, 151, 159, 161
- diffusion coefficient
 - multicomponent, 225
 - thermal, 225
- diffusion flame
 - hydrogen-air, 263, 282
 - stagnation point, 238
- diffusion flames, 197, 212, 221, 224, 227–229, 234, 247–249, 253, 255, 256, 259, 264, 274, 280, 281, 283, 298, 309, 310, 314, 316, 347, 401, 406, 411, 413
 - free-convection, 212
 - laminar, 223, 232, 234, 238, 239, 253, 272, 280, 388
 - turbulent, 252, 254, 256, 263, 274, 276, 279, 281–283, 298, 308–311, 314, 338, 383, 391
- dimensionless temperature, 322
- direct numerical simulation, 66, 252
- direction cosine, 17, 22, 56, 59, 62, 146, 174, 185, 297
- directional averaging approximation, 168
- direction-dependent dispersion coefficients, 442
- discrete ordinates method, 169, 173, 176, 188, 193, 195, 209, 213, 230, 234, 300, 306, 315, 399, 423, 439
- discrete transfer method, 108, 169, 177, 194, 296, 337
- distribution function
 - photon, 15, 49
- droplet combustion, 155, 212, 217, 241, 244–247, 250, 349, 350
- droplet ignition, 217
- droplet mass balance, 359, 405
- droplet size distribution, 352, 353
- droplet vaporization, 250, 363, 378, 379, 404
- Dufour effect, 373

E

- Eddington approximation, 119, 137, 172, 179, 188, 192
- eddy-dissipation concept, 291
- effective broadening ratio, 90

efficiency factor
 absorption, 117, 120, 353, 355, 372
 extinction, 114, 116, 120, 352, 354, 368, 401
 scattering, 115, 120, 121, 355, 401, 404
 efficiency factors
 Mie, 112, 113, 121, 123, 352, 353, 355, 372
 Einstein's probability coefficients, 76
 electric field, 7–9, 11, 79, 115, 123
 electromagnetic spectrum, 5, 6, 53, 74, 106
 electromagnetic wave theory, 3, 7, 8, 34, 45, 46, 359
 elliptic flow, 310
 emission, 1, 3, 4, 6, 25, 27–29, 33, 34, 36, 38, 47, 48, 50–56, 58, 59–62, 71–73, 76–79, 81, 82, 85, 92, 99, 101–103, 105–107, 127, 129–132, 136, 139, 143, 146, 148, 149, 161, 162, 166, 175, 177–179, 186, 191, 195, 197–199, 202, 204, 210, 212, 213, 221, 226, 230–232, 238, 239, 241, 245, 248, 253, 257–259, 263, 271, 275–280, 283, 285–287, 294, 296, 304, 306, 310–312, 314, 315, 333, 338, 344, 346, 359, 365, 367, 373–375, 378, 384, 389, 390, 392, 393, 397, 398, 404, 433, 437, 441, 444
 spontaneous, 73, 76–79
 stimulated, 79
 emissivity
 spectral directional, 29, 141, 142
 spectral hemispherical, 29, 30
 total hemispherical, 30
 emittance
 carbon dioxide, 102
 isothermal gas, 57
 spectral hemispherical, 55, 56
 water vapor, 132
 emitted flux
 spectral, 29, 163
 total, 29
 enclosure, 25–28, 31–34, 57, 139–144, 149, 150, 151, 155, 157, 159, 161–166, 172–175, 178, 179, 181, 182, 188, 192, 195, 196, 203, 205, 220, 287, 289, 291, 296, 300, 318, 319, 326, 344, 357, 384, 396, 397, 398
 enclosure fires
 radiative transfer, 396
 energy
 internal, 203
 kinetic, 67, 261, 293, 300, 336, 359, 362
 potential, 395
 rotational, 72, 74, 75, 82
 rotational level, 82
 translational, 72
 vibrational, 72, 74, 75
 energy balance methods, 168, 169
 energy equation
 solid-phase, 208
 energy level
 rotational, 82
 vibrational, 74
 energy levels, 33, 73, 75, 79, 82, 106
 enhancement of flame radiation, 338
 enthalpy, 65, 133, 213, 215, 273, 274, 294, 298, 303, 311, 322–324, 329, 330, 336, 348, 359, 362, 374, 386, 390, 395, 398, 417, 430, 431, 438, 443, 445
 equivalent line width, 84, 85
 Eulerian coordinates, 48
 even parity formulation, 173, 176
 exponential integral function, 55, 129, 153, 154, 155, 159
 external radiation
 absorption, 199, 200, 216, 405
 extinction coefficient, 18, 19, 21, 22, 112, 114, 117, 121, 122, 124, 133, 134, 136, 153, 161, 164, 172, 352, 355, 372, 402, 421–424, 432, 433, 436, 443, 445
 extinction efficiency factor, 114, 116, 120, 353, 355, 369, 402
 extinction enhancement factor, 422
 extinction limit
 radiation induced, 213

F

Favre averaging, 69
 finite volume method, 169, 176, 194, 313, 381
 finite-rate chemistry, 207, 233, 388
 fire
 suppression, 398, 400–402, 404, 406
 fire field models, 384
 fire spread
 fuel beds, 407
 fire suppression
 compartment, 406
 fires
 building, 410
 enclosure, 395
 unwanted, 251, 383, 399, 410
 wildland, 383, 400, 406, 408, 409, 410
 First Law of Thermodynamics, 26, 32
 first-order Arrhenius reaction, 205
 flame front, 197, 244, 424
 flame jets
 impinging, 341
 flame quenching, 1, 197, 343, 426, 442
 flame spread
 characteristic length, 388
 downward, 206, 208, 220
 opposed-flow, 206, 210, 220
 upward, 206, 207, 209, 220, 238, 387, 411
 velocity, 206
 flame stabilization, 207, 209, 220, 340, 411, 434, 440
 flammability, 197, 225, 231, 247, 248, 373, 388, 416, 417, 427, 430, 442, 445
 flashback, 416, 419, 440
 fluctuating component, 257
 four-flux approximation, 289, 331, 334, 337, 343
 fractional blackbody functions
 third kind, 39
 frequency, 4–7, 14, 15, 17, 20, 26, 33, 40, 41, 45, 47–49, 58, 72, 75, 79, 106, 122, 142, 395, 408

circular, 8
Fresnel equations, 118, 124
fuel dilution, 277
furnace, 109, 168, 169, 180–183, 187, 188, 191,
192, 194, 195, 286, 290, 297, 302, 304, 313–
315, 318–342, 344–347, 363, 365, 366, 368,
370, 372, 375, 377, 378, 381–383, 397
furnaces
heat transfer, 193, 194, 196, 344

G

gamma distribution function, 121
gas turbine combustor, 139, 175, 178, 191, 313,
315, 351
gas-phase
ignition, 202, 203, 220
reaction, 200, 201, 203, 204, 211, 213, 236,
242
gas-turbine combustors
radiative transfer, 306, 307, 312
geometric optics, 4, 45, 46, 116, 123, 124, 356,
360, 371, 372, 402, 403, 404, 422, 424
geometric optics theory, 45, 46, 116, 359, 423
global chemical mechanism, 425
gray approximation, 239
gray medium, 157, 165, 166, 288
GRI 2.11 mechanism, 439

H

harmonic oscillator, 33, 75, 76
harmonic plane wave, 9
heat feedback, 214, 384, 385, 388, 390, 392, 436
heat of pyrolysis, 202, 397
heat recirculation, 338, 415, 419
heat transfer coefficient
overall, 288, 291, 322, 333, 363, 426, 432, 436
volumetric, 420, 438
Helmholtz equation, 172, 309
HITEMP database, 107
HITRAN database, 86
hybrid methods, 168, 169

I

ideal gas, 64, 65, 204, 219, 359, 395, 426, 433
ignition delay, 200, 216, 217
ignition of droplets
thermal, 219
ignition of solids, 198
index of refraction
complex, 8, 10, 13, 18, 111–114, 116–118,
120–122, 124–127, 132, 352–355, 368, 369,
372, 401
in-scattering, 47, 52, 146, 175, 364
interaction of radiation with matter, 7, 45, 65
intermittent flame, 391
internal recirculation, 418
irradiance
spectral, 16, 17, 58, 147, 161–164, 243, 258,
295, 366

total, 151, 162, 288, 366, 398
isothermal cavity, 25, 27, 33

J

jet flames, 195, 196, 266, 270, 274, 278, 280,
281, 283, 284, 349, 380

K

k-distribution
cumulative, 88
Kirchhoff's laws, 28, 30
Knudsen number, 61
Konakov number, 322

L

Ladenberg and Reiche function, 80, 84
Lagrangian approach, 361
laminar flamelet, 225, 253, 261, 269, 272–277,
283, 292, 395, 413
laminar flow
two-dimensional, 207
large eddy simulation, 66, 69, 291, 314, 412
large particle limit, 114, 116
latent heat of vaporization, 245
lattice Boltzmann method, 442
Legendre polynomials, 118, 172
LES models, 252, 395
Lewis number, 213, 221, 227, 247, 248
line
absorption-emission, 106
broadening, 73
collision broadened, 79
Doppler broadened, 79
half-width, 79, 132
intensity, 79, 90, 91, 183, 234
isolated, 79, 81
Lorentz, 85, 88
natural broadening, 79
overlap, 84
overlap parameter, 84
spacing, 83, 85, 102
spectral, 78, 82, 84, 85, 99, 109, 186, 195, 268,
283
strength, 79, 84, 88, 337
strength parameter, 84
line width
equivalent, 84, 85
linear momentum, 65
line-by-line model, 226
locally homogeneous flow, 350, 360
logarithm of wavelength, 41
Lorenz-Mie theory, 123

M

Mach number, 61, 260, 343
macroscopic coefficients, 78
magnetic field, 7–10, 46
Marshak boundary condition, 172
mass conservation, 360

mass flux
 gasification, 385
 Maxwell's equations, 7, 8, 45, 120, 421
 mean absorption coefficient
 incident, 233
 mean absorption/emission coefficients, 104, 131
 mean beam length, 57, 58, 102, 131, 289, 305,
 307, 323
 mean free path
 photon, 61, 287
 mean radiation intensity, 218, 270, 309
 mean value of spectral intensity, 16
 methane, 91, 92, 98, 107, 125, 132, 216, 228,
 230, 232–236, 238, 241, 248, 249, 254–256,
 264, 265, 266, 270, 274, 277, 278, 280–284,
 290, 291, 294, 315, 317, 323, 337, 413, 414,
 426–428, 434, 435, 437, 440, 445, 446
 methane oxidation models, 426
 methane-air combustion
 ceramic foams, 439
 Mie scattering, 113, 137
 Mie theory, 112, 114, 118–120, 122–124, 126,
 131, 216, 354, 355, 368, 369, 371, 372, 374,
 401–404, 422
 mixing length, 388
 mixture fraction/PDF model, 336
 modified differential approximation, 188, 377,
 382
 mole fraction
 fuel, 225
 moment method, 171
 moments of intensity, 17
 monodisperse spray, 219, 221
 Monte Carlo method, 169, 177, 189, 191, 196,
 267, 275, 330, 422, 424
 MSFCK model, 187
 multiflux method, 168–171

N

narrow band model, 165
 statistical, 86, 88, 107, 194, 195, 213, 236,
 248, 336
 natural line broadening, 79
 nitric oxide, 279, 284, 290, 291, 315, 340, 347,
 367
 nonspherical particles, 120
 no-overlap approximation, 84
 Nusselt number, 360, 406

O

optical
 dimension, 22, 60, 173, 175, 258, 288, 289
 distance, 21, 22, 52, 54, 62
 thickness, 22, 49, 53–55, 93, 130, 134–136,
 239, 258
 optically thick approximation, 62, 259, 374
 optically thick medium, 62, 287
 optically thin approximation, 62, 213, 214, 226,
 230, 232–236, 238, 239, 241, 244, 246, 254,
 271, 272, 275–277, 297, 298

optically thin medium, 287

P

P₁-approximation, 169, 172, 173, 179, 188, 194,
 209, 267, 269, 309, 409
 P₃-approximation, 172, 173, 181, 376
 partial premixing, 283
 partially premixed flames, 231, 248, 265, 281
 partially stabilized zirconia, 423, 433, 443
 particle size distribution, 120–123, 125, 130, 132,
 353, 368, 369, 372, 377
 PIM
 combustion, 445
 PIM embedded heaters, 436
 Planck mean absorption coefficient, 61, 104, 105,
 209, 212–214, 228, 233, 238, 244, 245, 254,
 259, 275–277, 297, 298
 Planck's function, 34, 38, 42, 62, 83, 100, 128,
 136, 159, 233, 356
 Planck's law, 34, 36, 41, 54, 93, 128, 130
 Planck's second constant, 128
 plug flow furnace model, 327
 P_N-approximation, 171, 172
 polar angle, 16, 55, 141, 142, 295
 pool fires
 laminar, 388
 porosity, 420, 423, 438
 porous burner
 embedded flame, 419
 porous media
 inert, 417, 421, 443
 radiative transfer, 408, 421
 Poynting vector, 8, 9
 Prandtl number, 302
 preexponential factor, 201, 398
 preheating region, 418
 premixed flames, 213, 221, 231, 248, 272, 273,
 283
 premixed gas mixture, 230
 pressure
 molecular, 17, 64
 radiant, 59, 64, 65
 probability density function, 258, 260, 266, 268,
 282, 297, 309, 314, 316, 346, 365
 pulverized coal combustion, 122, 367, 368, 375–
 377, 381
 model, 367, 377
 radiative transfer, 366
 pulverized coal-fired combustion, 121
 pyrolyzing fuel
 vertical slab, 240
 pyrolysate gas, 210
 pyrolysis temperature, 200, 205, 388
 pyrolyzed gases, 202

Q

quantum number, 72, 74, 75, 76
 rotational, 74
 vibrational, 75

R

radiant burners, 445, 446
radiant energy
 density, 9, 15–17, 31, 32, 58, 59, 65, 66, 78
 flux vector, 16, 17, 59
 light, 4
radiant energy equation, 58, 60, 66, 157, 162, 185, 186, 204, 242, 258, 259, 269, 286, 288, 291, 295, 351, 363
 spectral, 61, 148, 158
radiant fraction, 253, 254, 271, 277, 278, 338, 386, 394, 398
radiation
 absorption, 25, 50, 58, 71–73, 79, 123, 124, 148, 200, 217, 228, 230–235, 238, 245, 248, 254, 272, 275, 279, 307, 351, 355, 359, 366, 373, 384, 387, 401, 404, 405
 attenuation, 7, 149, 199, 219, 257, 404
 chemoluminescent, 6
 directional nature, 167
 emission, 29, 33, 38, 53, 54, 59, 71, 73, 79, 136, 139, 186, 198, 199, 202, 210, 230, 231, 263, 285, 333, 359, 373, 384, 390, 393, 404
 infrared, 71
 polarization, 49
 reflection, 146, 178, 389
 refraction, 10, 243
 scattering, 47, 119, 143, 306, 372, 401, 404, 413, 439
 spectral nature, 21, 167, 184, 393
 thermal, 4, 6, 25, 29, 30, 32, 35, 40, 64, 67, 69, 131, 137, 138, 200, 219, 220, 221, 245, 250, 275, 280, 283, 286, 316, 340, 341, 347, 363, 379, 400, 413, 424, 427, 429, 438, 441, 444
 transmission, 202
 visible, 40
radiation characteristics
 packed beds, 422
 particles, 363, 367, 377
 polydispersion, 111, 378
 soot, 126
radiation flux
 external, 198, 208, 211, 241
radiation fraction, 253
radiation from flames, 252, 256
radiation length scale, 287
radiation pressure, 17, 30, 31, 59, 64
 tensor, 17, 59
radiation properties
 soot, 137
radiation time scale, 287
radiation transport, 15, 223, 234, 235, 357, 374
radiative equilibrium, 50, 140, 145, 153, 155, 159, 164, 166
radiative extinction, 213, 221
radiative transfer
 gas-phase, 208, 212, 214, 241
 multidimensional enclosure, 188
 rectangular enclosure, 195
 theory, 3, 28, 45, 46, 49, 123, 124, 192, 355,

359

radiative transfer equation, 3, 46, 48, 49, 51–53, 58, 107, 137, 138, 164, 167, 195, 196, 213, 282, 305, 314, 375, 421, 433
radiative transfer regimes, 59
radicals, 257, 368
RANS models, 394
Rayleigh-Jeans' law, 34, 36, 38
reacting gas mixture, 438
recuperation, 418
recuperator, 341, 346
reflectance
 bidirectional, 142
reflectivity
 directional, 11, 13, 117, 118
 spectral, 55, 227
refraction, 4, 5, 7, 8, 10–13, 15, 18, 20, 27, 34, 49, 111–118, 120–122, 124–127, 132, 244, 353–356, 369, 370, 373, 375, 402
refractory tube
 combustion, 427
reticulated ceramics, 417, 422, 423
Reynolds number, 66, 69, 235, 255, 311, 312
Reynolds stress, 67
Rosseland diffusion approximation, 63, 173, 433
Rosseland mean absorption coefficient, 63, 104, 130, 259, 369, 371, 372

S

scalar fluxes, 67
scattering
 coherent, 50
 distribution function, 117, 374, 421
 forward, 117–119, 134, 135, 165, 179, 192
 isotropic, 19, 117, 119, 134, 155, 157, 159, 164, 166, 178
 linear-anisotropic, 146, 166, 195
 phase function, 48, 117–119, 122, 137, 152, 172, 174, 179, 188, 422, 443
 Rayleigh, 114, 115, 117, 119, 228
 Rayleigh-Gans, 114
scattering coefficient, 17, 18, 22, 26, 47, 49, 111, 112, 114, 119, 121, 122, 125, 134, 151, 155, 159, 160, 216, 242, 296, 297, 334, 351, 352, 354, 363, 366, 367, 369–372, 374, 376, 392, 401, 404, 421–424, 441, 443
scattering efficiency factor, 115, 120, 121, 356, 402, 405
scattering phase function, 48, 117–119, 122, 137, 152, 172, 174, 179, 188, 422, 443
Schmidt number, 68
scientific method, 2
Second Law of Thermodynamics, 26, 30–32
self-absorbing medium, 104
separated flow, 360
SG model, 99, 337
Sherwood number, 406
simulation model
 furnaces, 320, 341
single scattering albedo, 22, 50, 60, 114, 116,

133, 353, 369, 402, 422, 423, 433, 443
 six-flux approximation, 169, 296, 365, 404
 SLW model, 99, 100, 101, 188, 238, 268, 271
 small particle limit, 116, 131
 Snell's law, 11, 124, 199
 solid fraction, 423
 solid fuel
 ignition, 200, 219
 soot
 homogeneous cloud, 129
 propane, 120
 soot formation, 125, 127, 132, 229, 234, 241,
 247, 249, 253, 274, 276, 277, 282, 283, 298,
 299, 314, 334, 356, 357, 365, 366, 377, 379,
 389, 390, 392, 399
 soot volume fraction, 127, 128, 130, 131, 230,
 235, 236, 242, 247, 248, 275–278, 280, 287,
 291, 299, 310, 313, 358, 364, 367, 390, 391,
 393, 400, 410, 413
 Soret effect, 373
 spacing ratio
 mean line intensity, 90
 mean line width, 90
 spectra
 vibrational-rotational, 72, 75
 spectral intensity, 14, 15, 17, 19, 26–28, 47, 48,
 49, 51–56, 60, 61, 109, 123, 134, 141–144,
 157, 162, 164, 176, 187, 204, 205, 226, 257,
 265, 304, 307
 time averaged, 257
 spectral net radiant flux, 16
 spectral radiance, 14, 49, 58, 77, 133, 162, 183,
 184, 205, 226, 243, 262–265, 294, 295, 306
 speed of light, 34
 spherical harmonics approximation, 171, 172,
 192
 spray combustion, 123, 215, 241, 349, 350, 353,
 355, 357, 359, 360, 363, 365–367, 378–380,
 402
 radiative transfer, 350, 351
 staged combustion, 434
 state relationships, 261
 statistical models, 85, 86, 406
 statistical weights, 77, 78
 Stefan-Boltzmann constant, 38
 Stefan-Boltzmann law, 38
 streamwise radiation, 209
 stress tensor, 59, 65
 strong-line approximation, 80, 81, 84
 surface reactions, 419

T

temperature
 gas, 57, 97, 132, 216, 244, 273, 307, 319, 320,
 322, 324, 326, 328, 329, 337, 339, 366, 416,
 427, 435, 439
 wall, 95, 96, 165, 179, 183, 289, 295, 301,
 319, 325, 343, 427
 thermal conductivity, 206, 312, 327, 387, 421,
 430, 434, 436, 437, 444

thermal plume, 410
 thermodynamics of radiation, 3, 25
 total exchange area, 321, 323, 330
 total radiant energy quantities, 17, 157, 184, 256
 transitions
 downward, 77
 upward, 77
 transmissivity
 spectral hemispherical, 21
 transmittance
 beam, 51, 52
 spectral, 89, 183, 184, 352, 404, 423
 spectral hemispherical, 55
 transport properties, 444
 TRI
 model assessment, 269
 TTNH model, 88, 89, 189
 turbulence macroscale, 258
 turbulence/chemistry interaction, 337, 376
 turbulence/radiation
 interaction (TRI), 257
 modeling, 333, 336
 models, 336
 turbulent
 kinetic energy, 67, 260, 292, 299, 335
 kinetic energy dissipation, 260, 292
 scalar fluxes, 67
 stress tensor, 67
 turbulent combustion
 two-phase, 320, 378
 turbulent diffusion flames
 confined, 310
 turbulent flames
 radiation, 262, 269
 radiative transfer, 251, 256, 262, 266
 two-flux approximation, 134, 170, 171, 423

U

unstable combustion, 416

V

van de Hulst formula, 354
 Voigt
 broadening, 79
 profile, 85

W

water vapor, 71, 91, 97, 102, 106, 108, 132, 138,
 165, 213, 264, 265, 405, 435
 wavelength, 3–9, 13–15, 17, 18, 20, 21, 27–30,
 34–36, 38–42, 53, 61, 87, 102, 106, 111, 115,
 116, 123, 125–127, 138, 142, 146, 155, 233,
 275, 286, 295, 305, 357, 370, 381, 401, 403,
 404, 413, 421, 422
 wavenumber, 5, 6, 41, 42, 79, 84, 87, 89, 91, 100,
 151, 232
 weak-line
 approximation, 84, 90
 limit, 84

well-stirred furnace, 319–321, 323, 325, 329, 330
dynamic, 325
well-stirred reactor, 342
wide-band model, 89–92, 101, 109, 154, 182,
184, 237, 376
exponential, 91, 92, 95, 99, 136, 186, 290,
301, 339
Wien’s displacement law, 33, 34, 36, 41
Wien’s law, 34, 37, 128, 130
WSGG model, 95, 96, 99, 109, 132, 134, 184,

187, 189, 191, 282, 323, 324, 352, 365, 393

Y

YIX method, 188, 196

Z

zone method, 169, 194, 320, 323, 329, 331