Cambridge University Press 978-1-108-42704-3 — Chemical Kinetics in Combustion and Reactive Flows V. I. Naoumov , V. G. Krioukov , A. L. Abdullin , A. V. Demin Index <u>More Information</u>

Index

algorithm for calculation of processes in single reactor, 88 of Dijkstra's, 173 of polynomials conversion, 111 approach gas-dynamic, 35 reactor, 36, 232 Archimedean forces, 352, 354 action, 339 effect, 353, 363 impact on the flow pattern, 346 autooscillation, 104 average mass fraction of condensate, 11 ballasting component, 312, 331 boundary layer, 228, 230 thickness, 229, 235, 256 Brusselator, 103 catalytic particle (third body), 23 chemi-ionization, 381, 390 CHEMKIN collection, 96 coefficient of losses because of chemical noneqilibrium, 153, 195 stoichiomentric of reaction, 23 collision frequency electron-electron momentum transfer, 387 electron-neutral momentum transfer, 387 combustion, 5 autocatalytic, 209 of coal particles, 7 in the cylinder of spark-ignition ICE, 380 diffusion, 6 in the kernel, 384 of a liquid fuel droplet, 6 of metal particles, 6 of multicomponent fuel with air, 296 of natural gas, 303 pulsating, 157 separate, 224 of solid propellant, 8 of two-phase mixture, 284

concentration mole-mass, 10, 44 partial molar, 10 condensation of substance, 54 conservative parameters, 345 constant of dissociation of individual substance, 13 of equilibrium of s-th chemical reaction, 26, 77 control engine parameters, 391 in-cylinder temperature, 390 NO concentration, 390 NO emission, 395 convection to the cylinder walls, 385 to the piston bowl walls, 385 data base BURCAT, 96 IVTANTERMO, 13 of substances, 98 THERMO, 13 TTR, 12 density mixture, 10 partial, 10 diffuser, 336 configuration, 347 diffusion coefficient, 359 coefficient of vapor into gaseous medium, 271 concentration, 229 mass exchange, 237 mass exchange reaction rate, 238 discrepancy between databases, 117 in data on substances, 111 discrete distribution of droplets, 313 droplet averaged-mass enthalpy, 268 evaporation, 228, 231, 262, 313 evaporation rate, 230 evaporation simulation, 236

Index

419

```
heating, 228, 313
  thermal capacitance, 268, 315
eigenvalues, 62, 102
  calculation, 105, 140
  evolution, 142
  imaginary, 159
  important, 142
  of Jacobian matrix, 98, 159
engine
  air breathing, 228
  emission characteristics, 393
  internal combustion 228
  liquid-propellant rocket, 228
enthalpy
  of ith substance
    mass, 11
    molar, 11
equation
  calorific, 48, 318
  Dalton, 17, 19
  normalizing, 79
  of chemical kinetics of exponential form,
       47,84
  of conservation of atom, 17-18
  of conservation of energy, 317
  of dissociation, 17
  of droplet evaporation, 264, 315
  of droplet heating, 265, 268
  of equilibrium evaporation of k-component,
       278
  of gas velocity, 316
  of multicomponent droplet temperature, 277
  Ranz-Marshall, 320
errors
  in combustion product temperature, 125
  in conversion of polynomials, 116
  of reapproximation, 113
  of reduction in the composition, 169
evaporation
  of drops of a single-component liquid, 262
  of liquid substance, 54
  of multicomponent droplet, 262, 273
  stationary (equilibrium), 264
  at supercrical pressures, 262
excess
  of fuel. 15. 311
  of oxidizer, 15, 311
exhaust gas recirculation (EGR), 393
extinction line, 132, 155, 176, 181
feed
```

at the angle to the tank axis, 347, 355 axial, 347 peripheral, 347 simulation by conditional scheme, 347 flame front, 5, 207, 231, 382

cold boundary, 213 hot boundary, 211 propagation velocity, 384 thickness, 240 fraction mass, 10, 43 molar, 10, 44 fuel. 14 bicomponent, 220 monocomponent, 221 furnace radiant tubular, 39, 49 gas generator liquid, 228, 310 two-zone, 312 gas generator products fuel lean, 335 fuel rich, 335 gasoline conventional formula, 387 heat transfer to the propellant surface, 360 to the tank's walls, 356 ion current, 380 density, 386 peaks, 381, 390 simulation, 386 ion voltage history, 390 peaks, 392 ionization combustion products, 380 sensor, 380 current 381 thermal, 381 jet axially symmetric, 352 flat. 352 inclined, 355 submerged, 353 KINTECUS package, 97 large molecule, 22, 50 latent heat of vaporization, 265 law Fick. 237 Fourier, 237 of independence of chemical reactions, 26 of limiting transition, 26 mass action. 25 linearization of individual substance enthalpy, 75 linking force, 164, 165, 167 losses through the ring gaps, 384

More Information

420	Index

mass exchange processes, 357 mass feed reaction, 344 matrix analytical calculation of partial derivatives, 79 coordinating, 74 derivatives of Jacobian, 20, 79 Jacobian, 64 Jacobian frozen, 85 method Chebyshev, 113 explicit, 148 of Euler, 62 stability, 148 Gear, 68 implicit of Euler, 63 Lebedev-Medovikov of second order, 66 multi-step of Adams, 65 Newton's, 19 of direct sounding of species and reactions, 170 of directed relation graph(DRG), 109 of DRGEP, 173 of engagement, 164 of intrinsic low dimensional manifolds, 110 of large molecules, 22 of principal component analysis, 109 of reaction rates analysis, 108 of reduction of kinetic mechanisms, 107 of spline-approximation, 70 Pirumov, 69 Runge-Kutta of fourth order, 64 three-stage one-step of Skvortsov, 67 mixture lean, 15 rich 15 model chemical equilibrium, 16 of combustion in the flame front, 208 detailed (formal) chemical kinetics, 16, 23 of ethane pyrolysis in tubular furnace, 84 evaporation of single-component droplet, 263 global kinetics, 16, 32 heat of flame front, 209 instant response, 16, 30 of multicomponent droplet evaporation, 273, 278 multicomponent fuel, 296 nonequilibrium chemical kinetics, 16, 33 of reacting gas-liquid flow, 313 of supercritical droplet evaporation, 266 of system of PSR, 285 system of PSR, 291 two-phase nonisothermal jet, 286 two-zone for propellant tank, 339

molecular mass working medium, 10 natural gas substances, 387 nozzle of aerospace propulsion systems, 152 chemical nonequilibrium processes, 194 Laval, 37 of LPRE, 153 of SPRE, 155 subsonic section, 157 number on integration steps for explicit scheme, 148 for implicit scheme, 150 Nusselt number diffusive, 236, 275 thermal, 275 optimization of parameters of ICE, 393 oscillation period, 158 oxidizer, 14 parameters of Arrhenius, 23 activation energy, 25 pre-exponential factor, 25 temperature factor, 25 peak of pressure, 381 of temperature, 390 peak of concentration of electrons, 390 of H3O+, 390-1 of NO, 390 of NO+, 390-1 piston average velocity, 384 bowl, 384 Prandtl number, 317 pressure of saturated vapor, 264 supercritical, 313 partial, 10 pressurization chemical, 335 of LPRE propellant tank, 334 system, 334 pressurizing gas, 334 consumption, 346 feed into reactor. 344 feed into the ullage, 347 flow and heat-and-mass exchange, 346 flow calculation, 346 flow in ullage, 336, 350

More Information

Index

421

flow pattern in ullage, 338 heat exchange with tank walls, 337 injection velocity, 370 optimal velocity, 374 thermal stratification, 337 pressurizing system evaporated-propellant, 334 stored-gas, 334 turbopump feed, 335 propellant atomization, 228 conditional formula, 14-15 cryogenic, 335 enthalpy, 18 evaporation from the surface, 337 high-boiling, 335 solid of rocket engine, 38 tank of LPREs, 334 thermal stratification and circulation, 337 two-component, 14 vapor condensation, 337 rate constant, 23 of forward chemical reaction, 25 reaction basic of dissociation, 13, 17 of chemi-ionization, 381, 390 elementary, 23 global, 32 of ionization, 381 of ionization charge recombination, 381 of ionization charge transfer, 381 of Lindemann, 28 of mass exchange, 41, 53 mass feed, 317 thermo ionization by collision, 381, 390 reaction mechanism complete (C-mechanism), 164 global reduced, 164 in the boundary layer, 231 local reduced, 164 reactor batch (BR), 4 perfectly stirred (PSR), 4, 101, 184 plug flow (PFR), 4, 184 reduced film, 263, 359 model, 231-2 thickness, 236 reduced integral of collision, 359 reduction threshold, 108, 163 adaptive, 167

residence time, 45, 133, 138, 157, 178 Reynolds number, 317, 354 scale thermodynamic, 11 Schmidt number, 236 sensitivity analysis, 98, 126 local, 101 sensitivity coefficients, 101 analytic determination, 127 soot formation, 320, 322 sub-mechanism, 325 threshold, 329 specific heat of substance mass at constant pressure, 11 at constant volume, 11 molar at constant pressure, 11 at constant volume, 11 Stefan's flow, 230-1 velocity, 360 stiffness artificial, 143 of chemical kinetics equations, 103 stoichiometric ratio of components, 15 mass, 15 molar, 15 tank draining, 340 emptying, 340 propellant, 311 target species, 108 tested species, 168 ullage, 255, 311, 334, 337-8, 340, 345-6, 348, 353, 362, 364 ullage chemical nonequilibrium of gas composition, 338 Wiebe formula, 386 working capacity, 335, 369 working medium, 253, 257, 283, 296, 310, 322, 382, 384 zone burned mixture, 382, 385 spark kernel, 383 unburned air-fuel and residual combustion products, 382 unburned mixture, 384