- Preface p. xv
- Chapter 1 General Notions p. 1
- I. Medium in Gas Dynamics p. 1
- A. Composition of a Medium--Particles p. 2
- B. Processes in a Medium p. 2
- C. Models of Medium p. 4
- D. Levels of Description of Medium p. 4
- II. Relaxation Processes in Gases and Plasmas p. 5
- References p. 7
- Chapter 2 Translational Relaxation (T Models) p. 9
- I. Translational Relaxation p. 9
- A. Translational Relaxation in Single- and Two-Component Gases (T.1) p. 9
- B. Translational Relaxation in Lorentz and Rayleigh Gases (T.2) p. 12
- C. Strong-Collision Model (T.3) p. 16
- References p. 18
- Chapter 3 Rotational Relaxation (R Models) p. 21
- I. Introduction p. 21
- A. Rotational Relaxation: State-to-State Kinetic Model (R.1) p. 22
- B. Diffusion Approximation for Rotational Relaxation (R.2) p. 25
- C. Strong Collision Model (R.3) p. 29
- D. Model of Rotational Energy Relaxation (R.4) p. 30
- References p. 34
- Chapter 4 Vibrational Relaxation (V Models) p. 37
- I. Introduction p. 37
- A. Vibrational Relaxation of Diatomic Molecules as a Low-Concentration Impurity in a Gas of Structureless Particles: State-Specific Kinetic Model (V.1) p. 38
- B. Vibrational Relaxation of a Single-Component Gas of Diatomic Molecules: State-Specific Kinetic Model (V.2) p. 43
- C. Vibrational Relaxation in a Binary Mixture of Diatomic Molecules: State-Specific Kinetic Model (V.3) p. 49
- D. Vibrational Relaxation of Diatomic Molecules: Diffusion Approximation (V.4) p. 58
- E. Vibrational Relaxation in a Gas of Polyatomic Molecules: State-Specific Kinetic Model (V.5) p. 61
- F. Vibrational Relaxation in Chemically Reacting Gas: State-Specific Kinetic Model (V.6) p. 67
- G. Vibrational Energy Relaxation in Diatomic Molecules: Mode Kinetics Model (V.7) p. 75
- H. Vibrational Energy Relaxation in Polyatomic Molecules: Mode Kinetics Model (V.8) p. 81
- I. Vibrational Relaxation in Chemically Reacting Gases: Mode Kinetics Model (V.9) p. 88
- References p. 93
- Chapter 5 Electronic Relaxation (E Models) p. 97
- I. Introduction p. 97
- A. Adiabatic Approximation p. 97
- B. Nonadiabatic Approximation for Vibronic Interactions p. 98

- C. Nonadiabatic Semiempirical Approximation p. 98
- D. Atomic-Molecular Kinetics of a Medium of Simple Composition (E.1) p. 100
- E. Model of Electronic Excitation Exchange (E.2) p. 101

• F. Electronic Energy Exchange in Chemically Reacting Gases: A Kinetic Model of Oxygen-Iodine Medium (E.3) p. 103

- I. Introduction and Definitions p. 111
- G. Model of Photochemical Polymerization Wave (E.4) p. 106
- References p. 108
- Chapter 6 Chemical Kinetics (C Models) p. 111
- A. Chemical System p. 111
- B. Components (species) of Chemically Reacting Mixture p. 112
- C. Measurement Units of Chemical Composition p. 112
- D. Nomenclature p. 114
- E. Comments p. 114
- F. Chemical Reactions p. 114
- II. Chemical Reaction Stoichiometry p. 117
- A. Basic Definitions p. 117
- B. Example p. 118
- C. Example p. 120
- D. Stoichiometric Conservation Laws p. 120
- III. Chemical Reaction Rates p. 121
- A. Rate of Simple Chemical Reaction p. 121
- B. Units of Measurement of Chemical Reaction Rates p. 123
- C. Kinetic Model of Simple Irreversible Chemical Reaction (Mass Action Law) (C.1) p. 123
- D. Kinetic Model of Simple Reversible Chemical Reaction (C.2) p. 127
- IV. Rates of Complex Chemical Reactions p. 129
- A. Kinetic Model of Complex Chemical Reactions (C.3) p. 130
- V. Empirical Correlations for Overall Rates of Complex Chemical Reactions p. 132
- VI. Kinetic Behavior of Complex Reactions p. 133
- A. Parallel Reactions p. 133
- B. Consecutive Reactions p. 134
- C. Conjugated Reactions p. 135
- D. Simplest Kinetic Scheme of Two Conjugated Reactions p. 136
- E. Example p. 136
- VII. Photochemical Reactions p. 136
- A. Kinetic Model of Photochemical Reactions p. 137
- VIII. Radiative-Chemical Reactions p. 140
- A. Kinetic Model of Radiative-Chemical Reactions (C.5) p. 141
- IX. Oscillatory Chemical Reactions p. 142
- XI. Chain Reactions p. 144
- A. Semenov's Kinetic Model of Chain Reactions (C.6) p. 148
- XII. Combustion Reactions p. 153
- XIII. Models of Chemical Reactors p. 156
- A. Model of Isothermal Reaction at Constant Density (C.7) p. 157

- B. Model of Adiabatic Reaction at Constant Density (C.8) p. 159
- C. Model of Adiabatic Reaction at Constant Pressure (C.9) p. 162
- D. Models of Plug Flow Reactor (C.10) p. 163
- E. Model of Well-Stirred Reactor p. 166
- XIV. Mathematical Modeling in Chemical Kinetics p. 168
- A. Direct Kinetic Problem p. 169
- B. Inverse Kinetic Problem p. 170
- C. Analysis of Mechanisms of Complex Chemical Reactions p. 171
- References p. 172
- Chapter 7 Low Temperature Plasma Kinetics (P Models) p. 177
- I. Main Nomenclature p. 177
- II. Definitions and Criteria p. 179
- III. Models of Low-Temperature Plasma Kinetics p. 184
- A. Model of Local Electron Energy Balance (P.1) p. 185
- B. Model of Electron Temperature Relaxation (P.2) p. 190
- C. Model of Electron Heating Because of Recombination (P.3) p. 193
- D. Model of Gas Heating in a Plasma (P.4) p. 197
- E. Model of Nonequilibrium Ionization (P.5) p. 201
- F. Model of Nonequilibrium Steady Ionization (P.6) p. 206
- G. Model of Recombination- and Diffusion-Controlled Plasma Decay (P.7) p. 210
- H. Model of Kinetics for Electrons and Positive and Negative Ions (P.8) p. 214
- I. System of Balance Equations for Excited Atoms: Relaxation of Excited States (P.9) p. 217
- J. Atomic Excited State Populations in Steady or Quasisteady Plasmas: Single-Quantum Approximation (P.10) p. 221
- K. Atomic Excited-State Distribution in Steady or Quasisteady Plasmas: Diffusion Approximation (P.11) p. 225
- P. Model of Relaxation of Electron Energy Distribution Function (EEDF) (P.16) p. 241
- X. Catalytic Reactions p. 143
- L. Model of Recombination and Relaxation of Highly Excited Atoms Induced by Collisions with Electrons and by Resonant Deactivation by Neutral Particles (P.12) p. 228

• M. Model for Electron Energy Distribution Function (EEDF) in Weakly Ionized Atomic Plasmas (P.13) p. 232

• N. Model for Electron Energy Distribution Function (EEDF) in a Highly Ionized Atomic Plasma (P.14) p. 235

• O. Model for Electron Energy Distribution Function (EEDF) in an Atomic and Molecular Plasma (P.15) p. 238

• Q. Model for Electron Energy Distribution Function (EEDF) in Weakly Ionized Plasmas with Inelastic Collisions (P.17) p. 244

- References p. 248
- Chapter 8 Thermodynamics of Gases and Plasmas p. 251
- I. Nomenclature p. 251
- II. Basic Concepts p. 251
- A. Definitions p. 251
- B. Processes p. 252

- C. Quantities p. 253
- D. Systems p. 254
- E. Functions of State p. 254
- III. Laws of Thermodynamics p. 254
- A. Zeroth Law of Thermodynamics p. 254
- B. First Law of Thermodynamics p. 255
- C. Second Law of Thermodynamics p. 255
- D. Third Law of Thermodynamics p. 256
- IV. Thermodynamic Potentials p. 256
- A. Internal Energy U p. 257
- B. Enthalpy H p. 259
- C. Free Energy (Helmholtz Free Energy) F p. 259
- D. Gibbs Thermodynamic Potential [Phi] p. 261
- E. Thermodynamic Potential [Omega] of an Open System p. 262
- F. Entropy S p. 263
- V. Conditions for Thermodynamic Equilibrium and for Thermodynamic Stability of Systems (Refs. 1, 2 and 6) p. 265
- VI. Gibbs Distributions and Their Relations to Thermodynamic Quantities p. 267
- VII. Partition Functions and Statistical Integrals p. 270
- VIII. Summary of Basic Thermodynamic Quantities p. 272
- IX. Calculation of Thermodynamic Parameters in Chemically Reacting Media p. 274
- C. Nonlinear Thermodynamics of Irreversible Processes p. 289
- X. Thermodynamics of Irreversible Processes p. 285
- A. Definition p. 285
- B. Postulates of Thermodynamics of Irreversible Processes p. 286
- D. Dissipative Structures p. 290
- E. Fluxes and Thermodynamic Forces in Thermodynamics of Irreversible Processes p. 291
- References p. 293
- Chapter 9 Equations of State p. 295
- I. Nomenclature p. 295
- II. Thermal and Caloric Equations of State p. 295
- III. Equation of State for an Ideal Gas p. 296
- IV. Real Gases p. 298
- A. Virial Equation of State for a Nonideal Gas p. 298
- B. Empirical Equations of State p. 299
- References p. 302
- Index p. 303
- Series Listing p. 315