CONTENTS

I.	THE PRODUCTION OF EXCITED SPECIES IN SIMPLE CHEMICAL REACTIONS By Ian W. M. Smith	1
II.	Potential Energy Surface Considerations for Excited State Reactions By Joyce J. Kaufman	113
III.	VIBRATIONAL AND ROTATIONAL EXCITATION IN GASEOUS COLLISIONS By Robert C. Amme	171
IV.	SENSITIZED FLUORESCENCE AND QUENCHING By L. Krause	267
V.	Theory of Nonadiabatic Collision Processes Including Excited Alkali Atoms By E. E. Nikitin	317
VI.	Excitation De-excitation Processes Relevant to the Upper Atmosphere By J. Wm. McGowan, Ralph H. Kummler, and Forrest R. Gilmore	379
VII.	APPLICATIONS TO LASERS By Robert H. Bullis	423
Auth	or Index	467
Subje	ct Index	487

IINTRODUCTION

A. Classical Collision Dynamics

II STUDIES OF REACTION DYNAMICS USING MOLECULAR BEAMS

- A. Instrumentation
- B. Interpretation
- C. Measurements and Mechanisms

III SPECTROSCOPIC OBSERVATIONS OF CHEMICALLY EXCITED SPECIES

- A. Association Reactions
- B. Atom-Exchange Reactions
- C. Four-Center, Displacement, and Elimination Reactions
- D. Vibrationally Excited Molecules as Chain Carriers

IV MONTE CARLO CALCULATIONS OF REACTIVE DYNAMICS

- A. Equations of Motion
- B. Potential-Energy Functions
- C. Averaging Procedures
- D. Results

V SUPPLEMENT

- A. Reactive Scattering
- B. Spectroscopic Observations: Association Reactions
- C. Spectroscopic Observations: Atom-Exchange Reactions
- D. Spectroscopic Methods: Vibrational and Rotational Excitation
- E. Theory

ACKNOWLEDGEMENTS

IINTRODUCTION

II POTENTIAL-ENERGY SURFACES

- A. Correlation Rules
- B. Correlations for Negative Ions
- C. Supplementary Long-Range Forces

III CROSSING OR PSEUDOCROSSING OF MOLECULAR POTENTIAL-ENERGY SURFACES

IV AN EXAMPLE OF AN APPLICATION OF THESE CONCEPTS

ACKNOWLEDGMENTS

INTRODUCTION

II TRANSLATIONAL-TO-VIBRATIONAL ENERGY TRANSFER THEORY

- A. Preliminary Remarks
- B. Classical Theory of V-T Transfer
- C. Semiclassical V-T Theory
- D. Quantum-Mechanical V-T Theory
- E. Elementary Considerations of the Relaxation Process

III TRANSLATION-ROTATION ENERGY-TRANSFER THEORY

- A. Classical and Semiclassical Theories
- B. Quantum Theories of T-R Transfer

IV VIBRATION-VIBRATION TRANSFER THEORY

V VIBRATION-ROTATION ENERGY-TRANSFER THEORY

VI EXPERIMENTAL TECHNIQUES

- A. Absorption and Dispersion of Sound
- B. Aerodynamic Methods
- C. Optic-Acoustic Effect
- D. Vibrational Fluorescence
- E. Gaseous Transport Phenomena
- F. Molecular Beams

VII SELECTED EXPERIMENTAL RESULTS

- A. Diatomic Gases and Mixtures with Other Diatomic or Monatomic Species
- B. Polyatomic Gases and Mixtures

INTRODUCTION

II RESONANCE FLUORESCENCE AND SENSITIZED FLUORESCENCE

III EXCITATION TRANSFER IN COLLISIONS BETWEEN EXCITED AND UNEXCITED ATOMS

- A. Apparatus and Experimental Methods
- B. Excitation Transfer between Fine-Structure States in Alkali Atoms
- C. Transfer of Excitation from Mercury to Other Metallic Atoms
- D. Quenching in Collisions between Atoms

IV COLLISIONS BETWEEN EXCITED ATOMS AND UNEXCITED MOLECULES

- A. Quenching of Resonance Radiation
- B. Excitation Transfer between Fine-Structure States

IINTRODUCTION

II SEMICLASSICAL TREATMENT OF NONADIABATIC COUPLING IN THE SCATTERING PROBLEMS

- A. Almost Adiabatic Perturbations; τω >> 1
- B. Sudden Perturbations; ωτ ≪ 1

III TWO-STATE MODELS OF STRONG NONADIABATIC COUPLING

IV MOLECULAR TERMS FOR ALKALI-NOBLE-GAS AND ALKALI-ALKALI PAIRS

- A. Adiabatic Potentials for Alkali-Noble-Gas Pair M* + X
- B. Adiabatic Potentials for a Pair of Similar Alkali Atoms M'* + M"
- C. Adiabatic Potentials for a Pair of Dissimilar Alkali Atoms $M_1^* + M_2$

VINTRAMULTIPLET MIXING IN EXCITED ALKALI ATOMS UPON COLLISIONS WITH NOBLE-GAS ATOMS

- A. Mechanism 1
- B. Mechanism 2
- C. Nonlocalized Transitions

VI DEPOLARIZATION OF EXCITED ALKALI ATOMS UPON COLLISIONS WITH NOBLE-GAS ATOMS

- A. Energetically Isolated States $^2P_{1/2}$ and $^2P_{3/2}$; $\Delta V \ll \Delta \varepsilon$, $\xi_1 = \Delta \varepsilon / \hbar \alpha_1 v \gg 1$
- B. Adiabatically Isolated States $^2P_{1/2}$ and $^2P_{3/2}$; $\Delta v \sim \Delta \epsilon$, $\xi_1 = \Delta \epsilon / \hbar \alpha_1 v \ll 1$

- C. Quasidegenerate States $^2P_{1/2}$ and $^2P_{3/2}$; $\Delta V \ll \Delta \varepsilon$, $\xi_1' = \Delta \varepsilon R_1/\hbar v \ll 1$
- D. Adiabatic Approximation
- E. Uniform Mixing Approximation
- F. Exponential Approximation
- G. Matching Approximation

VII INTRAMULTIPLET MIXING AND EXCITATION TRANSFER IN COLLISIONS OF EXCITED AND GROUND-STATE ALKALI ATOMS

- A. Resonant S-P Excitation Transfer
- B. Nonresonant S-P Excitation Transfer
- C. Collisions of Similar Alkali Atoms
- D. Collisions of Dissimilar Alkali Atoms

VIII CONCLUSION

IX SUPPLEMENT

ACKNOWLEDGMENTS

I GENERAL CONSIDERATIONS

- II LIFETIMES OF, AND ENERGY STORED IN, EXCITED STATES
- III THE EXCITATION AND DEEXCITATION OF SPECIFIC STATES
 - A. Nitrogen
 - B. Oxygen
 - C. Metallic lons
- IV REACTION RATES FOR REACTIONS INVOLVING EXCITED SPECIES

INTRODUCTION

II ELECTRON KINETIC PROCESSES

- A. Electron Distribution Functions
- **B. Fractional Power Transfer**

III MOLECULAR KINETIC PROCESSES

- A. Small-Signal Gain
- **B.** Saturation Intensity
- C. Optical Power Density
- D. Pressure Dependence of Laser Discharge Properties

IV DISCHARGE PROCESSES

- A. Laser Discharge Characteristics
- **B. Plasma Chemical Reactions**

V PLASMA STABILITY

VI SUMMARY

ACKNOWLEDGMENTS

