

CONTENTS

CONTINUUM OPTICAL OSCILLATOR-STRENGTH MEASUREMENTS BY ELECTRON SPECTROSCOPY IN THE GAS PHASE <i>By C. E. Brion and A. Hamnett</i>	2
ROLE OF EXCITED STATES IN ION-NEUTRAL COLLISIONS <i>By T. O. Tiernan and C. Lifshitz</i>	82
ELECTRONIC EXCITED STATES OF SELECTED ATMOSPHERIC SYSTEMS <i>By H. H. Michels</i>	225
COLLISIONAL ENERGY-TRANSFER SPECTROSCOPY WITH LASER-EXCITED ATOMS IN CROSSED ATOM BEAMS: A NEW METHOD FOR INVESTIGATING THE QUENCHING OF ELECTRONICALLY EXCITED ATOMS BY MOLECULES <i>By I. V. Hertel</i>	341
SPONTANEOUS IONIZATION IN SLOW COLLISIONS <i>By A. Niehaus</i>	399
SCATTERING OF NOBLE-GAS METASTABLE ATOMS IN MOLECULAR BEAMS <i>By H. Haberland, Y. T. Lee, and P. E. Siska</i>	487

Contents

I INTRODUCTION	3
A Oscillator Strengths and Electron Spectroscopy	3
B Energy Transfer In Electron and Photon Experiments	5
C Scope of This Review	8
II THEORETICAL BACKGROUND	9
A Introduction	9
B Molecular Processes	12
C Born Approximation	13
D Derivation of $f(0)$ from Electron-Impact Measurements	17
E Continuum Effects and (e,2e) Coincidence Experiments	20
III CALCULATION OF OSCILLATOR STRENGTHS	21
IV EXPERIMENTAL CONSIDERATIONS	24
A Electron Analyzers and Transmission Efficiency	24
B Electron Detectors and Signal Processing	33
C Coincidence Methods	34
D Absolute Oscillator Strengths	38
V EXPERIMENTAL MEASUREMENTS	41
A Introduction	41
B The Noble Gases	41
C Hydrogen	50
D Nitrogen and Carbon Monoxide	54
E Methane	69
F Other Molecules	72
VI CONCLUSIONS	73

Contents

I EXPERIMENTAL TECHNIQUES	84
A Formation of Excited Ions and Determination of Internal-energy Distributions	84
B Excitation of Neutral Reactants	108
C Methods for Studying Excited Ion–Neutral Interactions	108
II INTERACTIONS OF EXCITED IONS WITH NEUTRALS	120
A Reactive Scattering	126
B Non-reactive Scattering—Energy Transfer	145
III REACTIONS OF IONS WITH EXCITED NEUTRALS	161
IV EXCITED PRODUCTS FROM ION–NEUTRALS COLLISIONS (ELECTRONIC, VIBRATIONAL, AND ROTATIONAL EXCITATION)	163
A Chemiluminescent Reactions	165
V COLLISION MECHANISMS AND THEORETICAL IMPLICATIONS	196
A General Effects of Internal Excitation	196
B Theoretical Treatment of Energy Partitioning	199
C Calculations of Energy States, Correlation Diagrams, and Potential Surfaces	201
D Quasiclassical and Collinear Quantum-mechanical Trajectory Calculations	205

Contents

I. INTRODUCTION	227
II. ELECTRONIC STRUCTURE CALCULATIONS	228
A. Electronic States and Wave functions	229
B. Born–Oppenheimer Separation	231
C. Variational Methods	232
D. Potential-energy Curves and Surfaces	239
III. ELECTRONIC STRUCTURE AND POTENTIAL-ENERGY CURVES	240
A. Nitrogen Molecule	241
B. Oxygen Molecule	265
C. Nitric Oxide Molecule	288
D. O_2^- Ion	301
E. NO^+ Ion	318

Contents

I INTRODUCTION	343
II EXPERIMENTAL TECHNIQUES FOR STUDYING QUENCHING PROCESSES IN GASEOUS MIXTURES	346
III THEORETICAL QUENCHING MODELS	351
IV CROSSED-BEAM EXPERIMENTS WITH LASER-EXCITED SODIUM ATOMS	358
A General Aspects	358
B Kinematics	362
C Scattering Signal	364
D Laser Optical Pumping of a Sodium-atom Beam	365
E Experimental Setup	367
V DISCUSSION OF THE ENERGY-TRANSFER SPECTRA FOR Na($3^2P_{3/2}$) QUENCHING BY SIMPLE MOLECULES	368
A Diatomic Molecules N₂, CO, H₂, and D₂	369
B Comparison of Experiments with Statistical State Populations	373
C Linearly Forced Harmonic Oscillator Model	376
D A More Complicated Case: E to E-V-R Transfer in Na* Quenching by O₂	377
E Triatomic Molecules CO₂ and N₂O	377
F Larger Polyatomic Molecules	379
VI POLARIZATION STUDIES IN QUENCHING PROCESSES FROM LASER-EXCITED Na*(3p)	380
A A Simple Example: e + Na*(3p) → e + Na(3s)	380
1 General Aspects	380
2 Linearly Polarized Light	382
3 Circular Polarization	384
B Polarization Effects in Quenching of Na(3p) by Simple Molecules	385
1 Difference to Electron-scattering Processes	385
2 Experimental Results	387
3 Interpretation	389
VII OTHER BEAM EXPERIMENTS RELATED TO QUENCHING OF ALKALI RESONANCE RADIATION	391
VIII CONCLUSION	393

Contents

I Introduction	401
II Penning Ionization—Simple Systems	402
A Theoretical Background	403
B Experimental Results and Their Evaluation	420
III Penning Ionization—Complications	460
A Atomic Targets	460
B Molecular Targets	463
IV Other Spontaneous Ionization Mechanisms	472
A True Associative Ionization	472
B Spontaneous Ionization by Electron Transfer	475

