

# *Laser-Induced Chemical Processes*

*Edited by*

***Jeffrey I. Steinfeld***

*Massachusetts Institute of Technology  
Cambridge, Massachusetts*

A

Dms.-Nr.: 5169

Bibliothek  
d. Fachbereichs 8 der  
Technischen Hochschule  
Darmstadt

L 137

PLENUM PRESS • NEW YORK AND LONDON

# Contents

## **1. Vibrational Excitation in Polyatomic Molecules**

*Harold W. Galbraith and Jay R. Ackerhalt*

1.1. Introduction .....	1
1.2. Complete Model .....	6
1.3. Application to SF <sub>6</sub> .....	14
1.4. Application to S <sub>2</sub> F <sub>10</sub> .....	22
1.5. Comparison with Another Complete Model .....	27
1.6. Comparison with a Thermal QC Model .....	34
References .....	37

## **2. Multiphoton Infrared Excitation and Reaction of Organic Compounds**

*Wayne C. Danen and J. C. Jang*

2.1. Introduction .....	45
2.2. Features Distinguishing Large from Small Molecules .....	46
2.3. Selected Literature Survey .....	50
2.3.1. Unimolecular Reactions .....	51
2.3.2. Bimolecular Organic Reactions .....	78
2.3.3. Sensitized Organic Reactions .....	86
2.3.4. Low-Intensity CW Infrared Multiphoton Dissociation .....	92
2.4. Application of Chemical Thermometers in Pulsed Infrared Laser Photochemistry .....	94
2.4.1. "Thermal" vs. "Nonthermal" Processes .....	94
2.4.2. Choice of Thermal Monitor Molecule .....	97
2.4.3. Complications in Utilizing Chemical Thermometers .....	102
2.4.4. Determining Effective Temperature and Reaction Time .....	112
2.5. Experimental Data for Ethyl Acetate .....	119
2.5.1. Dependence of Reaction Probability on Fluence .....	119
2.5.2. Dependence of Cross Section on Fluence .....	121
2.5.3. Energy Absorption .....	123
2.6. Computer Modeling Studies .....	125
2.6.1. Literature Models .....	125

2.6.2. Model Calculations with a Master Equation Formulation for Large Organic Molecules .....	138
References .....	159

**3. Sinterable Powders from Laser-Driven Reactions**

*John S. Haggerty and W. Roger Cannon*

3.1. Introduction .....	165
3.2. Laser-Heated Powder Synthesis .....	168
3.2.1. Process Description .....	168
3.2.2. Analyses and Characterizations .....	175
3.3. Summary .....	237
References .....	240

**4. Laser-Induced Chemical Reactions: Survey of the Literature,  
1965-1979**

*J. I. Steinfeld*

4.1. Introduction .....	243
Table 4.1A Reactions Directly Induced by Single- and Multiple- Infrared-Photon Absorption .....	245
Table 4.1B Thermal and Photosensitized Infrared Laser Induced Reactions .....	252
Table 4.2 Reactions Induced by Visible and Ultraviolet Laser Excitation .....	254
Table 4.3 Miscellaneous Laser-Induced Effects .....	256
4.2. References for Tables 4.1-4.3 .....	257
4.3. Selected Review Articles, Monographs, and References to Theory and Diagnostic Techniques .....	263

AUTHOR INDEX .....	269
SUBJECT INDEX .....	275