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UNIV SANTA BARBARA DEPT OF CHEMISTRY M T BOWERS
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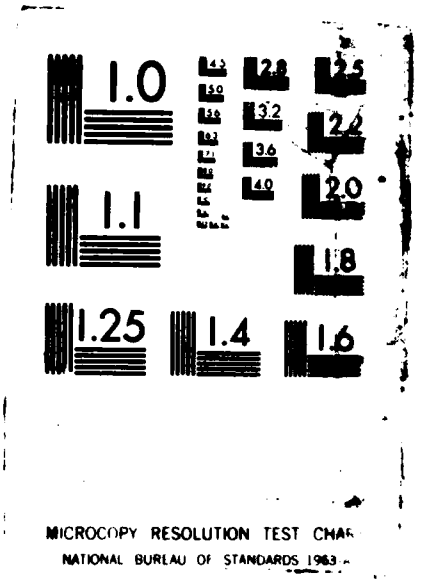
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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

An Excimer Laser (Lambda Physik 202 MSC) and Dye Laser (Lambda Physik 3002) were purchased. Preliminary experiments were completed in 3 areas:

A. Ion beam studies of state selected ions.
B. Semiconductor clusters.
C. Radiative lifetimes of long lived ionic states.

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22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE NUMBER (Include Area Code)	22c. OFFICE SYMBOL
Dr. Frank Wodarcyzk	(202) 767-4960	NC

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Energy Disposal in Ion-Molecule Reactions

Michael T. Bowers

Department of Chemistry
University of California
Santa Barbara, CA 93106

Grant No: AFOSR86-0268
Final Scientific Report
July 1, 1986 to June 30, 1987

I. ABSTRACT

During the tenure of this grant an Excimer Laser (Lambda Physik 202 MSC) and associated Dye Laser (Lambda Physik 3002) were purchased and installed. In addition, laser tables were constructed and a variety of optics were purchased. These lasers and optics were used to obtain preliminary results in the three areas listed under Objectives in the next section.

II. OBJECTIVES

A. To form state selected molecular ions and clusters by multiphoton ionization methods and study unimolecular or photoinduced decompositions of these species in mass selected ion beams.

B. To form clusters of carbon and other semiconductor materials, mass select them, and study their unimolecular and photoinduced reactions.

C. To form state selected ions of atmospheric importance and measure the radiative lifetimes of long lived metastable states.

III. PROGRESS

Progress in the three objectives listed above has been detailed in the Completed Project Summary. It is reproduced here.

A. Ion Beam Studies

In this work ions are being made in selected internal energy states using multiphoton ionization. These ions are then mass selected and either allowed to dissociate (if energy is sufficient) or crossed with a second laser for state selected photodissociation studies. Both branching ratios and kinetic energy release are measured. Preliminary work has been on parent ions of benzene and 2,4-butadiene. We are currently constructing a nozzle source that will allow us to investigate rotationally cold ions and small cluster ions.

B. Semiconductor and Metallic Clusters

We have recently initiated work in this area using the Excimer laser. Carbon cluster ions, C_n^+, have been observed up to $n = 140$. Metastable reactions of size^{n}selected clusters have been observed for $n \leq 60$. The products observed depend strongly on n. These results are being analyzed in terms of product stability and structure. Product kinetic energies have also been measured and are being modeled using statistical phase space theory. The important information we are extracting is the heat of formation of the cluster ions and small neutral carbon cluster fragments. A new "cooled" source is just being completed. This

source will allow photodissociation studies on size selected clusters as a further probe of both stability and structure. The new source will be universal and allow study of any semiconductor or metallic cluster or their mixtures. Separate support for this project will be sought in the near future.

C. Ion Cyclotron Resonance Studies

We have recently constructed an FT-ICR instrument with two skimmed pulsed jets attached. Atmospheric ions can be made by multiphoton excitation in selected electronic and/or vibrational states. Preliminary work has focused on the NO^+ ion. This ion can be made exclusively in $v = 1$ by firing the first pulsed jet of NO and triggering the Excimer pumped dye laser system to resonantly multiphoton ionize it. The NO neutrals are pumped from the ICR cell in less than 100 μs but the ions are trapped. At a variable time later the second pulsed jet is fired with a probe gas that reacts only with NO^+ ($v = 1$) and not NO^+ ($v = 0$). By varying the delay of the second jet the radiative lifetime of NO^+ ($v = 1$) is obtained.

IV. PAPERS PUBLISHED OR IN PRESS

Since the lasers have only been installed in the lab for several months we have not yet completed papers for submission to journals for publication. We expect several such papers to be submitted in the near future.

V. PERSONNEL ASSOCIATED WITH THE PROJECT

A. Senior Personnel

Dr. Paul Kemper
Dr. Thomas Bunn
Dr. Peter Radi
Dr. Chau-Hong Kuo

B. Junior Personnel

Ms. Marina Rincon
Ms. Hyun-Sook Kim
Ms. Michele Molchan

VI. PAPERS PRESENTED AT MEETINGS

Three invited talks have been given at the following meetings based partially or primarily on work done with the lasers purchased under this grant.

A. Symposium on Lasers in Mass Spectrometry, American Society for Mass Spectrometry, Denver, Colorado, May, 1987.

B. Gordon Conference on Semiconductor and Metallic Clusters, Plymoth, New Hampshire, August, 1987.

C. Plenary Lecture, British Mass Spectrometry Society, York, United Kingdom, September, 1987.

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