

Dist: A

REPORT DOCUMENTATION PAGE

FORM APPROVED
GPO NO. 0709-0188

1

AD-A284 945



ATED IN ADVANCE OF OUR PERFORMANCE, INCLUDING THE EMPLOYMENT OF...
REVIEWING THE QUALITY OF INFORMATION...
BUDGET...
OFFICE OF MANAGEMENT AND BUDGET PAPERWORK REDUCTION PROJECT...

1. REPORT DATE: ANNUAL 01 May 93 TO 30 Apr 94
3. REPORT TYPE AND DATES COVERED: ANNUAL 01 May 93 TO 30 Apr 94

4. TITLE AND SUBTITLE: (FY91 AASERT) LASER STUDIES OF GAS SURFACE INTERACTIONS
5. FUNDING NUMBERS: F49620-92-J-0230
61103D
3484/S2

6. AUTHOR(S): Dr Hanna Reisler & Curt Wittig

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES): Dept of Chemistry, Univ of Southern California, Los Angeles CA 90089-0482
8. PERFORMING ORGANIZATION REPORT NUMBER: AFOSR-TR 94 0569

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES): AFOSR/NL, 110 Duncan Ave Suite B115, Bolling AFB DC 20332-0001
10. SPONSORING / MONITORING AGENCY REPORT NUMBER: AFOSR-TR 94 0569

DTIC
SELECTED
SEP 29 1994
S B D

11. SUPPLEMENTARY NOTES: Dr Michael Berman

12a. DISTRIBUTION / AVAILABILITY STATEMENT: Approved for public release; distribution unlimited.
12b. DISTRIBUTION CODE: A

13. ABSTRACT (Maximum 200 words):
Our earlier studies of molecule-surface CID were extended to the case of NO2, which has been implicated as the emitting species in shuttle glow phenomena. The glow is believed to derive from the recombination of NO and atomic oxygen, yielding internally excited NO2. Because the NO2 zeroth order 2B2 excited state is strongly coupled to the 2A1 ground state, levels formed in recombination reactions emit throughout the visible. In our experiments, the reverse process was examined. Namely, NO2 entrained in a molecular beam was directed at a crystal surface and was photoexcited 2 cm (10 ms) before reaching the surface. The incident molecules had enough internal plus translational energy to undergo CID, which was observed for a range of NO2 internal excitations. Unexcited NO2 yielded no signal. Additionally, NO was detected with state and angular resolution and it was shown that products were scattered preferentially in the specular direction, ruling out a long residence time on the surface. It is most likely that NO2 decomposes rapidly following impact with the surface, in accord with k(E) measurements that indicate subpicosecond lifetimes for excess energies - 500 cm-1. This was the first demonstration of such an effect and supports the thesis that NO2 is responsible for the shuttle glow.

14. SUBJECT TERMS
15. NUMBER OF PAGES
16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT: (U)
18. SECURITY CLASSIFICATION OF THIS PAGE: (U)
19. SECURITY CLASSIFICATION OF ABSTRACT: (U)
20. LIMITATION OF ABSTRACT: (U)

July 1994

AIR FORCE OFFICE OF SCIENTIFIC RESEARCH - AASERT SUPPLEMENT
(Grant No. F49620-92-J-0230)
ANNUAL TECHNICAL AND EVALUATION REPORT
May 1993 - April 1994

PARENT AFOSR AWARD: Grant No. F49620-92-J-0168

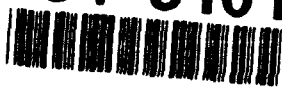
**GAS-SURFACE INTERACTIONS NEAR
DISSOCIATION THRESHOLD**

Prepared by: Hanna Reisler and Curt Wittig
Chemistry Department
University of Southern California
Los Angeles, CA 90089-0482

Submitted to: Dr. Michael Berman
Program Manager
Directorate of Chemical and Atmospheric Sciences
Air Force Office of Scientific Research
Bolling Air Force Base
Washington, D.C. 20322

DTIC QUALITY INSPECTED 3

94-31010



94 9 28 0 48

Technical Report:

Our earlier studies of molecule-surface CID were extended to the case of NO_2 , which has been implicated as the emitting species in shuttle glow phenomena. The glow is believed to derive from the recombination of NO and atomic oxygen, yielding internally excited NO_2 . Because the NO_2 zeroth order ${}^2\text{B}_2$ excited state is strongly coupled to the ${}^2\text{A}_1$ ground state, levels formed in recombination reactions emit throughout the visible. In our experiments, the reverse process was examined. Namely, NO_2 entrained in a molecular beam was directed at a crystal surface and was photoexcited 2 cm (10 ms) before reaching the surface. The incident molecules had enough internal *plus* translational energy to undergo CID, which was observed for a range of NO_2 internal excitations. Unexcited NO_2 yielded no signal. Additionally, NO was detected with state and angular resolution and it was shown that products were scattered preferentially in the specular direction, ruling out a long residence time on the surface. It is most likely that NO_2 decomposes rapidly following impact with the surface, in accord with $k(E)$ measurements that indicate subpicosecond lifetimes for excess energies $> 500 \text{ cm}^{-1}$. This was the first demonstration of such an effect and supports the thesis that NO_2 is responsible for the shuttle glow.

In addition, recent FTIR spectroscopy of CINO adsorbed on $\text{MgO}(100)$, suggest that CINO aggregates on the surface in a way that affects photon-induced processes.

The progress of the students, James Brandon and James Singleton, in their course-work as well as other requirements of the Ph.D. program is satisfactory.

Evaluation Report

The parent award number to which the AASERT students are linked is P49620-92-J-0168. The amount of funding of the parent award for the period 12/01/93 - 11/30/94 is \$175,000 and one (1) graduate student was supported under the said award prior to and after the AASERT award. The amount of funding under the AASERT program for the period 05/01/92 - 04/30/95 is \$94,091 (\$31,364 per year) and two (2) graduate students (above-mentioned names) were partially supported under this award for the period 05/01/93 - 04/30/94.

This is to certify that James Brandon and James Singleton are United States citizens. Verification was made through presentation of their birth certificates stating their birthdates and birthplaces, as well as their social security numbers.

Stat	Total
A-1	