THE FORMATION & STUDY OF EXCIPLEX SYSTEMS:
A LOW-PRESSURE APPROACH

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Dr. George Sanzone
Department of Chemistry
Virginia Polytechnic Institute & State University
Blacksburg, Virginia 24061

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I: PROJECT DESCRIPTION

A system is under development for the formation of excimers from their van der Waals ground states. Low temperatures obtained in a free-jet expansion are used to produce high steady-state concentrations of van der Waals dimers or oligomers. These are, in turn, to be excited by low-energy resonant electron bombardment to yield excimers or exciplexes. The mechanism is as follows:

It is proposed to prepare and study homo- and heteronuclear noble gas excimers as well as noble-gas halides.

II: SCOPE OF PRESENT CONTRACT

The present, short-term, goals of this work includes the development and construction of an experimental system to study excited-state kinetics of excimers, and the demonstration of the validity of the low-pressure approach outlined in the initial proposal. The apparatus is composed of the following principal components:

- a) Cluster-molecular-beam source of van-der-Waals dimers and higher oligomers;
- b) Modulated-beam mass spectrometer;
- c) Low-energy electron beam for the production of excimers;
- d) Vacuum-ultraviolet to Visible detection and photon-counting system to monitor excimer emission;
- e) Flash-excited tunable laser for studies of resonant self-absorptions.

Progress on the evaluation of the proposed experiments will be represented by completion of the following experiments:

- a) The formation of Ar_2 in its van-der-Waals ground state;
- b) Low-energy electron-beam excitation of Ar_2 to form Ar_2^* (and $\text{Ar}_2^{\dagger}$);
- c) Fluorescence studies of Ar_2^* ;
- d) Resonant photon-absorption studies of Ar_2^* .

III: THE STATUS OF THE APPARATUS

The experimental system is composed of the 25 major subsystems which are labeled A through Y on the Block Diagram. The interrelations among these subsystems are also shown on the Block Diagram. Figures 1 and 2 illustrate the total system.

The following subsystems were complete at the end of the report period:

A, B, D, G, H, I, J, K, L, M,
N, O, P, Q, R1, V, W

The following was completed after 28 Feb., 1977:

S

The status of uncompleted systems is as follows:

- C. Not required for Argon studies, but only requires vacuum plumbing.
- E. Will be worked on in summer of 1977. Not required in Argon studies.
- F. Same comments as for E.
- R2. Quadrupole will be in use during April, 1977. The TOF system proved inadequate for our studies.
- T. Same comments as for C.

- U. Same comments as for C.
- X. Will be built this summer.
- Y. Delivery expected by end of May, 1977.

Figure 3. Shows the chopper for the Modulated-Beam mass spectrometer.

Figure 4. Shows one of the beam collimators.

Figure 5. Shows one of the beam skimmers.

Figure 6. Shows the beam excitation chamber.

Figures 7-8. Shows one of the two excitation electron guns.

Figure 9. Shows an electron-beam collector.

IV: STATUS OF THE EXPERIMENTS

The experiments on Ar_2 formation should be completed in April, 1977. It will be required to characterize the performance of the excitation electron beam; during these studies the appearance potential of Ar_2^+ will be measured.

Studies on the formation Ar_2^* should be under way in May, 1977.

V: MEETINGS, ETC.

- 1) The principal investigator attended the following meetings:
 - a) Laser-Induced Chemistry (Feb. 13-16, 1977)
 - b) High-Power Visible Lasers (Feb. 16-19, 1977)
 - c) Symposium on State-to-State Chemistry (ACS - National Meeting, March 20-22, 1977)
- 2) The principal investigator gave an invited seminar at the ACS = Two-Year College-Chemistry Symposium (March 18, New Orleans, La.)
- 3) A paper will be presented at the ASMS meeting in Washington, D.C. (June - July meeting) on the Appearance Potential of Ar_2 .

- 4) Dr. Sheldon Datz of Oak Ridge visited our group Jan. 20, 1977.
- 5) Dr. Charles Rhodes of S.I. will visit our group on April 19, 1977.
- 6) The principal investigator visited EPA, Cincinnati, 24-27 Feb., 1977.

This involved unpaid consulting services; in effect we are paying for the mass spectrometer obtained for this research.

BLOCK DIAGRAM

BLOCK DIAGRAM
FIGURE 1

Figure 1.

The Cluster-Beam System

Figure 2.

Cluster-Beam with T.O.F. Mass Spectrometer

Figure 3.

Beam Chopper

Figure 4.

Beam-Collimating Orifice

Figure 5.

Beam-Forming Skimmer

Figure 6.

Beam Excitation Chamber

Figure 7.

Excitation Electron Gun Components

Figure 8.

Excitation Electron Gun Assembly

Figure 9.

Electron Beam Collector