AD-A036 012 RICE UNIV HOUSTON TEX DEPT OF CHEMISTRY F/G 9/3
ELECTRON SCAVENGING RESEARCH.(U)
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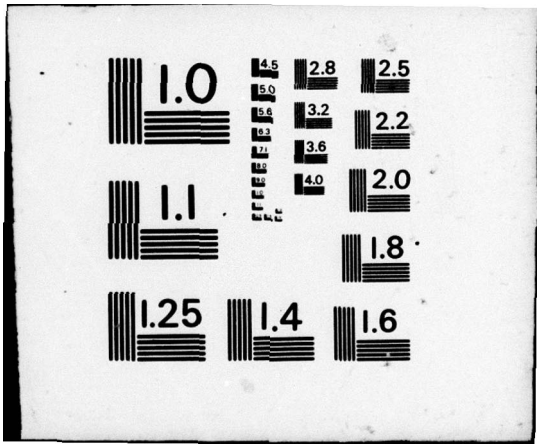
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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): (6) ELECTRON SCAVENGING RESEARCH.	5. TYPE OF REPORT & PERIOD COVERED: Final
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): (10) J. L. Franklin	8. CONTRACT OR GRANT NUMBER(s): (15) N00014-75-C-0415 new
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Rice University, Department of Chemistry, Houston, Texas 77001	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: (16) 122402 (17)
11. CONTROLLING OFFICE NAME AND ADDRESS: Dr. Richard S. Miller, Scientific Officer 473, ONR, 800 North Quincy Street, Arlington, VA 22217	12. REPORT DATE: 1 Feb [redacted] 77
	13. NUMBER OF PAGES: 5 (11)
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office): (12) 6 p.	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

(9) Final rept. 1 Jan 75 - 30 Jun 76,

17. ~~DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)~~

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Electron, Scavenging, Negative Ions

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report summarizes the work done at Rice University under Grant No. N00014-75-C-0415 during the period January 1, 1975 through June 30, 1976.

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ELECTRON SCAVENGING RESEARCH

ONR Contract N00014-75-C0415

FINAL TECHNICAL REPORT

In 1970 we proposed a research project directed towards development of information that might lead to a method of scavenging electrons from hot gases such as jet and rocket engine exhausts. The presence of electrons in such hot gases interferes with communication to the vehicle and it would be desirable to remove them. Such removal would almost certainly have to be accomplished by attachment to molecules or free radicals normally present or introduced into the hot gases. Unfortunately, at the time there was relatively little information concerning electron affinities of molecules and radicals or of the processes leading to the formation of such negative ions. Our project, then, was directed towards the study of such processes with a view to identifying those that would lead to the formation of negative ions in the appropriate energy range and of measuring the electron affinities of various important species. Cross sections would also be desirable to determine. Thus, it was necessary from the beginning to develop some understanding of the rules involved in the formation of negative ions and to measure the energies at which electrons are attached to various molecular species.

Since electrons do not attach directly to molecules, except in rare instances, the practical formation of negative ions must involve the process of dissociative resonance capture and the greater part of the work done on the research project has involved studies of dissociative resonance capture processes. A number of such reactions were known but

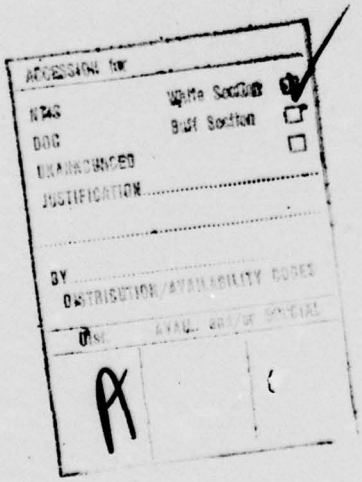
ABSTRACT

in most instances it was very obvious that a great amount of excess energy was involved. Thus, while we could measure the appearance potentials; i.e., the minimum electron energy at which a negative ion is formed from a given molecule, it was often very evident that at least one of the products of decomposition was highly excited. The only method available to us for measuring this excess energy was to measure the translational energy of the product ion. A technique for making such measurements had been developed in our laboratory and our first effort was to develop a means of applying this technique to negative ions. This was difficult because the intensities of negative ions is normally much less than those of positive ions. There was an advantage, however, in that with dissociative resonance capture processes the electron and its energy remains with the system and thus meaningful measurements of translational energy as a function of electron energy was possible. We found, in most instances, that translational energy increased linearly with electron energy. It was thus possible to extrapolate the translational energy curve to a thermal onset which would represent the energy of formation of the ions and accompanying neutrals in the ground, vibrational, rotational and translational energy states. In a number of instances one of the products proved to be electronically excited. This was usually the neutral partner but in one or two instances the negative ion proved to be electronically excited.

As our techniques improved, it became possible to make meaningful measurements on a considerable number of compounds that yielded an abundance of negative ions. The electron affinities and electronic

transition energies have been measured for a considerable number of molecular species and these results have been included in several publications. A list of these publications is attached. Note that one paper has been accepted for publication but hasn't yet appeared and a second has been completed but has not yet been accepted. One or two more papers dealing with positive ions are being prepared and will shortly be submitted for publication.

As a result of our studies, we have now determined a considerable number of electron affinities not previously determined and have begun to develop an understanding of the behavior of dissociative resonance capture processes. This has been especially true of the relation of molecular structure to the energy distribution in the products of reaction. We think that this has been an important development and we hope eventually to continue studies along this line. Although much remains to be done in this field, we are encouraged to think that we have made some very important developments with the support of the Navy.



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ONR Contract N00014-75-C0415

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"Energetics of Positive Ion Formation from the Group IV Halides," R. E. Pabst, J. L. Margrave, J. L. Franklin (in preparation)

STUDENTS AND POSTDOCTORAL FELLOWS SUPPORTED BY THE NAVY GRANT

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