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The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

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Electron/ion collisions, ~~$HgX_2$ and $CH_3HgX$ (X= Cl, Br, I)~~, Molecules, Emission cross sections, Kinetic energies, Mercury Halide lasers.

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

This report describes the formation of excited state species observed during collisions involving $HgX_2$/$CH_3HgX$ ( X=C, Br, I) molecules and electrons or ions at different laboratory kinetic energies. Electron impact dissociation of $HgX_2$ and $CH_3HgX$ has been studied and formation of HgX ($^2\Sigma$)-radicals and highly excited state of

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20. ABSTRACT CONTINUED

Hg atoms has been observed in the laboratory kinetic energy range of 1–100 eV. With electron and $CH_3HgX$ collisions, emissions from CH–radicals and atomic hydrogen have also been observed, in addition to the above mentioned species. Emission cross sections of the HgX ( $B\ ^2\Sigma$, $v' = 0 \rightarrow X\ ^2\Sigma$, $v'' = 22$ ) in the laboratory kinetic energy range of 1 – 100 eV have been measured. Similar results were obtained when the electrons were replaced by ions such as $N^+$, $N_2^+$, $CO^+$, $CO_2^+$, $O^+$, $Ar^+$, $Ar_2^+$, $He^+$ and $He_2^+$. Emission cross sections of the HgX ( $B\ ^2\Sigma$, $v' = 0 \rightarrow X\ ^2\Sigma$, $v = 22$ ) radicals and of mercury atomic lines during transitions from levels as high as Hg ( $7\ ^3S_1$ ) to various lower levels have been measured in the laboratory kinetic energy range of of 1 –1000 eV of the projectile ions.

Keywords:

Collisional studies involving some metastable molecules such as $N_2(A)$ and $HgX_2/CH_3HgX$ ( X= Cl, Br, I) molecules have also been studied. The $N_2(A)$ metastable molecules were generated by passing microwave discharge through $NaN_3$ vapors. Intense emissions from the HgX ( $B\ ^2\Sigma - X\ ^2\Sigma$ )–radicals were observed during collisions of $N_2(A)$ and $HgX_2/CH_3HgX$ vapors. The relative rate of HgX ( $B\ ^2\Sigma$, $v' = 0 \rightarrow X\ ^2\Sigma$, $v'' = 22$ ) formation with $HgX_2$ was determined to be $K_1$: $K_2$: $K_3$ :: 1 : 6.4 : 8.6 and with $CH_3HgX$ vapors, $K_1 : K_2 : K_3$ :: 1 : 4.8 : 7.7 respectively.

These results have either been published or submitted for publication in scientific journals. A list of publications through grant no. DAAG–29–85–G–0081 is attached here.

21. SCIENTIFIC PERSONNEL SUPPORTED BY THIS PROJECT AND DEGREES AWARDED DURING MAY 85 – JULY 1988 PERIOD:

(1). M. Mahmood

(2). William Hercules

(3). A. Michale

(4). Aaron White

Degrees awarded: One Ph.D. Degree

## LIST OF PUBLICATIONS THROUGH GRANT NO. DAAG–29–85–G–0081

1. Dissociative Excitation of HgX–radicals and Hg–atoms During Collisions of $CO^+$ and $HgX_2$ and $CH_3HgX$ (X=Cl, Br, I) Molecules.
   V. Kushawaha and A. Michael, Chem. Phys. ( submitted )

2. Chemiluminescent Studies involving Collisions of $He^+/He_2^+$ Ions and $HgBr_2$.
   V. Kushawaha and A. Michael, J. Chem. Phys. ( submitted )

3. Relative efficiency of HgBr(B–X) Formation due to Collisions of $CO^+/N_2^+$ ions and $HgBr_2$.
   V. Kushawaha and A. Michael, Chem. Phys. Lett. ( accepted )

4. Discharge Properties of $NaN_3$ Relevant to HgBr laser
   V. Kushawaha and A. Michael, JQSRT ( accepted )

5. HgBr(B–X) Formation due to $Ar^+/Ar_2^+$ and $HgBr_2$ Collisions.
   V. Kushawaha and A. Michael, JQSRT ( In Press )

6. Collision Induced Dissociative Processes Relevant to Mercury Halide Lasers.
   V. Kushawaha, A. Michael and M. Mahmood, J. Phys. B ( In Press )

7. Collisional Studies Involving $N^+$ and $N_2^+$ ions and $HgX_2$ (X=Cl, Br,I).
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13. Electron Impact Excitation of $HgX_2$ ( X=Cl, Br, I)
    V. Kushawaha and M. Mahmood, J. Appl. Phys. 62, 2173, 1987.