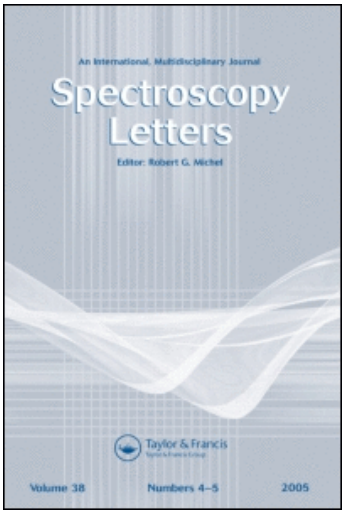

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HgCl (B-X) Chemiluminescence from Alkali Atom - $HgCl_2$ Reactions

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HgCl (B-X) CHEMILUMINESCENCE FROM ALKALI ATOM - $HgCl_2$ REACTIONS

Key words: Mercury Halides, Chemiluminescence

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ABSTRACT

Laser action on the $B^2\Sigma^+_{1/2} \rightarrow X^2\Sigma^+_{1/2}$ band of HgCl at 557.6 nm ($v'=0 \rightarrow v''=22$) has previously been achieved under a variety of electronic and optical excitation mechanisms. This letter describes a chemical mechanism for producing excited HgCl. We report on the gas phase reaction between alkali atoms (K, Rb, and Cs) and $HgCl_2$ which produces HgCl (B-X) emission.

INTRODUCTION

Mercury monohalides are proven active media for gas lasers that emit in the visible spectrum. In particular, the HgCl ($B^2\Sigma$-$X^2\Sigma$) laser, at 557.6 nm, has been the

subject of considerable theoretical and experimental research[1]. Production of $HgCl^{*}B^{2}\Sigma$ has been achieved by several means, for example, e-beam excitation of rare-gas mixtures containing Hg and CCl_4[2], electric discharge dissociation of $HgCl_2$[1], laser induced chemiluminescence of $Hg/Cl_2/Ar$ mixtures[3], and photodissociation of $HgCl_2$[4,5].

In this letter we report the observation of visible chemiluminescence from $B^{2}\Sigma$-$X^{2}\Sigma$ transitions in HgCl produced in gas phase reactions between alkali atoms (K, Rb, and Cs) and $HgCl_2$.

EXPERIMENTAL METHOD

In our experiments, the alkali metal was distilled into a 300 ml Pyrex cell connected to a vacuum system. The cell was heated to produce an alkali atom vapor pressure in the range 10^{-3} - 1 Torr. A side arm containing $HgCl_2$ was then heated to drive $HgCl_2$ vapor into the reaction cell. Chemiluminescence was observed and recorded with an optical multichannel analyser.

RESULTS

Fig. 1 shows a spectrum for the K + $HgCl_2$ reaction. Except for the alkali atom emission lines, the same spectrum was obtained for reactions with Cs and Rb. The

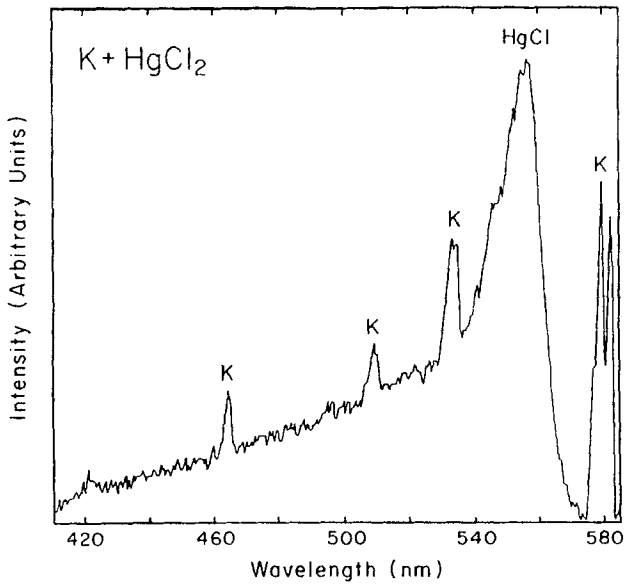

FIG.1 The spectrum of HgCl (B→X) emission from the reaction K + $HgCl_2$.

broad continuum peaking around 557 nm is the complex spectrum for the B-X band of HgCl[4].

Based on the bond strengths for HgCl-Cl[5] and M-Cl (M= alkali atom)[6], the reaction $HgCl_2$ + M → HgCl + MCl is approximately 0.9 ev exothermic, 2 ev less than is necessary to excite the B-state of HgCl[7]. Therefore, the production and excitation of HgCl is not a simple one step stripping reaction. This is further verified by the fact that a few Torr of Ar gas in the reaction cell quenched the HgCl emission but not the reaction or

alkali atom emission. We therefore conclude that the HgCl is probably excited to the B state by collisions with vibrationally excited MCl molecules produced during the stripping reactions.

REFERENCES

1. Mohammad F. Mahmood, Can. J. Phys. **68**, 166 (1990).

2. J.H. Parks, Appl. Phys. Lett. **31**, 192 (1977).

3. K.Y. Tang, R.O. Hunter,Jr., J.Oldenettel, and D.L. Huestis, J. Chem. Phys. **70**, 1492 (1979).

4. A. Mandl and J.H. Parks, Appl Phys. Lett. 33, 498 (1978).

5. J. Gary Eden, Appl. Phys. Lett. 33, 495 (1978).

6. Handbook of Chemistry and Physics, 65th ed., p. F-175 (CRC Press Inc. 1984).

7. G. Herzberg, Molecular Spectra and Molecular Structure, Vol. I, 2nd ed. p.538 (D. Van Nostrand Company, New York 1950).

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