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RADIO FREQUENCY STARK SPECTRA AND DIPOLE MOMENT OF BaS*

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The radio frequency Stark spectra of $^{138}\text{Ba}^{32}\text{S}$ have been observed at moderate fields using a molecular beam spectrometer that has been described previously. The single spectral line corresponding to the $J=1, m_J=\pm 1 \rightarrow J=1, m_J=0$ transition was observed for the three lowest vibrational states. Spectral frequencies obtained at field strengths of 30, 45, 60, and 75 volts/cm were fitted with the usual second order Stark equation:

$$
\nu = 3.8019 \times 10^{-2} \frac{\mu^2 E^2}{B}
$$

where $\nu = $ transition frequency, MHz

$E = $ field strength, volts/cm

$\mu = $ dipole moment, Debye

$B = $ rotational constant, MHz.

Correction for fourth order Stark effect was negligible. The following ratios of $\mu^2$ to the rotational constant, $B$, were obtained:

<table>
<thead>
<tr>
<th>$\nu$</th>
<th>$\frac{\mu^2}{B}$ (D$^2$/MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.03816 (10)</td>
</tr>
<tr>
<td>1</td>
<td>0.03841 (12)</td>
</tr>
<tr>
<td>2</td>
<td>0.03872 (18)</td>
</tr>
</tbody>
</table>
No rotational constants for BaS have been published in the literature, however, Clements and Barrow have recently obtained a value for $B_0$ for the ground rotational state from a study of an absorption band system of BaS. Using their value of $B_0 = 0.10308(4) \text{ cm}^{-1}$ and our experimental value of $(\mu^2/B)_0$, the value $\mu = 10.86 \pm 0.02 \text{ D}$ is obtained for the dipole moment of the v=0 state of BaS.

The quantity $\mu/\mu_r$ is sometimes used as a relative measure of "ionic character" in comparing chemical bonds. The near equality of this quantity for BaO (0.85) and BaS (0.90) indicates the close similarity of bonding in these two molecules. Further, the 6\% increase in $\mu/\mu_r$ in going from BaO to BaS reflected a similar 6\% increase found in going from CsF to CsCl.

The rather broad line widths of the spectral lines (from 10 to 15 KHz) and difficulties in generating a molecular beam of BaS did not permit the study of the Stark spectra at strong electric fields. Further details of the present work appear elsewhere.
REFERENCES

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