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Emission of Spectrum of BIF Molecule

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EMISSION OF SPECTRUM OF BiF MOLECULE

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INTRODUCTION

The BiF molecule has a very extensive spectrum, from 5065 \AA in the visible to 2250 \AA in ultraviolet region. It was studied by Howell and Rochester¹ in emission and by Morgan² in absorption. A year later, Rochester³ again studied its emission spectrum, and recorded three new band systems.

Joshi⁴ repeated the experiments of Morgan and photographed the absorption spectrum of BiF. He predicted the existence of two systems - one expected to lie near 5424 \AA and the other near 9027 \AA .

In view of his findings it was considered worth while to make a search for the system A - X₂ (first precited system near 5424 \AA) in emission. The heavy current transformer discharge through flowing BiF vapour was used as a source of excitation of BiF. The bands in the visible region were photographed on the Fuess glass and three prism glass steinheil spectrographs. Apart from the known A - X₁ system ($4150 - 5830 \text{ \AA}$) which was found to be greatly extended, we recorded an

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entirely new band system in the region (5925 - 6330 Å), consisting of four bands.

The new band system (6330 - 5925 Å)

All the bands of this system are degraded towards red. The wavelengths, wavenumbers of band heads measured from the plates on the Steinheil spectrograph are given in the following table in which (ν' , ν'') numbering and the visually estimated relative intensities are also included.

Table 1.

Emission Spectrum of BiF
Band head data of the New System (6330-5925 Å)

| Wavelength (Å) | Wavenumber ₋₁ in vac.(cm ⁻¹) | Relative Intensity | Degra- dation | (ν' , ν'') |
|--------------------|--|-----------------------|------------------|----------------------|
| 5927.5 | 16866 | 4 | Red | 1,0 |
| 5981.5 | 16714 | 5 | Red | 4,2 |
| 6032.7 | 16572 | 10 | Red | 0,0 |
| 6231.0 | 16044 | 3 | Red | 0,1 |

As the existence of this new system was not even mentioned by any of the previous investigators, care was taken to get additional evidence from the experimental view point before ascribing it to the BiF molecule. In an attempt to identify the emitter of the group of bands, a comparison was made with the spectra of the commonly occurring impurities in any discharge tube like CO, CO⁺, N₂, CN etc., in the visible region and a comparison was also made with the band head

data of the probable impurities like BiO and SiF which could possibly exist in our discharge tube. Just a look at the measurements of the wavelengths of the band heads of these groups of bands indicates that the wavelengths do not agree with any of those appearing in the list of the table of the persistent band heads due to impurities given by Pearse and Gaydon⁵. Thus, there remains only one possibility for the emitter of these bands viz., BiF. ω_e and ω'_e values for this system have been found to be 528 cm^{-1} and 294 cm^{-1} respectively. In view of the small difference between the lower state frequency of this system and that of λ_2 state ($= 535\text{ cm}^{-1}$) given by Joshi⁴, ~~it~~^{it} can be said that the two states are the same. The upper state of this new system may be identified with A', lying below the upper well known A state of the system A-X.

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