Emission Spectrum of the AsSb Molecule

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A SYSTEM of red-degraded bands in the region 3660—3860 Å attributed to the new molecule AsSb has been observed in a microwave discharge through a flowing mixture of $AsCl_3$ and $SbCl_5$. The spectrum has a simple vibrational structure and is very similar to that of AsP,[1] PSb,[2] and the known AsN ($A^1\Pi$–$X^1\Sigma^+$) system.[3]

Pressure of approximately 20 μm. each of $AsCl_3$ and $SbCl_5$ were used. The microwave discharge was generated by a Burdick model M.W/200 microwave unit operating at 2450 MHz. and rated at 125 w. The emission spectrum was originally recorded on Ilford HP 3 plate using a Hilger medium quartz spectrograph but has since been re-photographed in the second order of a 6·5 m. concave grating spectrograph with a dispersion of 0·5 Å/m. at the Institute of Physics, University of Stockholm, Sweden.

The Table gives the vibrational assignment, the wavelength in air, and the wave-number *in vacuo* of the band heads of the isotopic molecules $As^{121}Sb$ and $As^{123}Sb$. The higher relative intensities of the former molecule are consistent with the relative natural abundances of 57·25% and 42·75% for ^{121}Sb and ^{123}Sb, respectively. From the observed band heads the calculated vibrational constants of the lower electronic state are the following:

	ω_e(cm.$^{-1}$)	$\omega_e X_e$(cm.$^{-1}$)
$As^{121}Sb$	343·0	0·8
$As^{123}Sb$	341·7	0·7

The ω_e values satisfy the relation $\omega_e^1 = \rho\omega_e$ where the value of ρ for the two isotope molecules is 0·99688. The

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Band heads of the AsSb *spectrum*

v'–v''	$As^{121}Sb$ λ Å (in air)	$As^{121}Sb$ ν cm.$^{-1}$ (*in vacuo*)	I[a]	$As^{123}Sb$ ν cm.$^{-1}$ (*in vacuo*)	I[a]	Isotope shift
0–0	3662·35	27297·1 *R*	8	27297·1 *R*	8	0[b]
1–1	3680·65	27160·4[c] *R*	1			
0–1	3708·74	26955·7 *R*	10	26956·8 *R*	6	−1·1
	3708·94	26954·2 *Q*	10			
0–2	3756·08	26615·9 *R*	9	26617·9 *R*	6	−2·0
				26617·1 *Q*	6	
0–3	3804·47	26277·4 *R*	6	26280·9 *R*	4	−3·5
	3804·60	26276·5 *Q*	6	26279·5 *Q*	4	−3·0
0–4	3853·33	25944·2[c] *R*	1	25946·9[c] *Q*	1	

R. *R* head.
Q. *Q* head.

[a] Relative intensities.
[b] Isotope shift not detected.
[c] These bands are extremely weak and therefore uncertain.

small observed isotope shifts are as expected in view of the large value of ρ and therefore further supports the vibrational assignment. In addition to these values for the lower state an estimate of 204·7 cm.$^{-1}$ for $\Delta G'_{\frac{1}{2}}$ may be made from the weak 1–1 band.

Although the bands of the $v' = 0$ progression are strong the expected 1–0 band at 3636 Å was not observed. The absence of this band and the sudden drop in intensity of the 1–1 band relative to that of 0–1 suggests that predissociation occurs at $v' = 1$.

Preliminary rotational analysis suggests that the AsSb bands as well as those of AsP and PSb are due to a Π–Σ transition, analogous to the bands of AsN. At present, the rotational structure of AsSb is insufficiently resolved for detailed analysis but attempts will be made to re-photograph the spectra at higher resolution.

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