Rotational analysis of a few bands of the ultraviolet system of GeO

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The rotational structure of four bands (4, 0), (0, 2), (0,3) and (2, 4) has been studied in the second order dispersion (0 625 A/mm) of a 21 ft. Concave grating spectrograph. The results of the rotational analysis have confirmed that the transition involved is a $^1\Pi$-$^1\Sigma$. The analysis is further confirmed by the identification of the isotopic P and Q branches corresponding to three isotopic molecules ^{74}GeO, ^{72}GeO and ^{70}GeO. Rotational constants of the upper and lower states of the ^{74}GeO are evaluated.

The spectrum of GeO has been investigated by several authors[1-10] in emission as well as in absorption. Recently Murthy *et al.* (1971, 1973) reinvestigated the emission spectrum of GeO under the second order resolution (0.625 A/mm) of a 21 ft. concave grating spectrograph. On the basis of the rotational analysis of (3, 0), (2,0) (1,0), (1,1), (0,1) and (2,3) bands, it is confirmed that the transition involved is a $^1\Pi$-$^1\Sigma$. In order to determine the accurate rotational constants of higher vibrational levels of lower and upper states, the rotational structure of (4,0), (0,2), (0,3) and (2, 4) bands has been studied in the second order dispersion of a 21 ft. concave grating spectrograph. The error in the relative wavenumber of the lines is in general less than 0.05 cm^{-1}.

The structure of each of the bands (4,0), (0,2), (0,3) and (2,4) revealed the presence of three main branches P, Q and R of which the Q branch stands out more prominently as the most intense. This feature confirms that the transition involved is $^1\Pi$-$^1\Sigma$. The lines of P and Q branches in most of the bands appear as triplets due to the isotopic molecules ^{74}GeO, ^{72}GeO and ^{70}GeO.

The J numbering of the (4, 0) band is fixed by comparing the lower state combination differences $\Delta_1 F''$ of (4,0) with those of (3,0) and (2,0) bands.

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The J numbering of the (0,2), (0,3) and (2,4) bands is also fixed in a similar manner. The rotational constants for the upper and lower states were obtained from $\Delta_1 F(J)$ values adopting the usual graphical procedures. Rotational constants of the upper and lower states are determined and presented in tables 1 and II.

Table 1. Rotational constants B_v and D_v of the upper and lower states of $A^1\Pi$-$X^1\Sigma$ system of GeO

$X^1\Sigma$ state		V	$A^1\Pi$ state	
B_v (cm^{-1})	D_v X10^{6}cm^{-1}		B_v (cm^{-1})	D_v X10^{6}cm^{-1}
0 4860	0.55	0	0 4166	0 75
0 4822	0 50	1	0.4085*	0 57
0.4780	0.45	2	0.4050	0.40
4 4750	0 37	3	0 4017*	0.26
0.4715	0.30	4	0.3985	0.11

* Values from the work of Murthy[12] *et al*

Table 2. Molecular constants of the $A^1\Pi$-$X^1\Sigma$ system of GeO molecule

$X^1\Sigma$ state	$A^1\Pi$ State
B_e = 0.4878 cm^{-1}	B_e — 0 4133 cm^{-1}
α_e = 0.0036 cm^{-1}	α_e = 0.0033 cm^{-1}
D_e = 0.58 × 10^{-6}cm^{-1}	D_e — 0 16 × 10^{-6}cm^{-1}
β_e = 0.06 × 10^{-6}cm^{-1}	β_e = 0 83 × 10^{-6}cm^{-1}
r_e = 1.621 Å	r_e — 1 761 Å
I_e = 57.38 × 10^{-40}gm/cm^2	I_e = 67 12 × 10^{-40}gm/cm^2

The A-type doubling in the form of combination defect could be neglected in the upper $^1\Pi$ state since it is less than the random error in $\Delta F(J)$ values and a precise estimate of it is therefore hardly possible.

The system of GeO in the region $\lambda 2200$-$\lambda 3300$ Å appears as the analogous system to the $A^1\Pi$-$X^1\Sigma^+$ system of the isoelectronic molecules like CO, SiO and SnO. The ground $^1\Sigma^+$ state arises from the configuration

$$\ldots \quad (z\sigma)^2 \; (y\sigma)^2 \; (w\pi)^4 \; (x\sigma)^2 \qquad \ldots \quad {}^1\Sigma^+$$

and the $^1\Pi$ term arises from the configuration

$$\ldots \quad (z\sigma)^2 \; (y\sigma)^2 \; (w\pi)^4 \; (x\sigma) \; (v\pi) \qquad \ldots \quad {}^1\Pi$$

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