Laser Absorption Spectroscopy of LaF: Analysis of the $B^1\Pi$- $X^1\Sigma^+$ Transition

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Laser absorption spectrum of the LaF $B^1\Pi$-$X^1\Sigma^+$ (2,0), (1,0), (2,1), and (3,2) bands was recorded. Gas phase LaF was obtained by heating a mixture of a 0.2 g of La metal and 0.3 g of LaF_3 powder to 1900 K. In order to modulate the absorption signal, the concentration of LaF was varied by passing a 25 kHz discharge (80-100W, 0.5A peak current) through the vapor. Under these conditions the Tantalum heating tube used to vaporize the sample also acted as a hollow cathode. The B-X band system was observed previously [a]. In analyzing the spectrum, we have combined absorption data with that from the Reference. Accurate molecular constants (in cm^{-1}) and internuclear distance r_e (in nm) for the $X^1\Sigma^+$ state are:

$$\omega_e = 573.318,\ \omega_e x_e = 2.18,\ B_e = 0.246411(15),\ \alpha_e = 1.251(15) \times 10^{-3},\ r_e = 0.20232.$$

Rotational perturbations were evident in the $B^1\Pi$ v' =1,v' =2,and v' =3 levels. The pattern of the $B^1\Pi$ state perturbations was shown to be a consequence of the interaction with the $c_1^3\Delta_1$ state by using the experimental value of ω_e =450 cm^{-1} (see Reference) and estimated value of $\omega_e x_e$ =3.5 cm^{-1} for the triplet state. The principal new results to emerge from this investigation are the determination of the equilibrium constants for the $B^1\Pi$ and $X^1\Sigma^+$ states of LaF.

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[a] H. Schall, C. Linton, and R. W. Field, J. Mol. Spectrosc. 100, 437-448 (1985); B. Simard and A. M. James, J. Chem. Phys. 97,4669-4678 (1992)