THE PERMANENT ELECTRIC DIPOLE MOMENTS FOR THE $A^2\Pi$ AND $B^2\Sigma^+$ STATES AND THE HYPERFINE INTERACTIONS IN THE $A^2\Pi$ STATE OF LANTHANUM MONOXIDE

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The optical Stark effect in the (0,0) $A^2\Pi_{3/2} - X^2\Sigma^+$, $A^2\Pi_{1/2} - X^2\Sigma^+$ and $B^2\Sigma^+ - X^2\Sigma^+$ band systems of a lanthanum monoxide, LaO, supersonic molecular beam sample have been analyzed to produce permanent electric dipole moments, μ, for the $A^2\Pi_{3/2}$, $A^2\Pi_{1/2}$ and $B^2\Sigma^+$ states of 1.89(6)D, 2.44(2)D and 0.2(1)D, respectively. The ground state dipole moment was determined some time ago[1] to be 3.207(11)D. Fine structure splitting in the field free $A^2\Pi_{3/2} - X^2\Sigma^+$ and $A^2\Pi_{1/2} - X^2\Sigma^+$ spectra was analyzed to produce the magnetic hyperfine spectroscopic parameters a = 233(4) MHz, c = -261(12) MHz, and d = 410(4) MHz. The Group IIIA monoxides, ScO, YO and LaO are prototypical examples of transition metal-oxide bonded molecules. This work on LaO has resulted in the first complete set of dipole moment measurements for the $X^2\Sigma^+$, $A^2\Pi_{1/2}$, $A^2\Pi_{3/2}$ and $B^2\Sigma^+$ states for any of these monoxides. The permanent electric dipole moments for the low-lying states of LaO are exceedingly small, given that they are conventionally viewed as having a $La^{+2}O^{-2}$ charge distribution and exhibiting a large variation amongst the four states.

1. R.F. Seunram, F.J. Lovas, G.T. Fraser and K. Matsumura, J. Chem. Phys. 92, 4724 (1990).