

An Ultrahigh-resolution Study of Stark Effect in CO

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Studies of the Stark effect are of interest primarily because they can yield accurate values of the permanent electric-dipole moments. The electric-dipole moment is the first moment of the charge distribution in a molecule in a particular vibronic state and gives insight into the molecular structure and properties of molecule in that state [1]. Application of an external electric field (Stark effect) in molecules will result in splitting the spatial degeneracy of rotational levels, which has as a consequence the splitting of observed rotational fine structure. The magnitude of the splitting is determined by the applied electric field strength (V/cm), the rotational quantum number (J), and the change of the dipole moment ($\Delta\mu = \mu' - \mu''$) on excitation. The research field was mainly focused in the measurements of ground state dipole moment (μ'') [1,2]. Only limited measurements were carried out for the excited electronic states [e.g., 3]. This is because most of the electronic transitions of simple molecules occur in the VUV region, a spectral region where high-vacuum, high-resolution spectrometer and continuum light source are required.

The U9 CGM high-resolution spectrometer at NSRRC provides a resolving power of 4.5×10^4 , which exhibits a great possibility to meet the experimental challenge. Thus, we have carried out a preliminary Stark effect study on the (5, 0) and (8, 0) bands of the $A^1\Pi - X^1\Sigma^+$ transition of CO in VUV region. We have successfully

applied the high voltage up to 24 KV (6×10^4 V/cm) without breakdown. Positive changes in the band profiles have been visually discernible in the presence of electric field strength of 3×10^4 V/cm. The preliminary result suggests that our spectrometer resolution is marginally satisfactory and that the magnitude of the excited state dipole moment (μ') is probably comparable to that of the ground state. A detailed band contour analysis of the two bands is currently in progress according to the procedures previously described [4,5]. We hope that the present work will rekindle interest in Stark effect studies in molecules and the interplay between theories and experiments.

References

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