HIGH-RESOLUTION NEAR-INFRARED SPECTROSCOPY OF He/$N_2$/$H_2$ POSITIVE-COLUMN PLASMAS

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Like its isoelectronic cousins $BH_2^-$ and $CH_2$, the amidogen cation $NH_2^+$ has a quasilinear ground state $\widetilde{X}^3B_1$ with a low barrier to linearity (155 $cm^{-1}$) and metastable excited electronic states $\widetilde{a}^1A_1$ and $\widetilde{b}^1B_1$ that become degenerate ($^1\Delta$) at linearity. In addition to its theoretical interest (due to the quasilinearity and the Renner effect), $NH_2^+$ is one of the most fundamental molecular ions that exist abundantly in laboratory plasmas containing hydrogen and nitrogen. Despite this, only two high-resolution experimental detections of $NH_2^+$ have been reported (the observation of the antisymmetric N-H stretch[a] at 3360 $cm^{-1}$, and four hot bands[b] from 2900-3500 $cm^{-1}$).

In an attempt to observe the predicted near-infrared electronic absorption spectrum of $NH_2^+$,[c] we have recently obtained new spectra of positive ions in a liquid-nitrogen-cooled positive column He/$N_2$/$H_2$ plasma. The spectra were recorded using a high-resolution, high-sensitivity spectrometer based on a Ti:sapphire laser (11,000-13,000 $cm^{-1}$) and incorporating velocity modulation, phase modulation with heterodyne detection, noise subtraction, and optical multi-passing. The observation and assignment of the spectra is complicated by the presence of thousands of lines from the $A^2\Pi_u - X^2\Sigma_g^+$ system of $N_2^+$. We will report the results of our analysis of the new spectra.

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[c] G. Osmann, P. R. Bunker, P. Jensen, and W. P. Kraemer, J. Mol. Spectrosc. **186**, 319 (1997).