HIGH-RESOLUTION NEAR-INFRARED SPECTROSCOPY OF DEUTERATED CH_2^+

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Laboratory spectroscopy of deuterated molecular ions is essential in understanding deuterium ion chemistry-a significant area in astrochemistry since the discovery of many extraordinarily abundant deuterated species in prestellar cores and protostars in recent years. Aiming at providing approximate rotational constants for millimeter wave spectroscopists to identify the corresponding species in space, we are measuring the near-infrared spectrum of deuterated CH_2^+. CH_2^+ is the intermediate between the abundant CH^+ and yet to be observed but very important CH_3^+ in interstellar chemistry. Its abundance is expected in diffuse clouds although our search for interstellar CH_2^+ based on our infrared[a] and near-infrared[b] laboratory spectra has not been successful yet. CH_2^+ and its deuterated species are also of special interest for theoretical studies because of their unique intramolecular dynamics, i.e., the Renner-Teller interaction and quasi-linearity.

Using He-dominated liquid-N_2 cooled plasmas ($\sim$10 Torr) containing a small amount ($\sim$0.1 Torr) of CD_4, we have measured the spectra of CD_2^+ in the near-infrared from 11,000 cm^{-1} to 12,500 cm^{-1} with our Ti:sapphire laser spectrometer that combines velocity modulation and phase modulation with heterodyne detection for near shot-noise-limited sensitivity. The $\tilde{A}(0,5,0)^1 \leftarrow \tilde{X}(0,0,0)^0$, $\tilde{A}(0,5,0)^0 \leftarrow \tilde{X}(0,0,0)^1$ and $\tilde{A}(0,4,0)^2 \leftarrow \tilde{X}(0,0,0)^1$ bands of CD_2^+ have been identified and analyzed so far[c]. Currently a scan for CHD^+ using CH_2D_2 gas is underway. The spectrum will be discussed in comparison with the theoretical predictions by Bunker and colleagues[d].

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[a] M. Rösslein, C. M. Gabrys, M.-F. Jagod, and T. Oka, *J. Mol. Spectrosc.* **153**, 738 (1992).

[b] J. L. Gottfried and T. Oka, *J. Chem. Phys.* **121**, 11527 (2004).

[c] H.-M. Wang, C. P. Morong, and T. Oka, 62^{nd}, 63^{rd} OSU International Symposium on Molecular Spectroscopy, MJ02 (2007) and WG04 (2008).

[d] P. R. Bunker, private communications.