SUB-DOPPLER RESOLUTION LASER SPECTROSCOPY OF CH_4 AND CH_3I WITH HIGH SENSITIVITY AND WIDE TUNABILITY IN THE 1.6 μm REGION

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Recently Labachelerie and his coworkers have realized sub-Doppler resolution in vibrational overtone band spectroscopy using a Fabry-Perot cavity as an absorption cell [b]. Subsequently, Hall and his colleagues have greatly improved the sensitivity of the cavity-enhanced spectrometer by applying the frequency modulation technique [c].

We have demonstrated the potential capability of the cavity-enhanced spectrometer by observing the saturated absorption spectra of the $2\nu_3$ band of CH_4 and the $2\nu_4$ parallel band of CH_3I in the 1.6 μm region. Because the sensitivity is as high as 9.5×10^{-11} cm^{-1} all over the tunable range of 1.63 to 1.67 μm, we are able to observe the Lamb-dips of $^{13}CH_4$ of natural abundant sample. The high sensitivity has also allowed us to reduce the sample gas pressure, the optical power, and the modulation amplitude, hence we have obtained the narrower spectral linewidth of 0.32 MHz.

Furthermore, the quadrupole hyperfine components of CH_3I have been resolved in the whole band, which provides the nobel method of analyzing complicated spectrum because the splitting patterns reflect how strongly the levels are perturbed.

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[a] Support by CREST is gratefully acknowledged

[b] M. de Labachelerie, K. Nakagawa, and M. Ohtsu *Opt. Lett.* **19**, 840 (1994)

[c] J. Ye, L. S. Ma, and J. L. Hall *Opt. Lett.* **21**, 1000 (1996)