PRECISE TRANSITION FREQUENCY MEASUREMENTS OF CH_4 IN THE 1.66 μm REGION

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Sub-Doppler resolution laser spectroscopy with high sensitivity and wide tunability was presented by some of the authors (C. I. and H. S.) last year [a]. There we used a Fabry-Perot cavity absorption cell, an external-cavity diode laser (ECDL), and a frequency modulation technique, which drastically improved the performance of the spectrometer [b]. Because the spectral resolution was attained as high as 320 kHz, the corresponding precision has been required in the frequency measurement.

To this end, we stabilized the ECDL's frequency to the narrow saturation dip of CH_4 of the $2\nu_3$ band in the 1.66 μm region, and made two kinds of precise frequency measurements.

First, we stabilized two ECDL's frequency to different spectral lines respectively, and measured the frequency of the optical beat note between the ECDL's. Sixty-six frequency differences were measured with an accuracy of 40 kHz.[c]

The second is the absolute frequency measurement. We used a 1.54-μm saturated absorption line of $^{13}C_2H_2$ as a frequency reference and an optical frequency comb generator for bridging the 14-THz frequnecy gap between the 1.66 μm and 1.54 μm radiations. The absolute frequencies of the R(0) and Q(1) transitions were determined to be 180.345 065 08(37) and 180.021 253 10(61) THz, respectively.[d]

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[a] C. Ishibashi and H. Sasada, *Proc. of 54th Ohio State Univ. Int. Symp. Molec. Spectrosc.* **RJ04**, 237 (1999)

[b] C. Ishibashi and H. Sasada, *Jpn. J. Appl. Phys.* **38**, 920 (1999)

[c] K. Suzumura, C. Ishibashi, and H. Sasada, *Opt. Lett.* **22**, 1356 (1999)

[d] C. Ishibashi, M. Kourogi, K. Imai, B. Widiyatmoko, A. Onae, and H. Sasada, *Opt. Commun.* **161**, 223 (1999)