HIGH PRECISION MID-IR SPECTROSCOPY OF $^{12}C^{16}O_2$: $[10^01,02^01]_I \leftarrow 00^00$ BAND NEAR 2.7 μm

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We have observed the sub-Doppler saturation spectrum of the $^{12}C^{16}O_2$ $[10^01,02^01]_I \leftarrow 00^00$ band transitions near 2.7 μm using a mW-level DFG (Difference Frequency Generation) source. The DFG radiation is generated by a 1-W Ti:sapphire laser and a Nd:YAG laser amplified by a 10-W fiber amplifier in a 50-mm long PPLN (Periodically-Poled Lithium Niobate) crystal. We are able to generate 5 mW DFG power at 2.7 μm. The saturation spectrum is observed by a conventional arrangement by monitoring the saturated 4.3 μm fluorescence. To increase the signal a longitudinal cell having gold coating inside is used to collect the 4.3 μm fluorescence. This method provides zero background and better signal-to-noise ratio than the work by Groh *et al.*[a]. It also eliminates the interference fringes completely.

To measure the center frequency of a 2.7 μm transition, the Ti:sapphire laser is frequency locked to a highly stable Fabry-Perot reference cavity and its frequency is measured using an OFC (Optical Frequency Comb). The frequency of the Nd:YAG laser is scanned by offset locking to another iodine stabilized Nd:YAG laser. The center frequency is obtained by fitting the second harmonic demodulated spectrum to the theoretical profile. Up to now, the absolute frequencies of 19 transitions have been measured to an accuracy of 40 kHz which is one order of magnitude better than previous best results[a]. A new set of molecular constants is also derived.

[a] A. Groh, D. Goddon, M. Schneider, W. Zimmermann, and W. Urban, *J. Mol. Spectrosc.* **146**, 161 (1991).