# Compact, low power mid-infrared methane isotope $^{13}CH_4$ and $^{12}CH_4$ sensor using room-temperature CW interband cascade laser.

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Measurements of methane isotopic ratio is important for environmental monitoring. The level of gas in the atmosphere has a significant impact on its radiative forcing and its increase is estimated to be 0.48 $W/m^2$ since pre-industrial times [1]. The origin of the gas can be obtained from the isotopic ratio of carbon in $CH_4$. Due to recent development of compact, low power interband cascade lasers (ICLs) in the mid-infrared spectral region at room temperature conditions it is possible to design compact, field deployable gas sensors with low power consumption [2,3].

An experimental investigation of the performance of a compact gas sensor base on a 0.8 mW interband cascade laser (ICL) combined with a custom made, innovative 24 m optical-path spherical gas cell with a 80 ccm total volume will reported. The sensor was developed to target methane absorption lines at 3007.95 $cm^{-1}$ and 3008.39 $cm^{-1}$, corresponding to $^{13}CH_4$ and $^{12}CH_4$ respectively. Wavelength modulation spectroscopy was performed with a custom made, low noise current source, a custom acquisition card and a sensitive MCT detector from Vigo System S.A. Control signals and conditioned data were processed by a low power microcontroller and saved on a Secure Digital (SD) card. Furthermore, it is possible to use this sensor as a handheld device with an external battery source. A triangular signal was added to perform modulation of the ICL current between 3007.6 – 3008.7 $cm^{-1}$ in order obtain both isotopic absorption lines. The reported $CH_4$ sensor was able achieve a precision below 0.3‰ of isotopic ratio for a 200 ppm methane mixture, which is better than previously reported precision [4]. **Figure 1** depicts the directly acquired signal of a 200 ppm methane mixture.

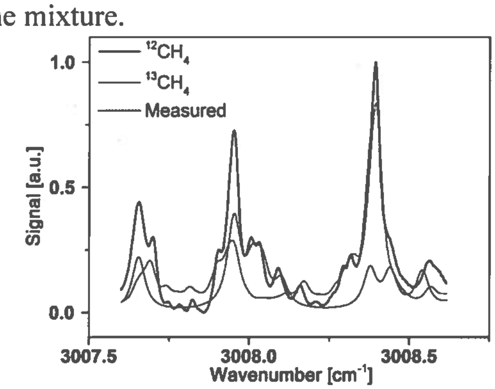


**Fig. 1.** Acquired absorbance spectra (black line) of a 200 ppm methane mixture with a simulated Hitran database plot for isotopic methane lines (green and red lines).

**References:**

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