MULTI-COMPONENT GAS DETECTION USING A SUPERCONTINUUM SOURCE IN THE MID-INFRARED RANGE

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For the last decade, supercontinuum sources[1] have been widely studied because of their unique properties, such as high brightness, broad spectrum and perfect spatial coherence. These unique properties can be efficiently utilised in many different applications including imaging, metrology or spectroscopy. Here, using a specifically developed supercontinuum source, we performed for the first time incoherent broadband cavity enhanced absorption spectroscopy (IBB-CEAS)[2] in the mid-infrared over a 500 nm spectral range, allowing to simultaneously measure the concentration of multiple gases at the sub-ppm level.

IBB-CEAS uses an incoherent broadband light source that is coupled to an external cavity where the gas to be characterised is injected, allowing to effectively increase the optical path interaction between the light and the gas and improve significantly the detection limit compared to direct absorption measurements. To perform IBB-CEAS in the mid-infrared where many gases posses their strongest absorption features, we have developed an all-fibered supercontinuum source that extends from 900 nm to 3700 nm. The cavity was formed by two highly reflective mirrors in the wavelengths range from 3000 to 3500 nm as shown in Fig. 1a. By comparing the measured spectral absorption with that modeled using the HITRAN database, concentrations at the sub-ppm level were retrieved as seen in Fig. 1b.

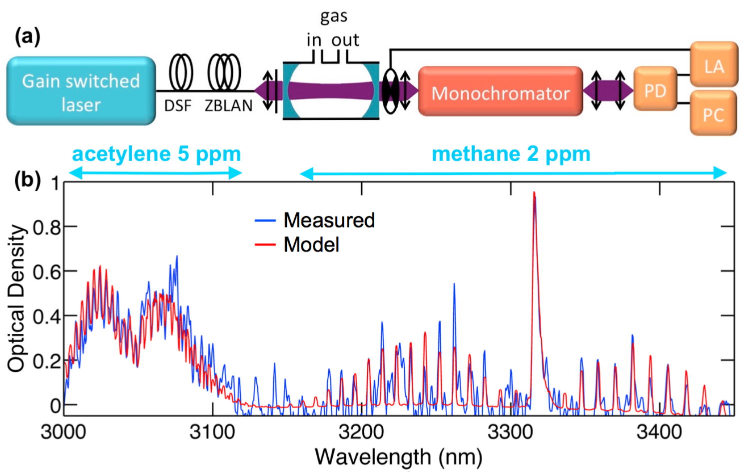

Figure 1: (a) Experimental setup. (b) Comparison between the measured and modeled absorption lines of 5 ppm of acetylene and 2 ppm of methane simultaneously in the cavity.

[1] J. Dudley and J. Taylor, Supercontinuum Generation in Optical Fibers, p. 418, (2010).
[2] S. Fiedler, A. Hese, and A. Ruth, Chem. Phys. Lett. **371**, pp. 284-294 (2003).