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Quartz-Enhanced Photoacoustic Spectroscopy based formaldehyde sensor using a mid-IR interband cascade laser

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Formaldehyde (H_2CO) detection and quantification at ppbv concentration levels is important in a number of applications such as environmental monitoring and atmospheric chemistry. A quartz-enhanced photoacoustic spectroscopy (QEPAS) based sensor [1] was developed to determine trace concentrations of formaldehyde. A liquid nitrogen cooled 3.57-micron continuous wave distributed feedback interband cascade laser was used as the excitation source to target a H_2CO absorption line at 2804.9 cm^{-1} delivering 8 mW of optical power to the QEPAS absorption detection module. Improvements made to the original H_2CO sensor architecture [2] resulted in an enhancement of the noise-equivalent sensitivity by a factor of 4.5. With a data acquisition time of 5 minutes a noise equivalent formaldehyde concentration level of ~ 25 ppbv was obtained. This sensitivity is sufficient for the monitoring of the air quality in spacecraft habitats in compliance with the established safe maximum allowed concentration levels of H_2CO. The influence of the sampled air humidity on formaldehyde molecule V-T relaxation rate as well as further improvements of the detection sensitivity will also be discussed.

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[2] M. Horstjann, Yu.A. Bakhirkin, A.A. Kosterev, R.F. Curl, and F.K. Tittel, Chung M. Wong, Rui Yang, "Formaldehyde Sensor using Interband Cascade Laser based Quartz-enhanced Photoacoustic Spectroscopy", Applied Physics **B 79**, 799-803 (2004).

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