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


Formaldehyde (H₂CO) 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 H₂CO absorption line at 2804.9 cm⁻¹ delivering 8 mW of optical power to the QEPAS absorption detection module. Improvements made to the original H₂CO 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 H₂CO. 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.


KEYWORDS: interband cascade laser, quartz enhanced photoacoustic spectroscopy, formaldehyde detection.

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