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Methane Detection by Means of Quartz Enhanced Photoacoustic Spectroscopy in NIR

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Abstract: Trace methane detection by means of quartz enhanced photoacoustic spectroscopy using a fiber-coupled DFB diode laser at 1651 nm will be reported. An autonomous sensor configuration will be described.

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Quartz enhanced photoacoustic spectroscopy (QEPAS) approach to trace gas sensing was first reported in 2002 [1]. This modification of a conventional photoacoustic spectroscopy (PAS) makes use of the unique properties of mass produced U-shaped quartz crystals (tuning forks, TFs) such as their extremely high Q-factor and low sensitivity to background acoustic noise. Their application as miniature, sharply resonant sound transducers lead to compact photoacoustic sensors suitable for field applications. To date, this technology has been used for detection of a number of molecular compounds including NH_3, H_2O, HCN, N_2O, and formaldehyde, using near-infrared and mid-infrared laser sources [2][3].

Detection of methane (CH_4) by means of PAS has been reported by a few research groups using different laser sources, see for example [4-6]. QEPAS based CH_4 sensing was performed in [1]. However, these experiments used ambient air as a diluent and did not take into account a significant O_2 and H_2O influence on the V-T relaxation [6]. In this talk a systematic study of NIR QEPAS methane sensor performance and the impact of O_2 and H_2O will be reported. A fiber-coupled DFB diode laser operating at 1651 nm is used as an excitation source. An advanced control electronics unit (CEU) will be described. The latest version of the CEU includes a diode laser driver and temperature controller, and performs all the functions necessary for autonomous, unattanded sensor operation

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including the laser modulation, locking to the selected absorption line, photoacoustic signal acquisition and processing, and time-stamped data logging to the internal flash memory chip.

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