Mid-Infrared Semiconductor Laser based Trace Gas Sensor Technologies: Recent advances and Applications

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The architecture and performance of four sensitive, selective and real-time gas sensor systems based on mid-infrared semiconductor lasers will be described [1-3]. High detection sensitivity at ppbv and sub-ppbv concentration levels requires sensitivity enhancement schemes such as tunable laser diode absorption spectroscopy (TDLAS) [2, 3] and wavelength modulation spectroscopy (WMS), photo-acoustic absorption spectroscopy (PAS) or quartz-enhanced-PAS (QEPAS) [3-4]. These spectroscopic methods can achieve minimum detectable absorption losses in the range from 10-8 to 10-11 cm-1/√Hz.

A 3.36 μm CW TEC DFB GaSb based laser diode was used as the excitation source for C2H6 detection with a detection sensitivity of 130 pptv with a 1 s. acquisition time. [5-7]. A QEPAS based sensor capable of ppbv level detection of CO was developed [8]. A noise-equivalent sensitivity (NES, 1σ) of 2 ppbv was achieved at atmospheric pressure with a 1 s. acquisition time at 2169.2 cm-1. Furthermore, high performance 5.26 μm and 7.24 μm CW TEC DFB-QCL (mounted in a high heat load (HHL) package) based QEPAS sensors for atmospheric NO and SO2 detection will be reported [9,10]. A 1σ minimum detection limit of 3 ppb and 100 ppb was achieved for a sampling time of 1 s. using interference free NO and SO2 absorption lines located at 1900.08 cm-1 and 1380.94 cm-1 respectively.

References may be included by the end, using the format:

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