ACETONE AND METHANE DETECTION WITH WAVELENGTH MODULATION SPECTROSCOPY IN THE NEAR- AND MID-IR

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A high sensitivity sensor, combining a multipass cell and wavelength modulation spectroscopy in the near-IR spectral region (1.651μm) was designed and implemented for trace gas detection. The sensor uses a DFB laser and software lock-in detection, realized with a LabVIEW code. The high sensitivity was achieved by combining the multipass cell having a long effective absorption length of 290 meters, the wavelength modulation spectroscopy, and noise suppression by using a dual beam scheme. The developed spectroscopic technique demonstrates an improved sensitivity for methane in ambient air and a relatively short detection time compared to previously reported sensors. The average methane concentration measured in ambient air was 2.01ppm with a relative error of $\pm$2.5%. With Allan deviation analysis, it was found that the methane detection limit of 1.2ppb was achieved in 650s. A modification of this scheme for acetone detection with a mid-IR distributed feedback interband cascade laser with the center wavelength around 3.367μm was also developed, achieving the detection limit was 0.58 ppm with 1s and down to 0.12 ppm with 60s signal averaging.

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