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Measurement of nitrous acid (HONO) by external-cavity quantum cascade laser based quartz-enhanced photoacoustic absorption spectroscopy

Hongming Yi (1), Rabih Maamary (1), Xiaoming Gao (2), Markus W. Sigrist (3), Eric Fertein (1), and Weidong Chen (1)

(1) Université du Littoral Côte d'Opale, LPCA, Dunkerque, France (chen@univ-littoral.fr), (2) Laboratory of Atmospheric Physico-Chemistry, Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Hefei, Anhui 230031, China, (3) ETH Zurich, Institute for Quantum Electronics, CH-8093 Zürich, Switzerland

Spectroscopic detection of short-lived gaseous nitrous acid (HONO) at 1254.85 cm-1 was realized by off-beam coupled quartz-enhanced photoacoustic spectroscopy (QEPAS) in conjunction with an external cavity quantum cascade lasers (EC-QCL). High sensitivity monitoring of HONO was performed within a very small gas-sample volume (of ∼40 mm3) allowing a significant reduction (of about 4 orders of magnitude) of air sampling residence time which is highly desired for accurate quantification of chemically reactive short-lived species. Calibration of the developed QEPAS-based HONO sensor was carried out by means of lab-generated HONO samples whose concentrations were determined by simultaneous measurements of direct HONO absorption spectra in a 109.5 m multipass cell using a distributed feedback (DBF) QCL. A minimum detection limit (MDL @ SNR=1) of 66 ppbv HONO was achieved at 70 mbar using a laser output power of 50 mW and 1 s integration time, which corresponded to a normalized noise equivalent absorption coefficient of 3.6×10-8 cm-1.W/Hz1/2. This MDL was down to 7 ppbv at the optimal integration time of 150 s. The corresponding minimum detected absorption coefficient (SNR=1) is ∼1.1×10-7 cm-1 (MDL: ∼3 ppbv) in 1 s and ∼1.1×10-8 cm-1 (MDL∼330 pptv) in 150 s, respectively, with 1 W laser power.

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References

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