Test of Laser Photoacoustic Measurement With a Compact Optical Parametric Oscillator

Introduction

A test setup was built to test low ppb level gas measurement using an extremely sensitive cantilever enhanced Gasera photoacoustic detector PA201, combined with a compact tunable mid-infrared optical parametric oscillator (OPO) laser source. The target molecule in the demonstration was methane whose detection limit was determined to be 4 ppb using 1 second observation time.

### Measurement Setup

Measurement setup included a Gasera PA201 photoacoustic detector with an optical cantilever microphone in 95 mm long cylindrical cell and a very compact mid-infrared range tunable OPO laser source from Cobolt AB. A collimated laser beam was directed through the photoacoustic cell to a power meter. Laser power was modulated using a mechanical tuning fork chopper at 135 Hz frequency.

Gas was sampled using an internal pump inside the photoacoustic detector. The cell was sealed during the measurement and sample gas pressure was set to 953 mbar.

### Results

Laser wavelength was scanned from 3236.45 nm to 3295.95 nm in 0.1 nm steps. Data was integrated 0.957 second time at each step. The resulting spectrum of 10 ppm of methane is shown in Figure 3.

The background signal and the noise level at different wavelengths was measured by setting dry nitrogen inside the photoacoustic detector. The cell was sealed during the measurement and sample gas pressure was set to 953 mbar.

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source is the precision of laser power and optical microphone (0.2 %). Detection limit was calculated by dividing the concentration by the signal-to-noise ratio (2 x RMS).

**Outlook**

The combination of cantilever enhanced photoacoustics and tunable mid-infrared OPO laser source make a perfect fit for rapid and selective trace gas analysis. High sensitivity of the photoacoustic detector and relatively high laser power at fundamental vibration bands of any hydrocarbon and also large selection of other molecules guarantees the low ppb sensitivity.

High selectivity is achieved by the wide tuning range of the laser source. Both the laser source and photoacoustic cell are already very compact and fit easily to a table top size analyzer, but it is also possible to implement the components to a portable size gas analyzer.

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