TECHNOLOGY OFFER

HIGHLY COMPACT TRACE GAS DETECTION

The presented auto-balanced-detection method demonstrates highly efficient cancellation of intensity noise within an ICAPS system. Due to the exact same intensity levels in both channels, this scheme is perfectly balanced and capable of detecting photothermal signals at the shot noise level by detection of both beams leaking out of the one cavity. The use of just one single cavity significantly reduces system complexity and furthermore enhances the signal-to-noise ration by 6 dB compared to conventional balanced detection ICAPS.

BACKGROUND

The miniaturisation of sensitive laser-based gas detectors is of big request among different fields of activity due to the specific characteristics such as a small sample volume or simply a small footprint. However, it still remains challenging. While methods based on direct absorption spectroscopy show a limited potential for miniaturisation due to their dependence of sensitivity on the optical path length according to the Lambert-Beer law, indirect spectroscopic techniques inherently exhibit high miniaturisation potential.

We have identified photothermal spectroscopy using a Fabry-Perot interferometer as transducer to be an excellent candidate for miniaturisation. Besides its overall simplicity, this transducer type exhibits unique characteristics emerging by the Finesse.

However, previous published setups employing photothermal spectroscopy together with a Fabry-Perot interferometer were susceptible to different sources of noise, essentially limiting the performance of the sensors. Here, we present a method for noise cancellation by application of balanced detection, improving sensitivity and ruggedness of this sensor technology.

TECHNOLOGY

The implementation of a balanced detection scheme to the interferometric cavity-assisted photothermal spectroscopy (ICAPS) method enhances the sensor's performance by efficient cancellation of excess noise, i.e. probe laser and environmental noise. The method uses two identical interferometers with a small interferometer spacing of e.g. 1 mm. This scheme combines the advantages of conventional photothermal spectroscopy employing a Fabry-Perot interferometer together with the merits arising by balanced detection.

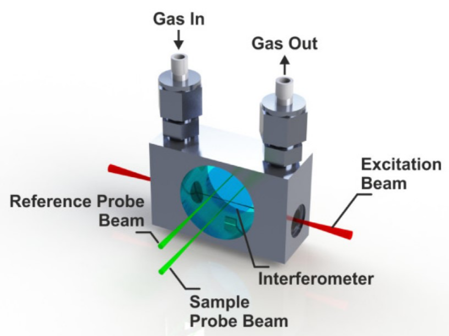

Fig.1: Compact gas cell including the FPI with a mirror spacing of 1 mm.

By this means shot noise limited gas detection becomes available, which greatly enhances the signal-to-noise-ratio by recovering tiny photothermal signals but also improves the ruggedness of the sensor to environmental perturbations by rejection of external noise sources. Thus, robust and highly sensitive detection of gases within an ultra-small absorption volume can be performed.

ADVANTAGES

- Ultra-small sample volume
- Fast sensor response (a few milli-seconds)
- High potential for miniaturisation – down to integration on a chip
- High sensitivity – shot noise limited detection (down to ppt-level)
- High dynamic range – over a few orders of magnitude
- Robust sensor – applicable in harsh environments

WISSENS/ TRANSFER/ OST/

REFERENCE

M060/2020
M026/2016

DEVELOPMENT STATUS

Basic technology established
Sensor integration in optimisation phase

APPLICATIONS

Suitable for a wide range of applications with the need of sensitive and robust gas detection, additionally featuring a small footprint; e.g. industrial process control, environmental monitoring, medical diagnostics, or scientific research.

KEYWORDS

Photothermal spectroscopy
Laser-based gas sensing

IPR

EU (AT, DE, GB, FR), CA, CN JP, US

OPTIONS

R&D – cooperation
License agreement
Patent sale

INVENTORS

Johannes P. WACLAWEK
Bernhard LENDL

CONTACT

Hildegard SIEBERTH
TU Wien
Research and Transfer Support
T: +43 1 58801 415243
hildegard.sieberth@tuwien.ac.at
www.rt.tuwien.ac.at

TECHNISCHE UNIVERSITÄT WIEN