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Editorial Open Access

Trace Gas Sensor Based on Quartz-Enhanced Photo Acoustic Spectroscopy

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Editorial

Laser absorption spectroscopy based trace gas sensing technology is widely used in many fields [1,2]. It follows the Beer-Lambert law which is shown as following:

$$I(v) = I_0 - I_0\exp[-\alpha(v)L]$$

where I(v) is laser intensity passed through the targeted gas, I0 is laser intensity without absorption, a(n) is absorption coefficient, L is path length, n is frequency. The process of laser absorption is depicted in Figure 1.

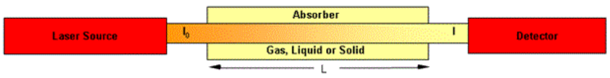

Figure 1: Laser absorption based on Beer-Lambert law.

Photo acoustic spectroscopy (PAS) is a widely used method for trace gas sensing. It is based on photo acoustic effect which was discovered by Bell in 1880's. When the laser power is absorbed by the medium, the absorbed energy can be transformed into heat energy by non-radiative processes. If the laser is modulated, the heat and the pressure wave generated by the heat will also be modulated. This process will produce acoustic wave. Microphone based PAS detection is employed for many years for gas sensing.

In 2002, a modification of traditional microphone based PAS was invented by Frank K. Tittel et al. [3]. Instead of broadband microphone, it uses a low cost, commercially available mm sized piezoelectric quartz tuning fork (QTF) as an acoustic wave transducer, which is shown in Figure 2. This technology is called quartz-enhanced photo acoustic spectroscopy (QEPAS).

QEPAS technique possesses the advantages of high sensitivity, immune to environmental noise, small volume, and so on. The total volume of a typical QEPAS acoustic detection module is ~4 cm^3. Till now, different QEPAS sensor architectures were developed such as an off-beam QEPAS sensor [4], an intracavity QEPAS sensor [5], and multi-QEPAS sensor [6]. Due to above mentioned advantages the QEPAS technique has been successfully used by several groups as a compact sensor for sensitive detection of various trace gases during the past decade.

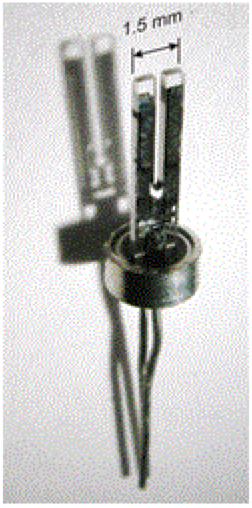

Figure 2: Quartz tuning fork.

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