

### OFF-RESONANT BROADBAND ABSORPTION BASED PHOTOACOUSTIC SENSOR FOR MULTIPLE GAS SENSING

#### IITM Technology Available for Licensing

#### Problem Statement

- Existing methods cannot simultaneously **measure concentrations of multiple gases** with **high precision** across a wide range, **hindering applications in industries and environmental monitoring**.
- A method and apparatus are required to accurately **measure multiple gases** across various concentrations, **addressing challenges in biogas monitoring**, industrial processes, medicine, and environmental tracking.

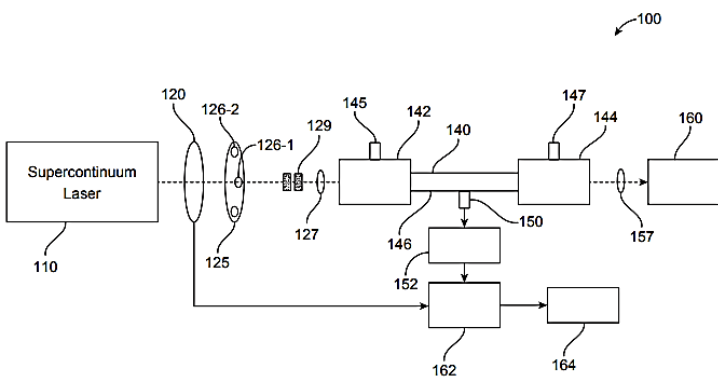
#### Technology Category/ Market

**Category** – Test Equipment and Design Manufacturing / Environmental Engineering, Spectroscopy Technology

**Applications** – Analytical chemistry, Environment Engineering, Manufacturing/ Chemical

**Industry** – Environmental, Biogas, Medical and healthcare

**Market Size** - The **Global Gas Detection Equipment Market Size** is to grow from USD 4.25 billion in 2022 to USD 13.87 billion by 2032, at a Compound Annual Growth Rate (CAGR) of **12.56%** during the projected period.



**Fig. 1 shows the apparatus for measuring multiple gases with tunable filter such as etalon.**

#### Intellectual Property

- IITM IDF Ref. 1843
- IN 382157 (PATENT GRANTED)

#### Technology

- The present invention relates generally to **gas sensing** and in particular to **measurement of gases in gas mixtures**.

#### Excitation Source:

Utilizes a pulsed or continuous wave broadband **infrared (IR)** light source to generate excitation in the gaseous sample.

#### Modulation:

Modulates the output of the light source using an **optical chopper** to create a precise modulation frequency.

#### Selective Detection:

The method which has gaseous sample comprises a gas selected from CH<sub>4</sub>, CO, water vapor, H<sub>2</sub>S, C<sub>2</sub>H<sub>2</sub>, NH<sub>3</sub>, H<sub>2</sub>CO, C<sub>2</sub>H<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>8</sub>, C<sub>4</sub>H<sub>8</sub>, N<sub>2</sub>O, NO or CO<sub>2</sub>, or mixtures thereof. Passes the modulated spectral output through a specific bandpass filter tailored to the target gas species being detected.

#### Photoacoustic Effect:

Illuminates the gaseous sample in a resonant **photoacoustic cell** with the modulated and filtered light, causing the target gases to absorb energy and emit acoustic signals.

#### Acoustic Measurement and Computation:

Utilizes a microphone to measure acoustic signals, enabling concentration computation of target gases via photoacoustic spectroscopy in the infrared range, ensuring precise detection from trace levels to 100% concentration.

#### CONTACT US

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**Key Features / Value Proposition**

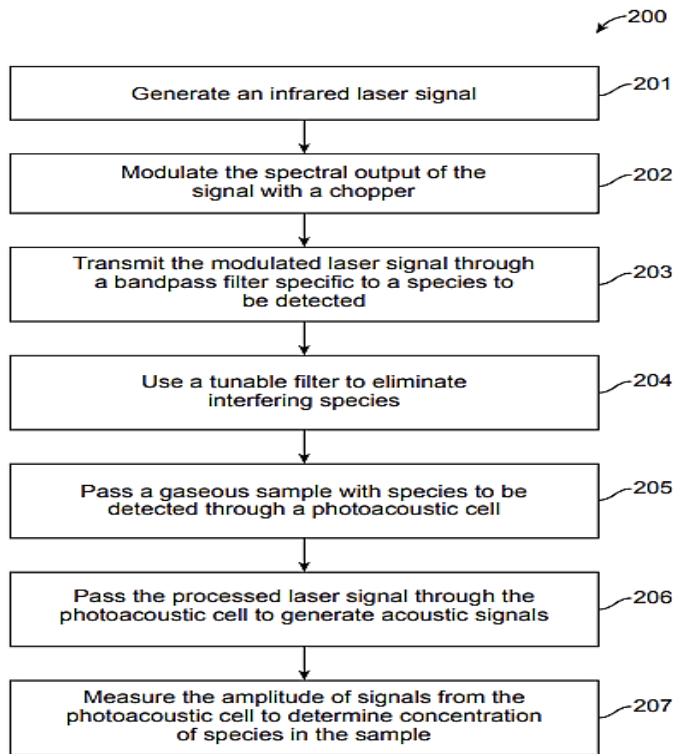
**Technical Perspective:**

- This technology employs modulated **infrared light**, specific **bandpass filters**, and the **photoacoustic effect** to accurately measure **gas concentrations** by detecting acoustic signals emitted when gases absorb light energy.

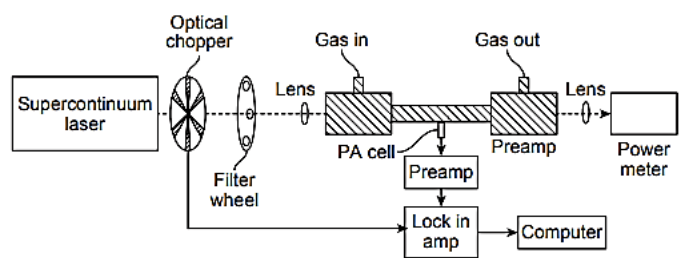
**User Perspective:**

- The method that can simultaneously measure gas concentrations, **spanning from trace levels** to full saturation, enabling applications like **environmental monitoring**, medical diagnostics, and **industrial process control** with high precision.

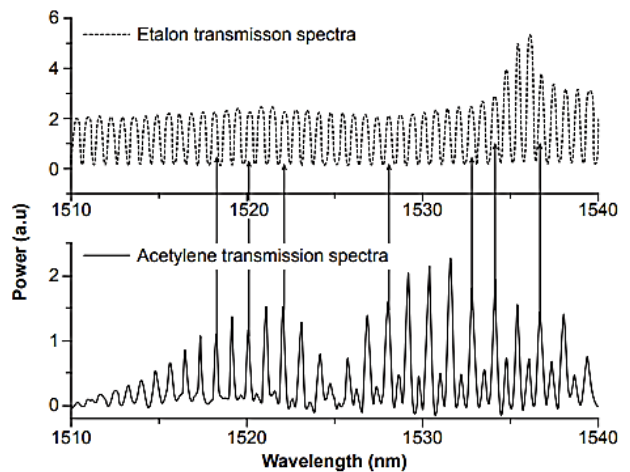
**Images**



**Fig. 2 shows the method of simultaneous measurement of multiple gases.**



**Fig. 3 shows the experimental setup**



**Fig. 4 shows the etalon transmission spectra with selective absorption lines matching with acetylene peaks.**

**Research Lab**

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**TRL (Technology Readiness Level)**

TRL- 4, Technology validated in lab.

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