# Portable Photoacoustic Methane Sensor for Medical Research



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## Photoacoustic spectroscopy based methane sensor



Schematic representation of the device

The photoacoustic instrument consists of four main parts a near infrared diode laser (DL); a dual-pass measuring cell (PA) with a microphone (M); a controlling and processing electronic unit (E). Gas sampling system incorporates a rotameter (RM), a membrane pump (MP) and sampling chambers that are optimized for the experimental subject group.

## Instrument performance:

- MDC: 0.3 ppm 12 s integration time (3σ)
- No cross correlation for common constituents of breath (CO<sub>2</sub>, H<sub>2</sub>O, CO, NH<sub>3</sub>...)
- Wide dynamic range (below ppm to several vol %)
- Near-infrared distributed-feedback diode laser 1.65 μm
- Long-term stability, low maintenance (~once a year)
- Adjustable flow rate from 2 ml/min to 150 ml/min
- Integrated eletronic unit containing laser driver and temperature controller, a microphone amplifier, a data processing unit, and several input and output ports
- Several communication channels RS232/RS485, Modbus or 4-20 mA
- · Internal memory to store the measured data



Calibration curve of the instrument



The compact, portable photoacoustic instrument

## Medical applications

### Breath analysis

- · Expired air contains information on substances in blood
- · Breath analysis can be a noninvasive, real-time, easy-to-use method
- for common clinical practice
- Numerous animal and human clinical studies investigates breath (including methane)

components and their correlation with metabolic processes and state of health

### Methane in breath

- · Animal studies (rodents with different treatments)
- · Human studies (normal respiration, artificial respiration during open-heart surgery)
- · Optimized sampling chambers, gas sampling rate and measurement protocol

Composition of inhaled air (respiratory gas) has to be taken into consideration because its oxygen concentration is occasionally adjusted and medical oxygen contains methane contamination





Methane measurements of two mice. Initially, methane concentration of room air was measured, vertical lines indicate time when gas flow from the sampling chamber started. Solid lines show moving average over 20 points









Two consecutively measured breath samples of a methane-producer person

**SZÉCHENYI PLAN** 

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