TRENDS AND CHALLENGES IN OPTICAL SENSING

Leti Photonics Workshop | Sergio Nicoletti | February 1st, 2017

OUTLINE

1. Benefits of the miniaturization
2. Ultra Low-Power CO_2 sensor
3. Micro Photoacoustic Spectroscopic Sensor
4. Focus on MIRPHAB Pilot Line

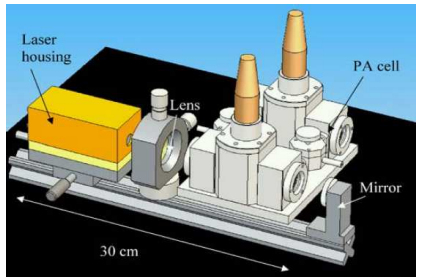
BENEFITS OF THE MINIATURIZATION

Approach

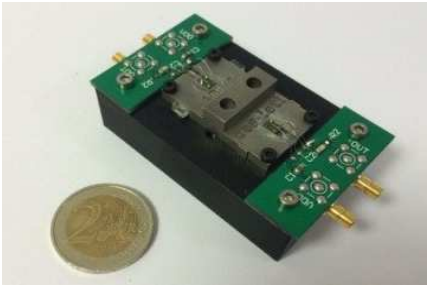
- Full MEMS fab - Combine Photonics and MEMS
- Miniaturize optical/sensing functionalities on planar substrates
- Handle the full chain of sensing from source to detection

Advantages

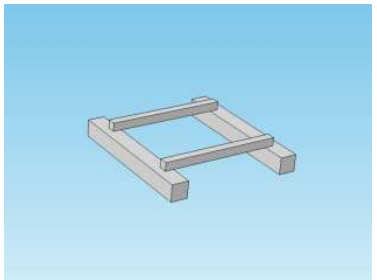
- Lower the price
- Shrink down size and power consumption
- Monolithic System-on-Chip/System-on-Packaging



Grossel et al., Appl. Phys. (2007)

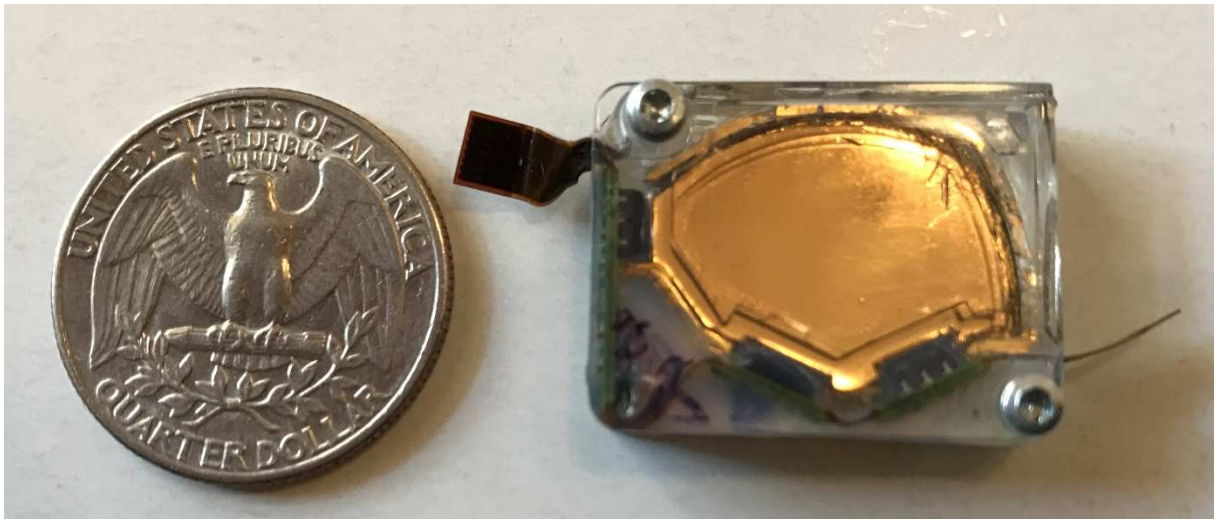


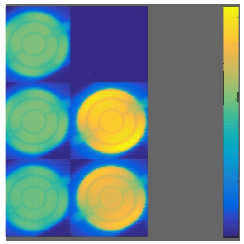
Mini PA – Leti 2015



µ-PA cell (2.6 x 2.6 mm^2) – Leti Ongoing

ULTRA LOW-POWER NDIR CO_2 SENSOR





Key figures

- Low power consumption: 2 mW
- Small footprint (~ 3 cm²)
- Resolution: 20 ppm @1000 ppm concentration for CO_2 gas
- Designed for CO_2 or CH_4
- Reference channel

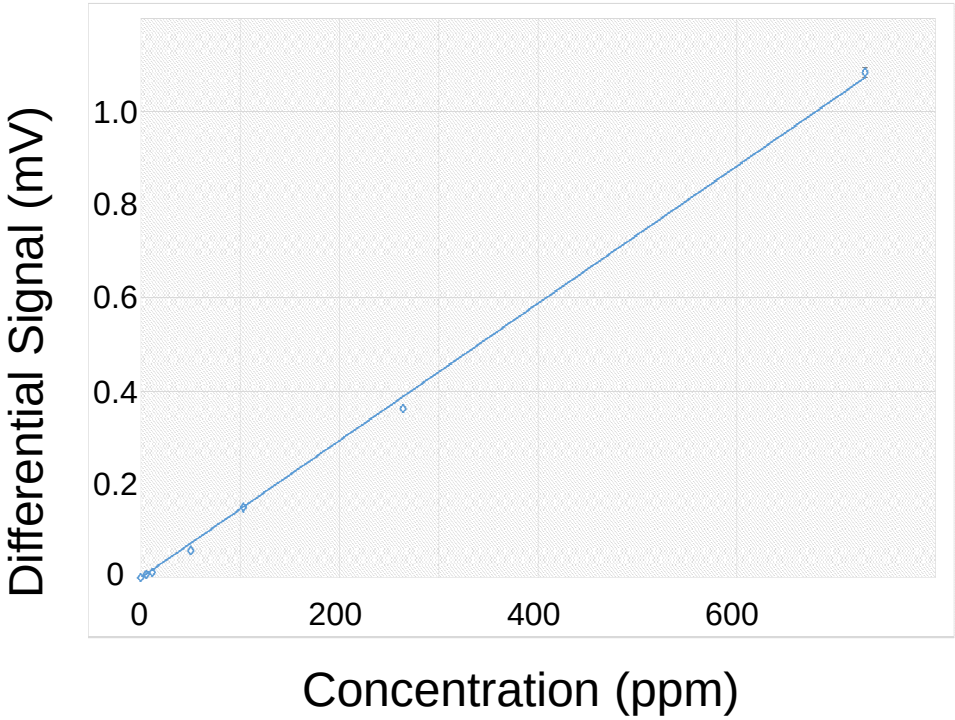
CO_2 SENSOR – REAL TIME MAPPING OF THE AIR QUALITY

elichens

CO_2 SENSOR – REAL TIME MAPPING OF THE AIR QUALITY

our gas sensor embedded into a bus shelter

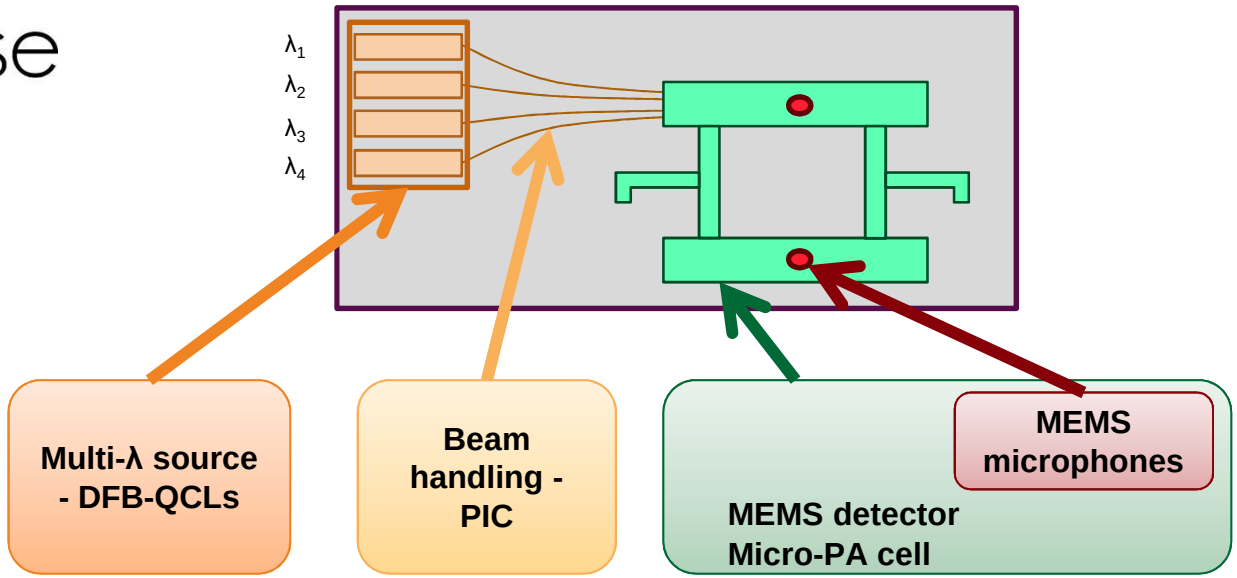
Micro Photoacoustic Spectroscopic Multigas Sensor

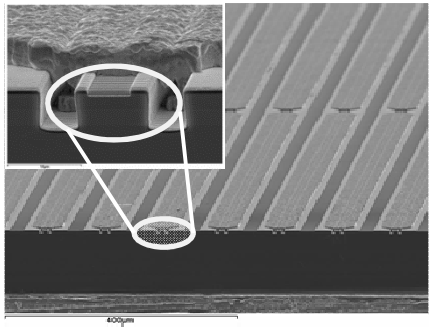


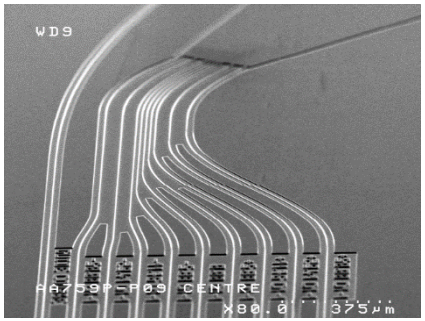
- LoD on CO_2 at 2302 cm^{-1}: **250 ppb**
- Integration Time: **1 sec**
- Laser Power: **5mW**
- Detection range : **1 ppm – 2000 ppm**
- Sample Gas flow rate **: 10 ml/min**

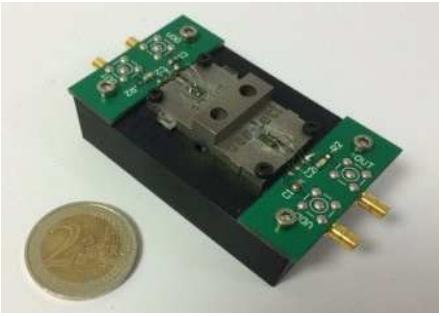
NO | CH_4 | CO_2 | H_2CO | N_2O | SO_2 | CO | NO_2 | NH_3

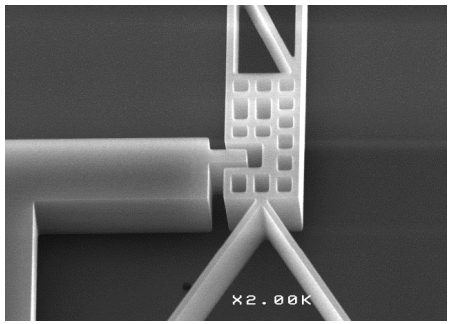
Micro Photoacoustic Multigas Spectroscopic Sensor









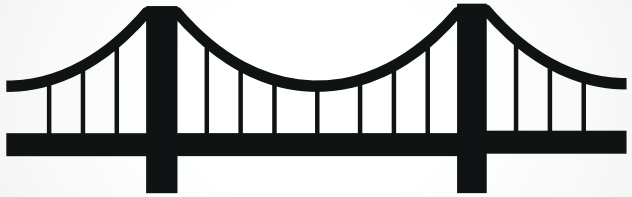


MIRPHAB – MIR PILOT LINE

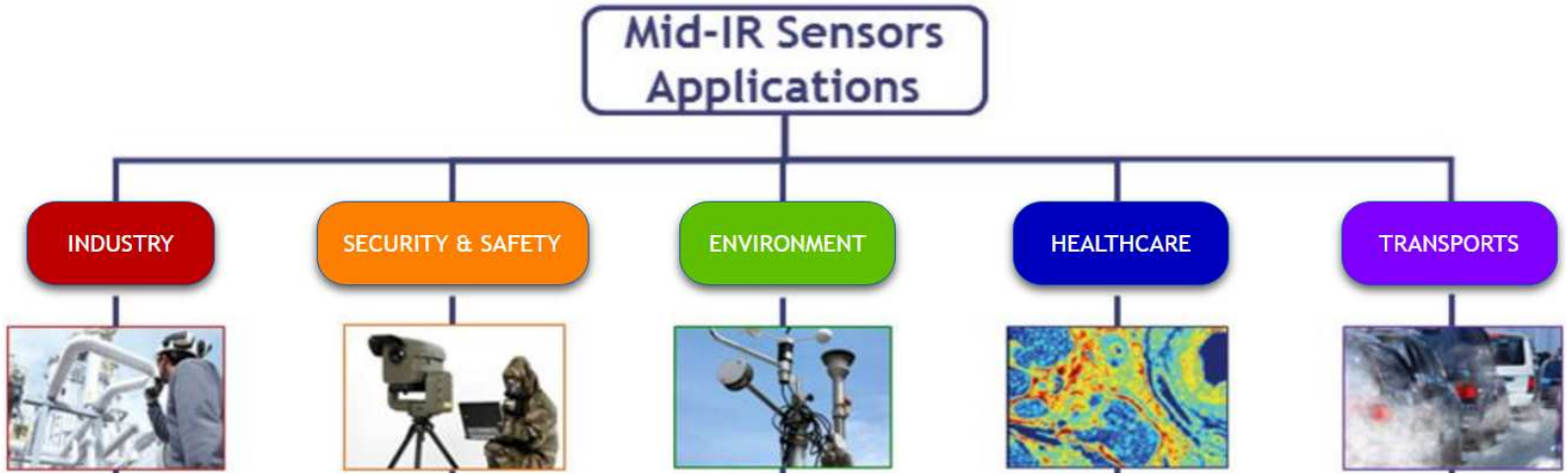
- *MIRPHAB is a pilot line for **prototyping and production of Mid-IR devices** for the detection of chemicals in gas and liquids*

- *MIRPHAB offers **open access to design, prototyping and fabrication** of miniaturized photonics devices for your specific application*

MIRPHAB



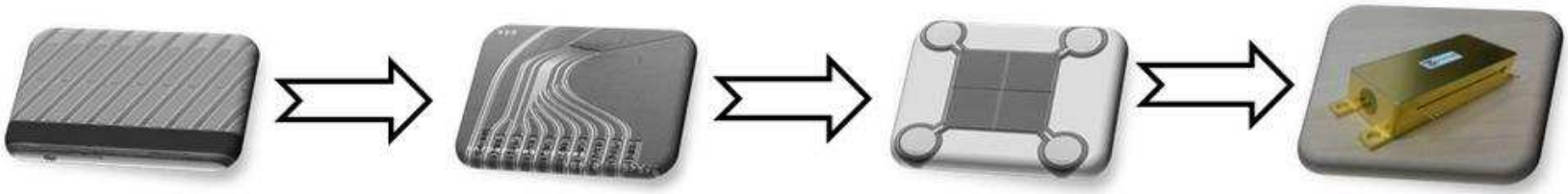
Bridging the Valley between Knowledge and Market and boosting the industrial deployment of MIR Photonics Technologies.



The LEGO™ approach

Assembly your unique chemical spectrometric system by combining sources, photonic circuits and detectors in a standard packaging.

Spectrometer System



Laser (QC/IC) → Optics (PIC Si/SiGe & Ge) → Detector (type2/InAsSb/QCD) → Packaging (SOC & SIP approach)

Thank you for your attention

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