



μPA sense

LETI INNOVATES IN CHEMICALS SENSING WITH PHOTO-ACOUSTIC SOLUTIONS

+ WHAT IS μPA sense

The photoacoustic spectroscopy technique is based on the absorption of light by the molecules of interest and the subsequent generation of acoustic waves. This technique, typically used for high-resolution mid-IR spectroscopy, is today confined to laboratory applications due to its size and cost.

Leti proposes μPA sense, a compact photoacoustic sensor working in the mid-infrared region, by assembling a multi-wavelength quantum cascade laser (QCL) source with a photonics integrated circuit (PIC) combiner in a small photoacoustic cell (a few cm³). **This sensor allows multigas detection with very high sensitivity down to a few ppb level.**

+ APPLICATIONS

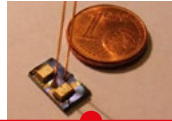
Trace gas detection and sensing in:

- Environmental
- Process control
- Quality assurance
- Safety & security
- Early disease diagnosis



2014
MINI PA

Electroformed metal foils



2017
MINI PA on Si

Monolithic integration



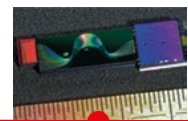
2018
MICRO PA

M&NEMs microphones



2020
QCL & PA sensor

All-in-One multigas PA sensor



On going
ON CHIP SENSOR

Butt-coupled PA
photonics components

+ WHAT'S NEW?

Leti's teams are focusing on miniaturization of the sensor at chip or packaging level to address cost reduction, multigas detection and portability.

Key achievements toward miniaturization are:

- The effective fabrication process for QCL sources (originally developed by our startup partner mirSense): the wavelength of each laser is selected independently after the growth of the epitaxial layers
- Low-loss waveguides based on Ge and SiGe alloy to realize the PIC combiner (losses as low as <math><1\text{dB/cm}</math> on the 3-12 $\mu\text{m}</math> range)$
- Mini acoustic Helmholtz detectors fabricated on silicon and based on MEMS microphones suitable for trace-gas detection

mirSense, a Leti's startup company, is currently industrializing and commercializing this mini photoacoustic gas sensor.

+ WHAT'S NEXT?

Leti currently is working on:

- Transfer of the QCL fabrication process on silicon wafer
- Realization of the photoacoustic detector on silicon
- New designs of the photoacoustic cell to improve resolution and stability
- Ozone detection in the UV band

PATENTS, PUBLICATIONS, PARTNERSHIPS

- 10 patents on photoacoustics & sensor integration
- 11 publications (2013-2019)
- Partnership with mirSense company since 2015

KEY FEATURES

- Multigas sensors from one to tens of species (with absorption lines in the 3-12 μm wavelength range)
- Ultra-low limit of detection down to few ppb
- Portable system, low volume
- Highly selective identification
- Real-time measurement

INTERESTED IN THIS TECHNOLOGY?

Contact:

Sergio Nicoletti

sergio.nicoletti@cea.fr

+33 438 780 289

+33 786 353 272

CEA-Leti, technology research institute

Commissariat à l'énergie atomique et aux énergies alternatives
Minatec Campus | 17 avenue des Martyrs | 38054 Grenoble Cedex 9 | France

www.leti-cea.com



@CEA_Leti



CEALeti



CEA-Leti

