FRANÇAIS ENGLISH

cea leti

µPAsense

PATENTS 10+ PATENTS

Together, light and acoustic waves offer selective, sensitive chemical sensing

What it is

This photoacoustic technique is based on the absorption of light by molecules of interest and the subsequent generation of acoustic waves from molecule excitation. Such acoustic waves lead to the determination of very low molecule concentration levels in real-time. Typically used for high-resolution mid-IR spectroscopy, this technique is currently limited to laboratory applications due to equipment size and cost.

CEA-Leti's µPAsense is a compact photoacoustic sensor operating in the mid-infrared range. It consists of quantum cascade laser (QCL) sources made on Silicon combined with a compact photoacoustic cell and microphones. It can perform multi-molecule detection, at very high sensitivity levels reaching parts per billion.

What it can do

This selective and sensitive µPAsense technology is fully-compatible with miniaturization and can be used for various applications:

- Medicine, health, and wellness
- Industrial process control
- Mobility
- New energy industries
- Environmental monitoring, food manufacturing, and farming

What makes it unique

This µPAsense technology is fully-compatible with high performances, extreme sensor miniaturization together with cost reduction, large scale manufacturing and easy integration. Key milestones have been already achieved towards a high performances, miniature, high-volume and low-cost technology:

- An effective CMOS fabrication process for mid-infrared QCL sources made on silicon, with very high manufacturing yields demonstrated.
- Low-loss waveguides based on Ge and SiGe alloys for PIC combiner fabrication, with optical losses as low as <1dB/cm within the 3 µm–12 µm range.
- MEMS photoacoustic cells and microphones made from a silicon MEMS technology, suitable for detection of traces of molecules.

CEA-Leti µPAsense technological developments ▼

2014	2017	2018	2020	On going
MINI PA	**MINI PA on Si**	**MICRO PA**	**QCL & PA sensor**	**On-chip sensor**
Electroformed metal foils	*Monolithic integration*	*M&NEMS microphones*	*All-in-one multigas PA sensor*	*Butt-coupled PA photonics components*

Working with CEA-Leti

CEA-Leti is ready to scale up and transfer the silicon CMOS QCL and the MEMS photoacoustic cell technologies and is developing ultra-miniaturized sensors for selective and sensitive detection of various chemicals into gas or liquids. Companies of all types and sizes can work with CEA-Leti to develop custom sensors and sensing systems, leveraging this breakthrough technology. With a proven R&D partnership management processes and robust intellectual property policies, CEA-Leti is poised to bring new ideas to the market through a fast track from lab to fab. Our objective is to accelerate time-to-market of new generations of products developed by partners.

Key facts

- Detection of 1 to 10 chemicals on the same chip
- Wavelength engineering for optimal sensing performance
- Ultra-low detection limit, down to a few ppb
- Portable, low-volume system
- Miniaturized and easy-to-integrate solution
- Real-time measurements

Scientific publications

- Constancias, C. et al. (2024). "A multi-gas sensor for environmental gases: towards miniaturization with mid-infrared Quantum Cascade Lasers (QCL) and silicon integration of photoacoustic cells". Proc. SPIE 12999, Optical Sensing and Detection VIII, 129990J
- Coutard, J.G. et al. (2024). "Neogly™ QCL-based NI-CGM medical device". Proc. SPIE 12838, Biophotonics in Exercise Science, Sports Medicine, Health Monitoring Technologies, and Wearables V, 1283802

Interested in this technology?

Contact:
Vincent Destefanis
vincent.destefanis@cea.fr
+33 660 908 508

CEA-Leti, technology research institute
17 avenue des Martyrs, 38054 Grenoble Cedex 9, France
cea-leti.com

@CEA-Leti

Research for industrial innovation

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