



# Optical multi-sensors



## Ultra-miniaturized, high-performance optical multi-sensors for gas & liquid detection

### What are optical multi-sensors?

CEA-Leti has worked on innovative photonic sensing technologies for many years. One result of this expertise is the development of new generations of miniaturized, optical photoacoustic and interferometric sensors:

- **Photoacoustic sensors using quantum cascade lasers:** By using the thermal laser excitation of a gas or a liquid, it is possible to selectively determine very low concentrations (down to sub-ppm) in real-time.
- **Interferometric Mach-Zehnder sensors:** By adsorbing molecules onto arrays of SiN waveguides, it is possible to measure in parallel concentrations for a wide variety of chemical species.

CEA-Leti develops novel sensor solutions from low technology readiness levels (TRL) up to demonstrated proof of concepts (TRL 4-5). Our innovative R&D covers topics such as modeling, design, prototyping, manufacturing and characterization methods from components to sensing systems.

### Applications

Photoacoustic and interferometric sensors can help overcome a wide variety of societal and environmental challenges through applications for:

- Environment
- Health
- Industry
- Transportation
- Safety & security
- Agroindustry

## A wide range of applications

- **Environment:** reduction of environmental pollution through the monitoring of air (indoor & outdoor) and water quality. Development of new energy sectors thanks to innovative green gas sensing solutions
- **Health:** improved patient health & comfort thanks to monitoring systems for physio parameters and bio-sensing for point-of-care diagnostics as well as drug manufacturing
- **Industry:** reduction of industrial emissions through improved monitoring of gas emissions, gas leak detection and gas quality control
- **Transportation:** safer & cleaner transportation with in-cabin gas monitoring for driver safety and comfort as well as the monitoring of vehicle emissions
- **Safety & security:** improved safety & security thanks to better monitoring solutions for toxic and explosive gases in both industrial and public environments
- **Agroindustry:** waste reduction for agrifood thanks to improved food quality monitoring

## What's new?

Photoacoustic and interferometric sensors aim to support a variety of high volume and high performance applications, including consumer markets. Notable features and performance indicators include:

Photoacoustic Sensors	Interferometric Devices
Small to ultra-small footprints—cm <sup>3</sup> size	
Large-scale cmos & mems manufacturing process	
Low manufacturing costs—in the €/€ range	
Real-time measurements	Fast measurements in the minute range
Ultra-high selectivity use of qcl lasers with very narrow wavelength emission	Massively parallel detection use of mzi sensor arrays
Ultra-high sensitivity—LOD in the ppm or below the ppm range	
Easier integration & operation = wider use & adoption	

## What's next?

CEA-Leti is working on a variety of challenging technological topics such as Photonic Integrated Circuits in Mid-Infrared (PIC MIR), QCL on Silicon, Si/SiGe/Ge or SiN waveguide photonic platforms and MEMS emitting MIR light source...



## Interested in these technologies?

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