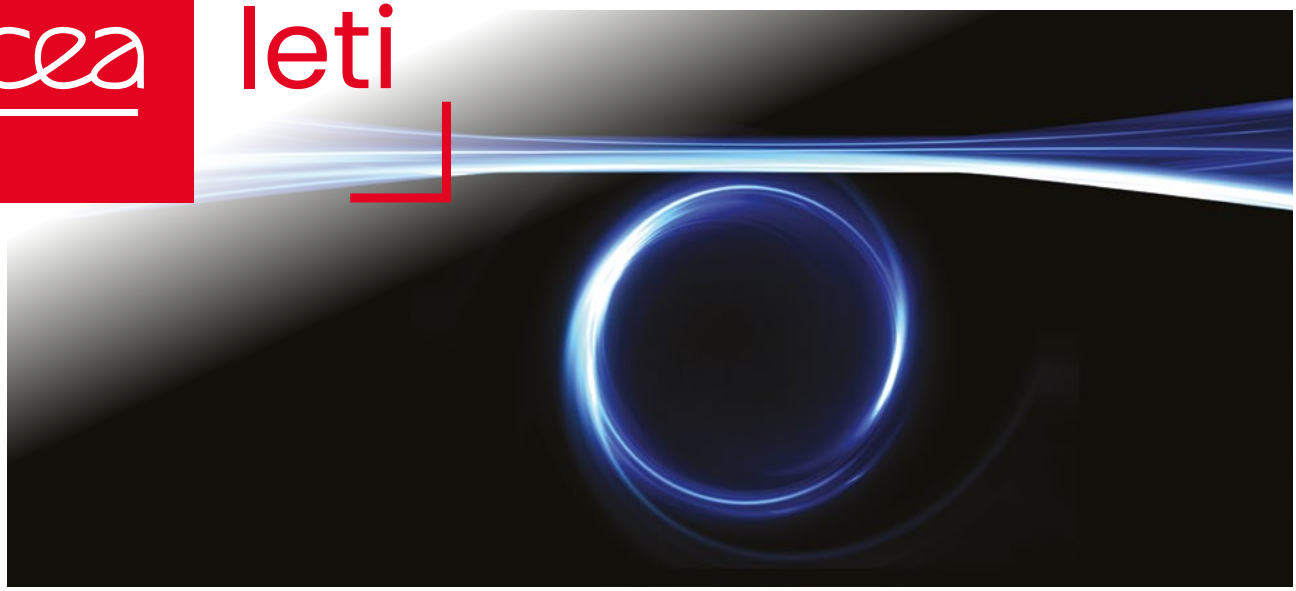


Optomechanical sensor

PATENTS 20 PATENTS

Light-based motion detection for extreme sensitivity, ultra-rapid response, and superior integrability

What it is

CEA-Leti's optomechanical sensor technology represents the next evolution of microelectromechanical (MEMS) sensors. From the capacitive sensors of the 1980s to the more recent piezoresistive sensors, MEMS have become increasingly sensitive over the past several decades. Today, CEA-Leti is bringing silicon photonics to high-performance MEMS for a new generation of optomechanical sensors.

An electromechanical sensor is combined with an optical cavity. Instead of generating an electrical signal like a conventional MEMS sensor, a moving mass generates an optical signal of varying intensity—the measurement.

What it can do

CEA-Leti's optomechanical sensing platform is ideal for:

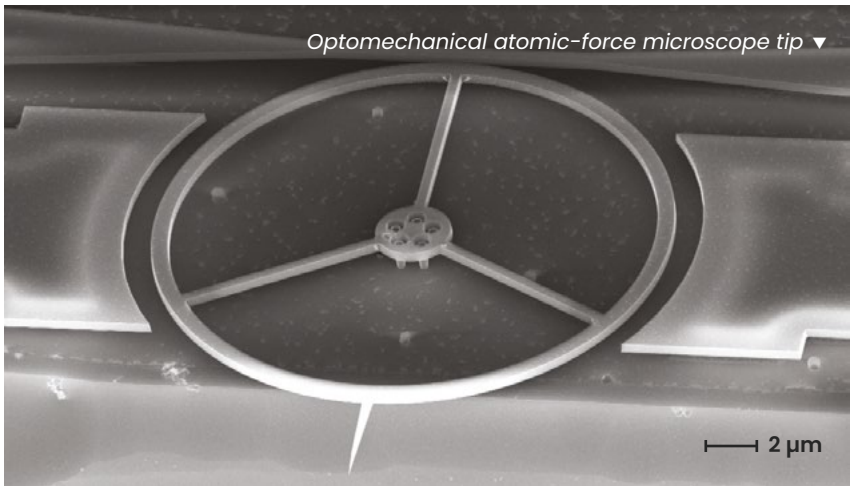
- **Portable in-situ mass spectrometry** with extreme sensitivity down to individual viruses and proteins for biological analysis and environmental monitoring.
- **Portable biological sensing** offering rapid biomarker detection and sensitivity down to single bacteria for diagnostics and water testing.
- **Real-time atomic-force microscopy** approaching video-rate imaging for the observation of fast biological processes.
- **It also supports silicon clocks** with quartz-like accuracy for native GHz-frequency clocks with no electronic multiplication for the ultimate in precision.

The technology also brings new levels of precision and compactness to **inertial sensors** and is being investigated for **quantum information transfer** and rheology.

What makes it unique

Optomechanical sensing—sensing through light—is a new paradigm. And silicon-based optomechanical devices represent a giant leap in performance, with:

- Extreme sensitivity: femtometer (1/100,000th of an atom) detection capabilities.
- Ultra-rapid response in the terahertz range.
- Superior integrability using proven 200 nm VLSI MEMS and photonic integrated circuit technologies. The same multiplexing techniques used in optical telecommunications could lead to multiplexed optomechanical arrays for multiple measurements on a single chip.



Optomechanical atomic-force microscope tip ▼

Working with CEA-Leti

CEA-Leti's chip-level developments will be followed by system-level advances to obtain a compact system-in-package (SiP) with the optical function and readout electronics. CEA-Leti's optomechanical sensing technology is of interest to equipment manufacturers looking for high-precision clock technologies, scientific instrument manufacturers developing testing and analysis solutions, and chemical or materials manufacturers, for example.

Companies of all types and sizes can work with CEA-Leti to develop 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 from the lab to fab securely and efficiently.

CEA-Leti optomechanical sensing advantages

- 1,000 times more sensitive than capacitive sensors
- 1,000 times faster than commercial atomic force microscope probes
- 100 times faster than piezoelectric sensors
- Potential integration of thousands of sensors

Scientific publications

- M. Sansa et al. (2020). "Optomechanical mass spectrometry". Nature Communications 11.
- T. Furcatte et al. (2024). "Towards GHz low phase noise oscillators with electro-optomechanical resonators" 2024 IEEE Ultrasonics, Ferroelectrics, and Frequency Control Joint Symposium (UFFC-JS) pp. 1–4.

Interested in this technology?

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