



μPMSense



On-chip air quality sensors: expanding the detection of pollutants

What is μPMSense?

CEA-Leti's μPMSense is an innovative particle matter optical sensor that offers an extended pollution source detection. In fact, μPMSense detects particle matter (PM) down to 0.3 μm and identify inorganic, metallic and carbon-based particles—currently not addressed by standard commercial products.

μPMSense leverages the light scattering technique. It collects the full 'light scattering signature' of a single particle using a lens-less imaging set-up by combining a solid-state visible light source with an unconventional CMOS retina, having a vertical air channel drilled into the chip.

Applications

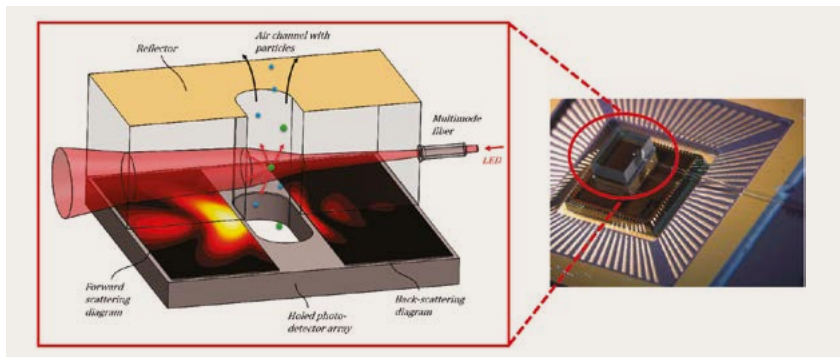
μPMSense may fuel various air quality sensing solutions:

- Particle detection and counting
- Air quality monitoring
- Pollen and other key pathogens detection

What's new?

Regular PM sensors leverage a single light source –visible or near infrared– that illuminates an air channel where a particle can deviate a part of light. A single photodetector, located off-axis, detects the light scattered by the particles within the air stream only.

μ PMsense is composed of a holed CMOS image sensor and a miniaturized fan. A fluidic channel help drive the air stream generated by the fan into the detection area. The light beam illuminates particles in the air stream and the image sensor collects the scattered light signature. The diffraction pattern is then processed and translated into relevant information –type and size of particle detected.



What's next?

This technology is now well functioning, and CEA-Leti's team is working towards the miniaturization of the sensor at chip level. So far, the team reports:

- No false positive due to water
- Low flow rate at comparable resolution
- High resolution ($1 \mu\text{g}/\text{m}^3$), single particulate detection
- Particulate counting as with bulky system
- Identification / classification (metallic, carbon based, etc.)
- Machine learning & classification

CEA-Leti's team continues improving the technology with:

- New designs of CMOS retina specifically developed for PM detection
- Design and fabrication of a miniaturized optic setup
- Integration of a miniaturized fan required to generate the air stream
- Fluidics' optimization

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Publications

- G.Jobert et Al.
Miniature particulate matter counter and analyzer based on lens-free imaging of light scattering signatures with a holed image sensor
Sensors and Actuators Reports, doi.org/10.1016/j.snr.2020.100010
- M.Fournier et Al.
A miniaturized optical sensor for particulate matter detection
SPIE OPTO 2020 doi.org/10.1117/12.2546128
- G.Jobert et Al.
A Miniaturized Optical Sensor for Fire Smoke Detection
Transducers & Eurosensors XXXIII doi.org/10.1109/transducers.2019.8808611

Interested in this technology?

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