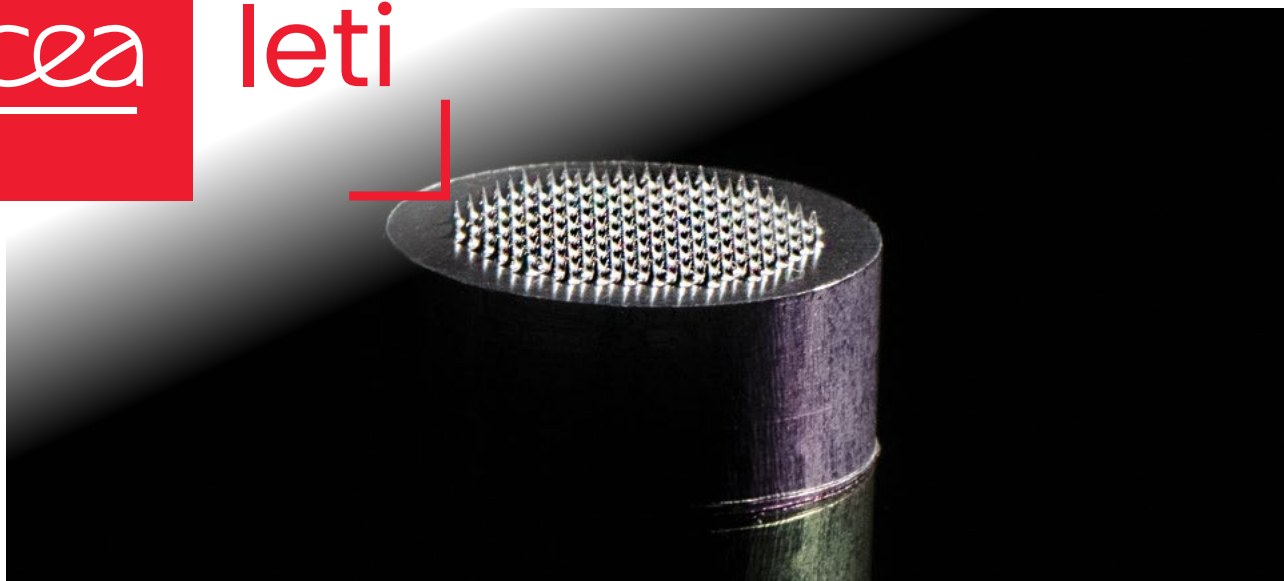




Instrumented Microneedles



Intradermal device from biological monitoring to therapy

What it is

Less invasive than conventional needles and totally painless, CEA-Leti's biocompatible polymer microneedles reach the dermis to collect interstitial fluid, deliver an active ingredient, or inject and collect light for therapeutic or measure purpose, addressing both physiological characteristics or biomarkers.

These microneedles are integrated into microfluidic, optical, or electrochemical components to create a complete patch system that is applied directly to the skin. This technology is designed for various diagnostic and therapeutic use cases, enabling personalized medicine.

What it can do

CEA-Leti's microneedles meet a variety of healthcare needs:

- **Photodynamic therapy (PDT):** Bimodal microneedles, similar to an optical waveguide, can target skin cancers and other skin diseases deeper by delivering simultaneously a photosensitive active ingredient and light.
- **Transdermal delivery of active ingredients:** Drugs, proteins, vaccines, and local anesthetics can be delivered over periods ranging from a few minutes to several days.
- **Interstitial fluid sampling:** Active microfluidics (micropump, electroactive system) and passive microfluidics (capillary action) can be selected to collect interstitial fluid on a smooth way depending on the application.
- **In situ diagnosis and monitoring:** Physiological parameters (pH, impedance, etc.) can be measured and biomarkers (glucose, lactate, cortisol, etc.) can be monitored using different modalities (electrochemical, impedance, or optical).

What makes it unique

CEA-Leti's microneedles, combined with the appropriate instrumentation for the desired function (*in situ* measurement, interstitial fluid sampling, or administration of light and/or active ingredients), offer a minimally invasive, highly effective solution.

Thanks to their optical properties which allow controlled light propagation in tissues, CEA-Leti's microneedles, when used in combination with an active ingredient, can make PDT more effective and less painful. The resorption rate of biocompatible polymer is also controlled to precisely adjust the release of the active ingredient over time.

Finally, for the measurement and monitoring of biomarkers in interstitial fluid, microneedles may be connected to a unique large sensor to reinforce the sensor response, or to individual sensor each, to enable multiplexed measurements.



▲ Molded cellulose-derivative based micro-needles



▲ Intradermal microneedle device



▲ Hollow microneedles

What's next

CEA-Leti draws on its multidisciplinary expertise in biocompatible polymer engineering and silicon components to integrate microfluidic, optical, or electrochemical functions into its microneedles, supporting its partners from feasibility studies through to clinical trials.

Thanks to its in-depth knowledge of the regulatory environment, CEA-Leti can collaborate with pharmaceutical companies that manufacture photosensitizers, vaccines and other transdermal products, medical device manufacturers such as PDT light source manufacturers, and *in vitro* diagnostic companies to develop TRL 6-8 products that comply with healthcare market requirements.

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Key figures

- A wide range of microneedle sizes and geometries, from 400 μm to 1,400 μm in height, from 300 μm to 400 μm in diameter, solid or hollow, conical or cylindrical, with 1 or more beveled tips.
- A variety of patch formats: round or square, from 1 cm^2 to 6 cm^2 , with a density varying from 4 to 140 microneedles per patch.

Scientific publications

- L. Gautier, L., et al. (2025). *Design of hydrogel microneedle arrays for interstitial fluid analysis and animal physiology monitoring*. Micromachines 16, 1015. Invited paper. DOI:10.3390/mi16091015
- Juillard, S., et al. (2025). *Biodegradable microneedle-based electrodes for electrophysiological measurements*. Journal of Materials Chemistry B, 13, 10009-10019. DOI: 10.1039/d5tb00727e

Interested in this technology?

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