FRANÇAIS ENGLISH

cea leti

Organoid-on-a-chip

Microfluidic devices with cellular systems that model human physiology and pathologies to facilitate targeted healthcare

What is an organoid-on-a-chip?

Organoids are self-organizing multicellular assemblies created from the proliferation and differentiation of stem cells.

Microfluidic chips create an environment that encourages their growth and reproduces the spatial and biological constraints to which cells would be exposed in their original tissue. Sensors can also be added to the system. This combination makes it possible to grow a tissue substitute, observe it and eventually communicate with it in real time. This is a revolution for biology research, biopharmaceutical R&D and regenerative medicine.

CEA-Leti is developing technologies to guide cell self-organization, differentiation and maturation in space and time, as well as the means to characterize and measure the physiological functions of one or more organoids-on-a-chip.

Applications

Areas of research include:

- Translational research tools for biology
- Identifying new therapeutic targets
- Improving the success rate of clinical trials for innovative therapies
- Personalized medicine: selecting therapeutic agents tailored to a patient's disease
- Graft monitoring

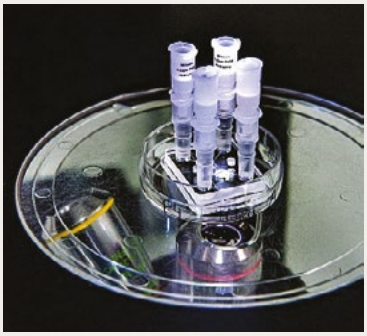
A world first

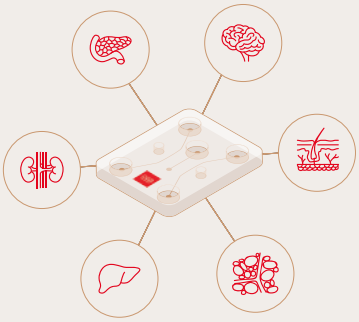
In 2022, the CEA was able to sustain for a month islets of Langerhans, which help regulate blood glucose levels by releasing insulin. In addition, individual islet insulin production was quantified to determine which were the most "efficient". A first that may one day improve the efficacy of islet transplants performed on diabetic patients.

What's new?

CEA-Leti's organoids-on-a-chip enable precise monitoring by using:

- Organoid vascularization (in collaboration with CEA-Irig)
- On-board sensors for real-time monitoring of organoid physiological functions
- Innovative microfluidic architectures to integrate complex biological protocols
- Heterogeneous thermoplastic/silicon integration
- Pre-industrial equipments, rapid prototyping and support for industrialization





Trapping and culturing pancreatic organoids on microchips and integrating microsensors used to characterize them.

Publication

"Microfluidic device integrating a network of hyper-elastic valves for automated glucose stimulation and insulin secretion collection from a single pancreatic islet", C. Quintard, E. Tubbs, J-L. Achard, F. Navarro, X. Gidrol, Y. Fouillet. Biosens Bioelectron (2022) doi: 10.1016/j.bios.2022.113967

What's next?

CEA-Leti teams are taking advantage of their unique working environment to achieve a variety of goals:

- Combining vascularization and immuno-competence on microfluidic components (in collaboration with CEA-Irig)
- Organ-on-a-chip functionality using dedicated sensors
- Monitoring with holographic imaging and associated interpretative algorithms
- Developing complex microfluidic test benches to control and monitor organs-on-a-chip
- Manufacturing micro-fluidic components that can be industrialized and standardized

Interested in this technology?

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