# Sensorised, biomimetic organ-on-a-chip system

micronit microtechnologies

We aim to recapitulate *in-vivo* complexity in simple *in-vitro* devices

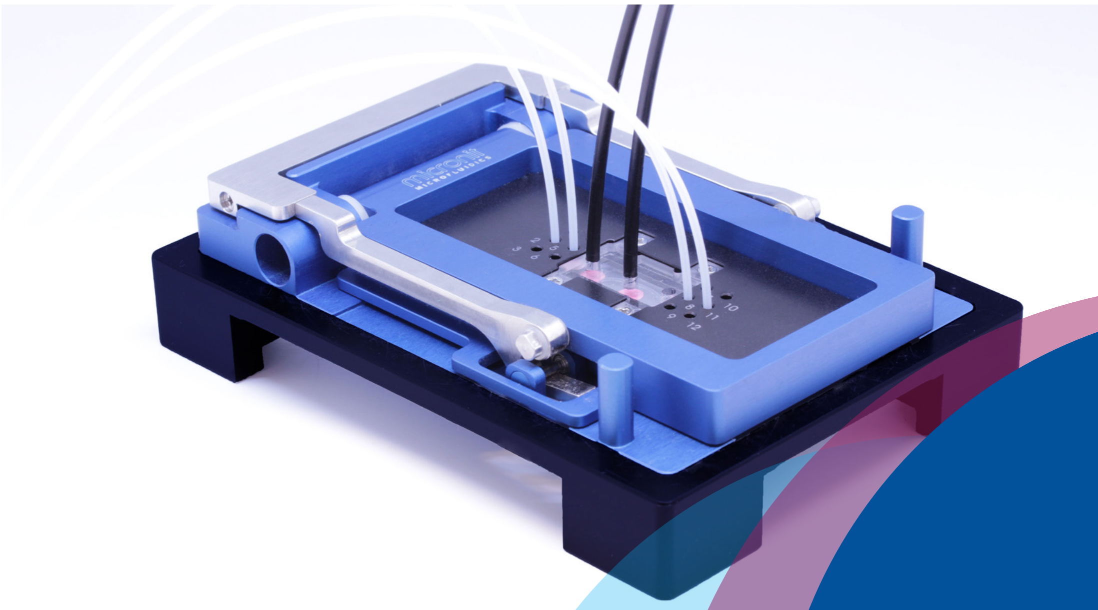
**Organ-on-a-chip devices are powerful tools used to create artificial, in-vitro-like structures. However, the easy monitoring of biological content is still a challenge. To overcome this, Micronit Microtechnologies plays an active role in the integration of various kinds of sensors through its commercial device.**

Living organisms have complex and dynamic structures; the tissues that form their bodies are composed of a three-dimensional matrix in which cells can migrate, guided by chemical and mechanical cues. Liquids flow in intricate networks of vessels that regulate nutrient supply, waste product wash-out and endocrine signalling, allowing the homeostasis of the entire system. Investigating this complex entity without impairing its integrity is not a trivial task, and finding the anomalies that cause pathologies can be like looking for a needle in a haystack. Organ-on-a-chip (OOC) devices are a way of overcoming this issue. They consist of microfluidic networks designed to mimic a biological niche in an artificial environment, thus reproducing physiological features in a controllable system, where biologically relevant parameters can be easily measured.

## State of the art

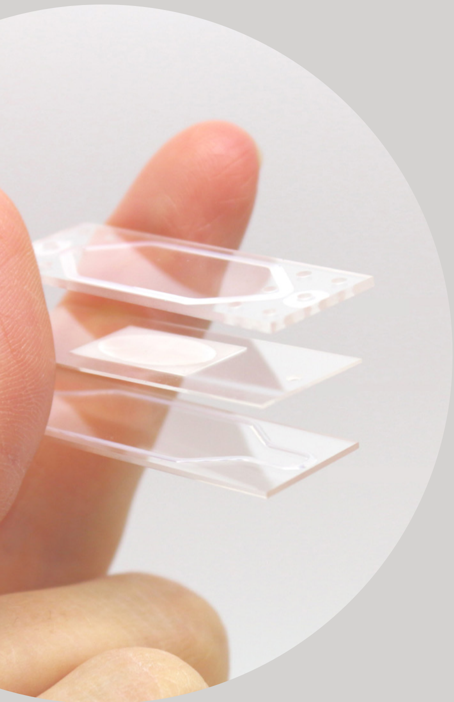
OOC rapidly permeated the research laboratories, feeding from the well-known microfabrication capabilities polished by microfluidics during the past two decades. However, despite the high quality of the specific experiments for which they were designed, the devices born in such environments tended to suffer from two major weaknesses: the limited scalability of the fabrication and complex user protocols.

Micronit Microtechnologies aims to recapitulate in-vivo complexity



**The OOC platform is equipped with optical sensing. The cell culturing device, which is visible inside the clamping system, has integrated sensing elements (red dots produced by PreSens) that are aligned to optical fibres used for readouts.**

in simple in-vitro devices, thereby bridging the gap between technological advancements and researchers who own the expertise to extract biologically relevant information from those advancements. The company's devices are already in use at several research laboratories across the world, proving their suitability in creating artificial barrier models (including the gut and lung) in the field. The device is built around a cartridge that carries a porous membrane and is directly accessible by pipetting, making it compatible with the standard protocols used in cell culture laboratories. Its resealable architecture makes it possible to create a flow chamber around the device by using a dedicated, customisable clamp.



Micronit's OOC platform is equipped with optical sensing. The cell culturing device, which is visible inside the clamping system, has integrated sensing elements (red dots produced by PreSens) that are aligned to optical fibres used for readouts.

## Stimulating and sensing

The ability to assemble the device using mechanical forces makes the chip suitable for the integration of sensitive biological content (such as living cells, protein coatings and engineered biomatrices), as well as sensing elements. Particular interest has been paid to the optical sensing of dissolved chemicals and, more specifically, to oxygen. This plays a significant role in cell biology, as it is the central substrate of the aerobic metabolism and, therefore, regulates the energy available to the cells. Being able to monitor the concentration of oxygen in the cell culture medium is important. This helps to ensure that homeostasis is not only maintained, but also measures the cell metabolism (consuming oxygen in the medium) in real time.

Additionally, it also enables the step to mimic pathological conditions (such as ischaemia) or to tailor niches with low oxygen levels; for example, the section of the gut that is normally inhabited by anaerobic bacteria. To achieve this goal, Micronit has partnered with PreSens in Germany, which is an expert in the contactless sensing of chemicals in solution. This partnership has resulted in a resealable OOC device that is compatible with the continuous monitoring of the oxygen available for the cultured cells, without being in physical contact with the medium, and without the risk of compromising the fluidic integrity and sterility of the chip.

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