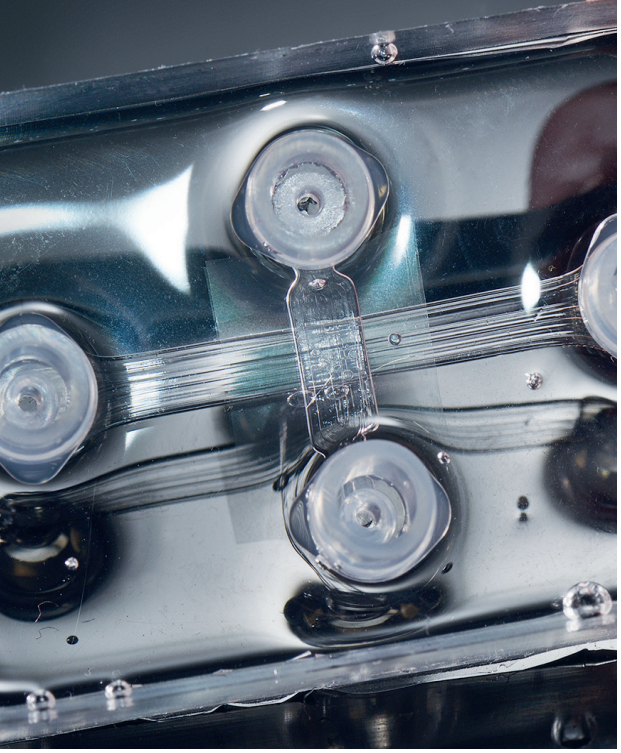

1 OoC of PDMS with intersecting channels separated by a membrane. 2 Cell cultivation in four OoCs with automated perfusion.

3D bioprinting of organ-on-chip systems

Organ-on-chip (OoC) systems have found their way into biomedical and pharmacological research in recent years. OoCs are microfluidic chip systems that supply 3D cell cultures with nutrients and better reflect in-vivo conditions of living organisms than two-dimensional in-vitro cell cultures. Testing new drugs on such 3D cell cultures greatly accelerates their development and helps make animal experiments less necessary. In the future, OoCs could even serve as a precursor for the cultivation of artificial organs.

Building cell models for artificial organs

Fraunhofer ILT scientists are researching the production of organ-on-chip systems by extrusion printing according to the sacrificial bioprinting process. This process uses different polymer materials as well as cell-laden hydrogels, so-called bio-inks. Typical cells for colonization are endothelial cells for vascularization of tissues. The continuous perfusion of the OoC system makes it possible to cultivate and investigate the cells over longer periods of time. In this context, thanks to the transparent properties of the microfluidic chips, cells can be examined with an optical microscope. Thus, organotypic cell models with functional properties can be constructed and examined in the laboratory.

Co-cultivation models for assay development

OoCs fabricated by extrusion-printing methods were seeded with different cell types and cultured under continuous perfusion in the laboratory. For endothelial cells, flow conditions were determined in which growth occurred directionally along the direction of flow, a mandatory requirement to build artificial blood vessels and vascularized organoid structures. In addition, the project partners have developed both a co-cultivation model with endothelial and epithelial cells in separate cell spaces and a migration assay for monocyte stimulation. Both are fundamental to linking multiple organ systems and involving the immune system in the assembly of OoCs. Potential applications are in drug discovery, biomedical research, and the development of patient-specific assays. The work carried out in the project SiCellNet was funded by the Fraunhofer "KMU-akut" program.

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