LASER-BASED 3D PRINTING OF HYDROGEL BARRIER MODELS FOR MICROFLUDIC APPLICATIONS

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The placenta secures the survival and development of the fetus. As placental tissue connects the fetus with the mother and is responsible for endogenous and exogenous material transfer. The maternal and fetal blood are thereby separated, by the so-called placental barrier, which is made up by the trophoblastic syncytium and the fetal capillary wall. Research in the field of placenta biology represents a challenging topic, as current approaches are difficult to perform, time consuming and often carry the risk of harming the fetus. The establishment of a reproducible *in-vitro* model, simulating the placental transport is necessary to study fetal development and for identification of underlying causes of maldevelopment. In this study, a photosensitive hydrogel material, in combination with two-photon polymerisation, was used to produce high resolution structures with nanometre precision geometries. Gelatine modified with methacrylamide and amino-ethyl-methacrylate (GelMOD AEMA) was thereby crosslinked within a customised microfluidic-device under the addition of photoinitiator, separating the chip in two different compartments (Figure 1). The fetal compartment contains HUVEC cells which are cultivated in EGM2, while BeWo B30 cells are supplied with DMEM Ham-F12 to mimic the maternal compartment. This microfluidic approach in combination with native flow profiles can be used to precisely remodel the microenvironment of placental tissue. The establishment of a functional placenta-on-a-chip-model allows the modulation of different clinical and biological scenarios in the future. A potential application can be found in the simulation of altered sugar transport across the placental membrane and evaluation of the effects of altered nutrient balance *in-utero*.

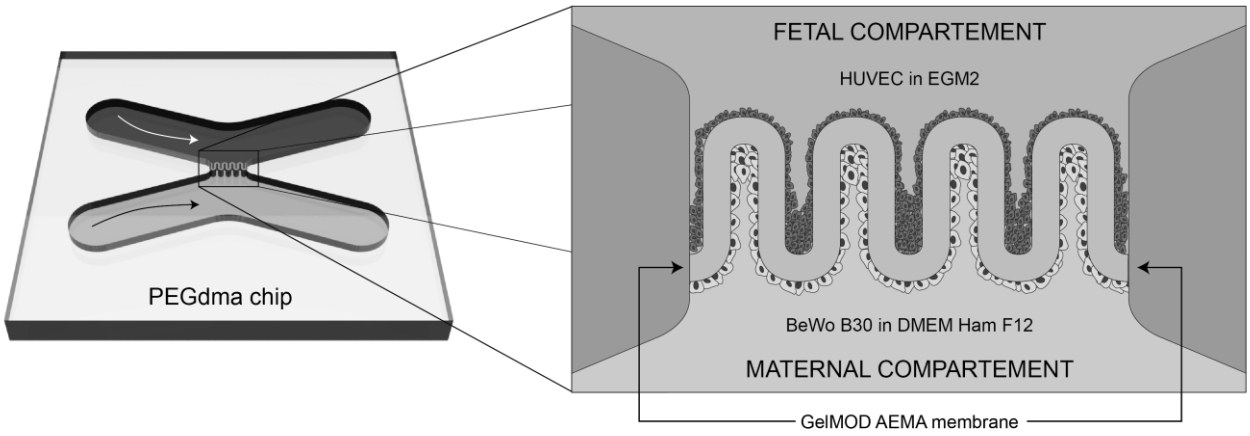

Figure 1 – Schematic illustration of the Micro Device Set-Up used to Study Membrane Transport. The 5-loop GelMOD AEMA membrane was structured in the intersection of an x-shaped PEGdma Chip which separates the cultivation chamber in two different channels. The fetal compartment which contains HUVEC cells, to mimic the fetal endothelial cells and the maternal compartment containing BeWo B30 cells to remodel the syncytiotrophoblastic layer of the placental barrier. The Chip was connected to a microfluidic pump and cells were cultivated under constant flow in the respective cell culture media, EGM2 (HUVEC) and DMEM Ham-F12 (BeWo B30). The flow direction is indicated by arrows in the left image.