Case study: mixing and degassing PDMS for microfluidic manufacture

This paper describes the development of a microfluidic platform for the formation and maintenance of blood microvessels. A mould is fabricated using photolithography, which is then used to cast the microfluidic from PDMS (poly-dimethylsiloxane). One of the key issues during the microfluidic production is the complete filling of all the microstructures with the uncured PDMS. Air bubbles that are often trapped in PDMS must be avoided. A **Thinky mixer** was used successfully during the process, enabling them to simultaneously mix and degas the PDMS.

Thinky mixers with their twin mixing and degassing modes, give fast, efficient and homogeneous mixing of many high technology materials. For ultra-critical applications, where even micro-bubbles cannot be tolerated, models with integral vacuum like the **Thinky ARV-310** are recommended. Results show that no bubbles can be observed in a cured resin, even at 100x magnification.

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Microfluidic platform for perfusable microvascular self-assembly

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The project objective is to develop a platform for the formation and maintenance of blood microvessels. The platform is used as physiologically relevant *in vitro* model of the microvasculature to understand the vascular dynamics in health and disease. The microvessels grown on chip are functional and perfusable from the outside with a defined pressure drop[1].

To define the flow channels and chambers for hydrogel and cells, soft lithography is used. Briefly, negative resist (SU-8) is spin-coated on a silicon wafer at 100 µm height and structured using photolithography (Fig.1). The wafer is then used as mold for Poly-dimethylsiloxane (PDMS) that is poured on the wafer, cured, cut and finally bonded to a glass slide (Fig.2).

One of the key issues during the chip production is the complete filling of all the SU8 microstructures with the uncured PDMS. Air bubbles that are often trapped in PDMS must be avoided. For this, the **Thinky mixer**, which enables to simultaneously mix and degas the PDMS, was used successfully during the process.

The resultant chips are then sterilized and used to culture cells in the defined compartments (chambers of 2 mm diameter and 100 µm height). Endothelial cells and fibroblasts in a fibrin hydrogel are filled in these compartments, and the flow channels are filled with cell culture medium. Within one week, perfusable microvascular structures assemble (Fig.3).[1]

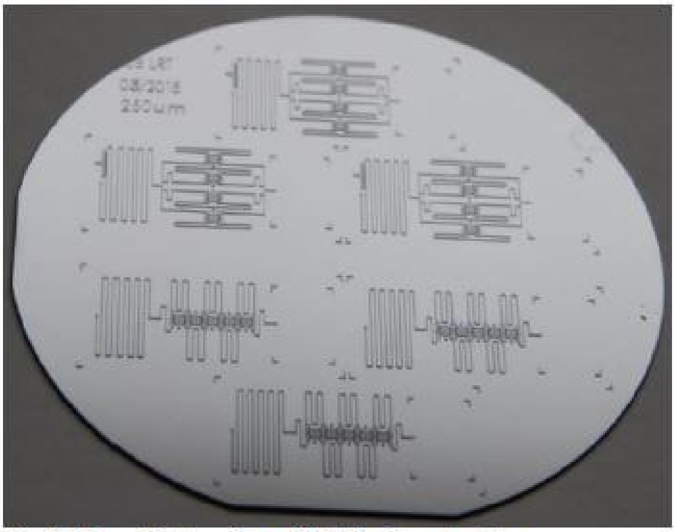

Fig. 1: View of a Si-wafer with SU8 microstructures.

Fig. 2: The vascular chambers are filled with endothelial cells and fibroblasts suspended in a fibrin matrix. Gel inlets are labeled with an asterisk.

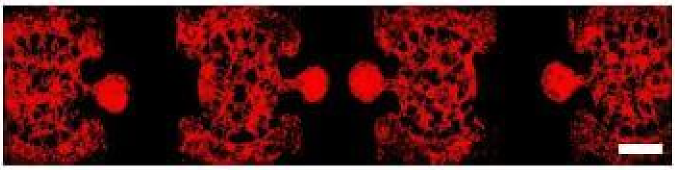

Fig. 3: Rfp-labeled VeraVec endothelial cells self-assemble into 3D microvascular structures. Scale bar: 1 mm

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