Lab project M1 PPN & QuanTEEM

04/05/2026 – 19/06/2026

Title of the project:
Development of lithography process for embedded microfluidic channels.

Supervisor(s): Laurent MARKEY

Laboratory / Department / Team : ICB / Nanosciences

and Nanofabrication team of ARCEN Carnot platform, I. Gallet

Scientific Context :

Microfluidics develops applications in an increasing number of domains, including clinical diagnostic and care, environmental or food diagnostic, biological sciences, bio-production, pharmaceutical drugs, chemical synthesis, catalysis, micro-energy etc. At ICB we develop microfluidics mostly for bio-sensing applications. More recently, an emerging microfluidics project is also starting, aiming to control the transport of photopolymer droplets in a two-photon polymerization (TPP) tool used to functionalize the tip of a fiber-optic. In this context the internship will aim at fabricating embedded microfluidic channels by lithography with openings for the inlet/outets. Moreover, it will contribute to the development of our lab's microfabrication process portfolio as the developed process might be used for applications other than microfluidics, like e.g. photonics.

Lithography of SU-8 provides the suitable high aspect-ratio structures with precise control of the dimensions. SU-8 is a photoresist amongst the most widely used in microfluidics and in general in the field of MEMs (Micro-Electro-Mechanical Systems). Obtaining an embedded channel by lithography has been described in the literature [1]. However, a specific process needs to be developed for the targeted microfluidics applications.

Objectives and content of the internship:

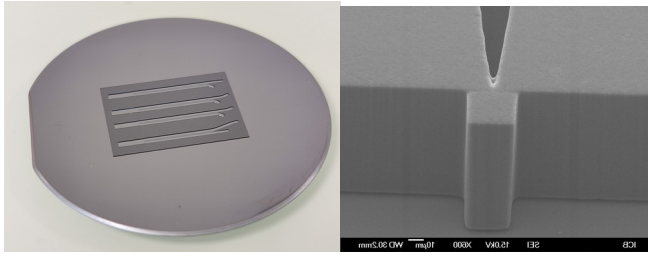
The main objective is to develop a fabrication process to embed microfluidic channels in a SU-8 resist layer with some vias for inlet/outlets. It will be mostly based on lithography techniques, (UV maskless or mask aligner) and combined with different options which can be investigated, among the following:

- Dry film lamination of channel's roof layer
- Greyscale lithography [1, 2, 4, 6]
- Dual exposure with deep UV flood exposure of channel roof [2]
- Dual exposure with glass substrate flipping [5]
- Double lithography with sacrificial layer using a secondary resist [7]
- Double lithography with or without metal masking [8]

As a secondary activity the student will participate to the fabrication of SU-8 master molds and PDMS replication to fabricate microfluidic modules.

Main activities of the student:

Lithography - PDMS molding – (Metal deposition if needed)



Example of SU8 structures realized on platform ARCEN-CARNOT from another project

References :

1. Dykes, J. M. et al. Creation of embedded structures in SU-8. in 64650N (San Jose, California, United States, 2007). doi:10.1117/12.702876.

2. Gaudet, M. & Arscott, S. A user-friendly guide to the optimum ultraviolet photolithographic exposure and greyscale dose of SU-8 photoresist on common MEMS, microsystems, and microelectronics coatings and materials. Anal. Methods 9, 2495–2504 (2017).

3. Mata, A., Fleischman, A. J. & Roy, S. Fabrication of multi-layer SU-8 microstructures. J. Micromech. Microeng. 16, 276–284 (2006).

4. Kudryashov, V., Yuan, X.-C., Cheong, W.-C. & Radhakrishnan, K. Grey scale structures formation in SU-8 with e-beam and UV. Microelectronic Engineering 67–68, 306–311 (2003).

5. Lee, J., Choi, K.-H. & Yoo, K. Innovative SU-8 Lithography Techniques and Their Applications. Micromachines 6, 1–18 (2014).

6. Rammohan, A. et al. One-step maskless grayscale lithography for the fabrication of 3-dimensional structures in SU-8. Sensors and Actuators B: Chemical 153, 125–134 (2011).

7. Zhang, J., Tan, K. L., Hong, G. D., Yang, L. J. & Gong, H. Q. Polymerization optimization of SU-8 photoresist and its applications in microfluidic systems and MEMS. J. Micromech. Microeng. 11, 20–26 (2001).

8. Campo, A. D. & Greiner, C. SU-8: a photoresist for high-aspect-ratio and 3D submicron lithography. J. Micromech. Microeng. 17, R81–R95 (2007).

Type of project (theory/experiment): experimental

Required skills: methodic – experimental ease