Master project in nanostencil lithography

Master's thesis

(Section: Microengineering)

Nanostencil lithography is well known for its simple and efficient resist-free nanopatterning [1]. Despite some limitations it enables unique micro and nanopattern made on fragile substrates without the use of 'harsh' process steps typically involved in photo or electron beam lithography. Still, the thin stencil membranes suffer from significant limitations in terms of pattern design flexibility. In the past, two engineering improvements in stencils have shown great improvements: a) corrugated stencil membranes to increase the cross-sectional moment of inertia [2] and b) stencil with small bridges to allow for long and even closed-loop topologies [3]. Both techniques have shown improvements in the use of stencils, but both together have not yet been implemented.
The goal of this master project is to combine corrugated stencils with bridge stencil design and demonstrate the improvement for their use.

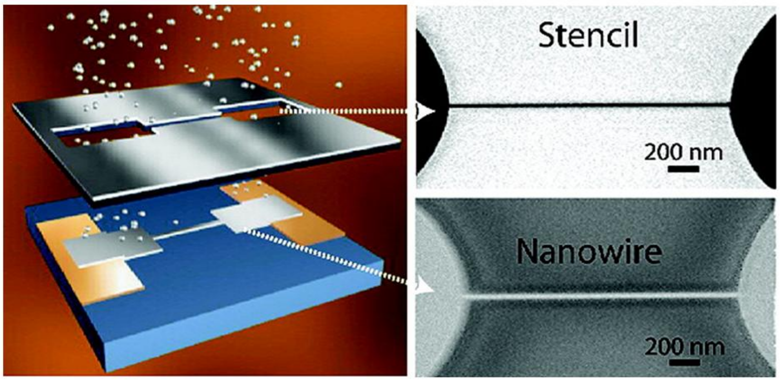

Figure 1 : *schematic showing the principles behind stencil lithography.*

The work involves the following steps (draft plan):

1. Literature study of stencil technology up to date (1 week)
2. Design of test patterns allowing to quantify the stencil performance (1 week)
3. Design of process flow for stencil microfabrication (to be done in CMI) (1 week)
4. CAD of stencil microfabrication process (1 week)
5. (Optional, if needed) FEM for selected design and topology to optimize design parameters (1week)
6. Microfabrication of test stencils in CMI (3 weeks)
7. Testing of stencils using PVD and pattern characterization (2 week)
8. Benchmark various stencils with design/FEM data (2 week)
9. Report and presentation prep, pending tasks

Contact: Prof. J Brugger *(Juergen.brugger@epfl.ch)*

[1] O. Vazquez-Mena et al. (2015) https://doi.org/10.1016/j.mee.2014.08.003
[2] M.A.F. van den Boogaart et al. (2006) https://doi.org/10.1016/j.sna.2005.08.037
[3] Y.C. Yang et al. (2022) https://doi.org/10.1002/admt.202201119

École polytechnique fédérale de Lausanne

Microsystems Laboratory 1
(Prof. J. Brugger)

EPFL STI IMT LMIS1
(Batiment BM)
Station 17
CH - 1015 Lausanne

E-mail : juergen.brugger@epfl.ch
Office : BM 3.112