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Scalable Integration of Phase Change Materials on the Silicon Photonic Platform for Non-Volatile Reconfigurable Photonics

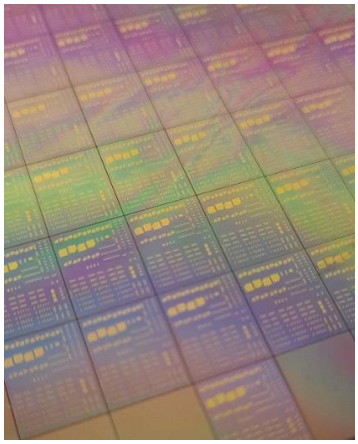
Master Thesis

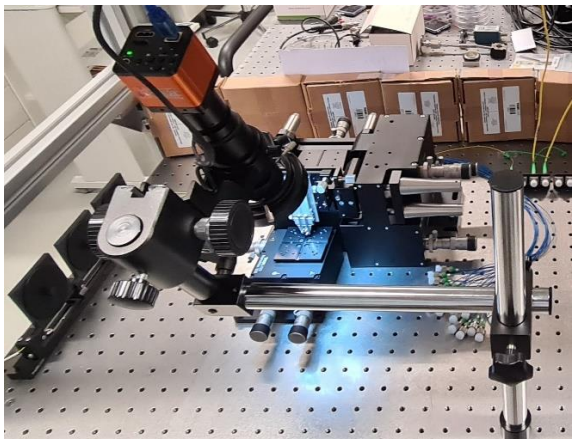
Photonic integrated circuits (PICs) are key components in today's optical networks, sensing systems, computing and even in emerging quantum applications. One specific area of interest is the use of programmable PICs with non-volatile switching mechanisms. For the last three years, we have been working on making the integration of PCM on PICs more scalable, in terms of loss, device size, fabrication throughput and actuation. Achieving a scalable PCM platform could be revolutionary for the advent of non-volatile high scale PICs in telecom, sensing, computing and even quantum photonics.
PCM are materials that have very distinct refractive index and absorption coefficients depending on whether they are in crystalline or amorphous phase. PCM with low optical loss have recently made their entrance in the field of integrated photonic components. However, nowadays no clear path has been identified for a scalable integration and nano-patterning of these materials on a standard photonic platform, with high production throughput techniques and integrated actuation.

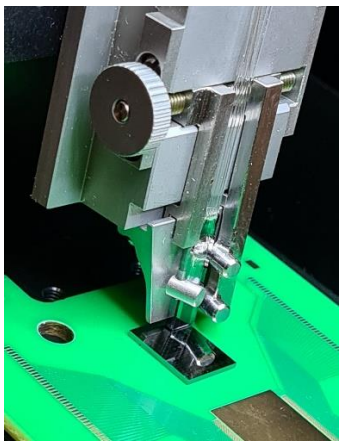
In this project we seek to demonstrate the integration of PCM on SOI standard platform using DUV lithography at wafer-scale only, with integrated electrical actuation for the PCM transition. We will also design, fabricate and test novel photonic components based on this integration concept.

The student will contribute to:
- design and simulation of photonic components,
- implementation of lithography layouts,
- microfabrication runs in cutting-edge EPFL cleanrooms (where we can access an ASML DUV Stepper),
- mise-à-point of different steps of the overall process
- fabrication of SOI wafers / chips running full process.
- characterization of photonic chips.

At the end of the thesis it is expected to perform an assessment of the capabilities of the proposed photonic design and fabrication flow based on the performance of the finally obtained devices. Bringing to maturity this technology will revolutionise the field of programmable PICs.


Fabricated PIC chips.


Electro-Optic characterization setup.


Chip under optic fibers.

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