PhD offer – 3 years

(Starting on 2024 October 1st)

Programmable metasurfaces based on Phase Change Materials

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Thanks to a unique portfolio of optical, electronic and structural properties, chalcogenide materials have been used in a wide range of applications, from non-volatile memory devices to infrared (IR) nonlinear photonics and optical computing. The growing demand for programmable photonic devices has enabled phase-change materials (PCMs) to establish themselves as attractive materials, thanks to their ability to change their optical properties at will. PCMs offer a wide contrast of optical properties, resulting from a reversible and non-volatile amorphous-to-crystalline phase transition, and can therefore be integrated as tunable media in various optical devices such as optical filters, switches, modulators, couplers, multiplexers or multipliers [https://doi.org/10.1038/nphoton.2017.126]. For all these applications, PCMs can be conveniently combined with existing silicon photonics technology that makes use of complementary metal-oxide-semiconductor (CMOS) compatible materials of the microelectronics industry [https://doi.org/10.1002/adma.201304476].

In this PhD, we propose to study the properties of PCM-based metasurfaces [https://doi.org/10.1088/2040-8986/abbb5b]. The idea is to combine the ability of metasurfaces to manipulate light and its properties (polarization, direction, phase, ...) in a programmable fashion, thanks to the PCMs' properties. The objectives of the PhD will be 1) to numerically model the properties of metasurfaces in both crystalline and amorphous phases and to establish a continuous path governing the evolution of these properties during phase change; 2) to experimentally test previously designed metasurfaces by pump-probe microscopy both in far and near-field.

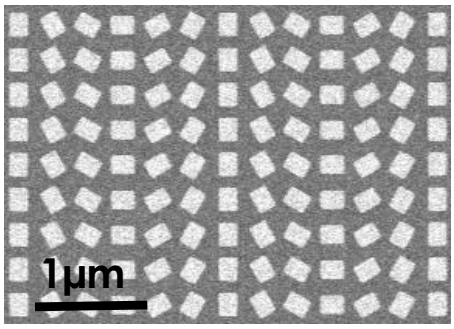

Figure: SEM view of a metasurface fabricated at ICB lab

The PhD will include both numerical and experimental tasks. It will involve the use of finite element simulation tools for the numerical analysis of metasurfaces and will require a deep understanding of the underlying electromagnetic properties. The materials used are being developed as part of a close collaboration between ICB and CEA Grenoble on chalcogenide materials, and the PhD student will be actively involved in this collaborative work. Nanofabrication of metasurfaces will be conducted both in clean room facilities at ICB (Dijon) and CEA Grenoble. Finally, to access to the transient properties of dynamic metasurfaces, experimental tests will be carried out in the far field on a polarimetric test bench dedicated to the analysis of metasurfaces in pump-probe configuration, and in the near field on the new state-of-the-art equipment of ICB's SMARTLIGHT platform.

Knowledge and skills in photonics, in numerical methods for electromagnetism, in nanofabrication and/or optical testbeds are required for this PhD. The student will be part of a dynamic research group at ICB laboratory. He/she will become familiar with the conceptual, numerical and instrumental tools used in nanophotonics, and will participate in the research team's working groups.

To apply, please send your **CV** and a **transcript of your Master's or engineering school grades** to benoit.cluzel@u-bourgogne.fr and aurelien.coillet@u-bourgogne.fr

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