Erasmus Mundus Master QuanTEEM
Master Internship

TITLE	Programmable metasurfaces based on Phase Change Materials
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INSTITUTION	Université de Bourgogne
LAB / DEPARTMENT / TEAM	ICB / Photonics / PRISM
TYPE OF PROJECT (theory / experiment)	Experiments – Numerical simulations

Summary

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].

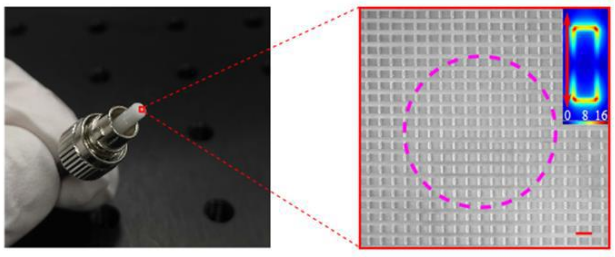

Figure 1: Photograph and SEM views of a metasurface made on a fiber optics end-face. Scale bar on SEM image is 500nm [https://doi.org/10.1038/s41377-020-0291-2]

In this internship, 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 internship will be 1) to numerically model the properties of a metasurface 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 in order to validate the numerical models. As such, the internship will include both numerical and experimental tasks. It will involve the use of finite element simulation tools for the numerical analysis of metasurfaces. The experimental tests will be carried out on a polarimetric test bench dedicated to the analysis of metasurfaces under pulsed excitation. The

materials used are being developed as part of a close collaboration between ICB and CEA Grenoble on chalcogenide materials, and the trainee will be actively involved in this collaborative work.

Knowledge and skills in photonics, in numerical methods for electromagnetism, in nanofabrication and/or optical testbeds are required for this internship. The trainee 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.

Additional Information

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.