MASTER INTERNSHIP M2 PPN (5 months)

2023-2024

Title of the project: Phase Change Materials based Metasurfaces

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Laboratory / Department / Team: ICB/Photonics Department /PRISM Group

Collaborations: CEA Léti

Summary:

Chalcogenide materials are widely studied since long time owing to their uncommon electronic, structural and optical properties. This unique portfolio of properties has led their use for a wide number of applications, ranging from infrared (IR) optics, nonlinear photonics as well as non-volatile memory devices for photonic computing. Among the large family of chalcogenides, the growing demand for increasingly functional photonic devices has seen phase-change materials (PCMs) cement themselves as attractive optically active materials. Thanks to a large and unique contrast of optical properties, arising from a reversible and non-volatile amorphous-to-crystalline phase transition, PCMs can be integrated as the tunable medium in different optical devices such as optical filters, switches, modulators, couplers, multiplexers or multipliers [https://doi.org/10.1038/nphoton.2017.126] to name just a few. 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 internship, we propose to study the properties of PCM-based metasurfaces [https://doi.org/10.1088/2040-8986/abbb5b]. The objectives 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. The internship is both numerical and experimental. 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 student will be actively involved in this collaborative work.

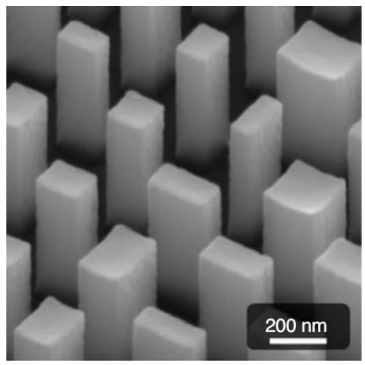

Figure: SEM view of a metasurface (from [https://doi.org/10.1038/s41566-020-0623-z])

Type of project (theory / experiment): Numerical/Experimental

Required skills: Knowledge in photonics, numerical methods for electromagnetism, nanofabrication, optical testbeds.