Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 21/10/2015

Responsable du stage / *internship supervisor*:

Nom / *name*: François Marquier et Christophe Sauvan

Tél : 0164533278 Fax :

Courriel / *mail*: christophe.sauvan@institutoptique.fr / francois.marquier@institutoptique.fr

Nom du Laboratoire / *laboratory name*: Laboratoire Charles Fabry (LCF)

Code d'identification : UMR8501 Organisme : Institut d'Optique - CNRS

Site Internet / *web site*: https://www.lcf.institutoptique.fr/

Adresse / *address:* 2 avenue Augustin Fresnel, 91127 Palaiseau Cedex

Lieu du stage / *internship place*: Palaiseau

Titre du stage / *internship title*: **Metasurfaces for a smart control of light beams**

The development of nanotechnologies has recently opened a wide range of possibilities for controlling light at the wavelength scale or below. Among the different research fields in nanophotonics, much effort is devoted to the realization of artificial materials (so called metamaterials) that are composed of microscopic (subwavelength) inclusions and that exhibit macroscopic optical properties that do not exist in nature. Because of the technological difficulty to fabricate real bulk metamaterials in 3D, many works are devoted to the control of light with 2D metamaterials, often called metasurfaces [1]. *The term Metasurface refers to surfaces that are functionalized by arrays of nanostructures, the so-called optical nanoantennas. Such a functionalization provides optical properties that go far beyond those of standard flat surfaces and metasurfaces can in principle be used to control at will optical beams.*

Because they rely on resonant scattering by nanostructures instead of phase-accumulation through propagation, metasurfaces offer new abilities to control optical beams. However, until now, metasurfaces have not yet been used to demonstrate new optical functionalities that cannot be implemented with other known technology. In addition, as most optical components, their optical properties are fixed by the geometry and cannot be tuned.

The objectives of the PhD will be twofold. We plan to explore the physics of metasurfaces for understanding their ultimate potential. We also propose to develop original optical devices with completely new properties. In particular, we will develop active metasurfaces, whose optical properties can be controlled electrically through a bias voltage. For that purpose, we could take advantage of the so-called "epsilon-near-zero" (ENZ) mode. It is a confined optical mode that can be supported by extremely thin semiconductor films.
The work will involve theory/numerical calculations and experimental characterizations.

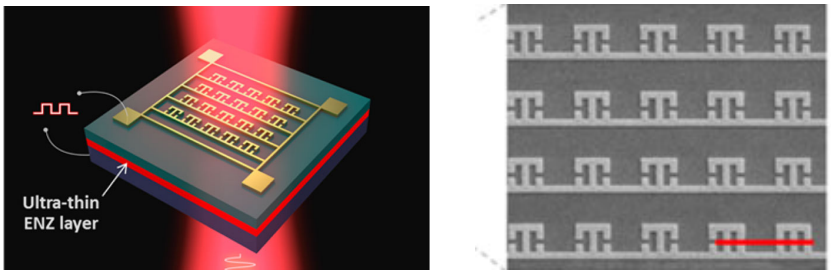

Figure from Nano Letters, **13**, 5391 (2013) : "Epsilon-Near-Zero Strong Coupling in Metamaterial-Semiconductor Hybrid Structures".

[1] N. Yu and F. Capasso, Nature Materials **13**, 139 (2014).

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : YES**

Financement de thèse envisagé/ *financial support***: Fellowship from the Ecole Doctorale EDOM**

Lumière, Matière, Interactions	**X**	Lasers, Optique, Matière	**X**

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