Spécialité de Master « Optique, Matière, Plasmas »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 9 October, 2012

Responsable du stage / *internship supervisor*:

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

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

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

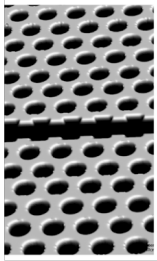
Adresse / *address:* Campus Polytechnique – 2 av. Augustin Fresnel – 91127 Palaiseau Cedex

Lieu du stage / *internship place*: Palaiseau

Titre du stage / *internship title*:**Nonlinear photonic crystal slot waveguide**

Résumé / *summary*

Silicon on Insulator (SOI) photonics has raised an increasing interest in the last years due to the foreseen possibility of merging electronics and photonics on the same chips using large scale wafers and well-established fabrication technologies. Significant breakthroughs have been demonstrated on both passive and active optical devices. One of the main forthcoming challenges is the on-chip integration of all-optical signal processing devices, which requires highly nonlinear waveguides or microcavities. A first approach consists in exploiting the high optical nonlinearities of silicon [Bar]. This approach has lead to several significant results for all-optical signal processing [Mon] but suffers for strong limitations induced by Two-Photon Absorption (TPA) and by the lifetime of the free carriers generated by TPA.



Alternatively, **hybrid-silicon approaches are envisaged, which consists in depositing a specific nonlinear material on the top of a silicon photonic waveguide or microcavity.** Such hybrid photonic structures should give rise to more flexibility into the conception and realization of nonlinear devices.

In collaboration with our colleagues of Minaphot group at IEF (Institut d'Electronique Fondamentale, Orsay), we propose to **study slow-mode SOI photonic crystal (PhC) slot waveguides to enhance nonlinear optical interactions**. Slot waveguides are empty-core planar waveguide that can be filled by nonlinear optical materials. The strong electromagnetic field confinement achieved in the slot area is significantly enhanced by the slowing down factor provided by the periodical corrugation of PhC waveguides when operating in the slow light regime.

Our colleagues at IEF have proposed and studied a new design of slot PhC [Cae]. Optical characterizations of the PhC slot waveguides being fabricated in the IEF-Minerve clean room facilities have been recently conducted. Group velocities down to c/100 have been measured, which is a major result in the perspective of the nonlinear interaction enhancement [Bar] being addressed within this project. The nonlinear behaviors of the slot photonic crystal structures will be numerically studied. These simulations are intended to provide insights for the realization of nonlinear hybrid slot waveguides either based on liquids or polymers. The nonlinear properties of the hybrid structures will be investigated using a pump-probe set-up that has been developed in the Manolia Group of LCF.

The internship will be conducted in collaboration between the LCF-Manolia and the IEF-Minaphot. The project relies on our complementary skills in studying the enhancement of nonlinear interactions in microstructures (LCF-Manolia) and designing, fabricating and characterizing slow-mode photonic crystals devices (IEF-Minaphot).

[Bar] - A. Baron et al., J. Eur. Opt. Soc. Rapid Publ., Vol. 6, 11030 (2011) - A. Baron et al., Optics Express, Vol. 17, N°2, 552-557 (2009).
[Mon] - C. Monat et al., Optics Express, Vol. 18, N°22, 22915-22927 (2010).
[Cae11] - C. Caer, et al., Photonics Technology Letters, Vol. 23, N°18, 1298-1300, (2011) – C. Caer et.al EOS Annual Meeting 2012.

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

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

Si oui, financement de thèse envisagé/ *financial support for the PhD*: **Doctoral Schools**

Lasers et matière	**X**	Lumière, Matière : Mesures Extrêmes	**X**
Optique de la science à la technologie	**X**	Plasmas : de l'espace au laboratoire	

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