Post-Doc position

Laboratoire Charles Fabry de l'Institut d'Optique Graduate School
Palaiseau, France

Subject :

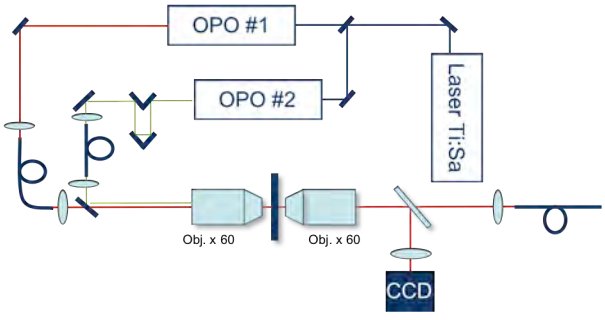
All-Optical on-chip devices based on nonlinear microcavities

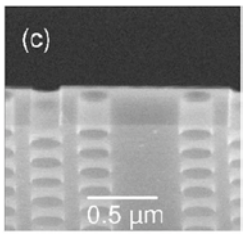
Start Date : before 31th December 2009
Duration : 18 months

Location : Laboratoire Charles Fabry de l'Institut d'Optique (LCFIO), Palaiseau, France

Research Context :
The future need for on-chip optical interconnects drives the research towards new class of ultra-compact and low-power photonic devices. One of the research topics of the LCFIO's group MANOLIA concerns characterizations and modeling of nonlinear optical devices and their applications for optical information processing. These devices are photonic crystal waveguides (PCWs) or optical microcavities realized on semiconductor platform. They are known to exhibit peculiar propagation characteristics, such as strong transverse confinement and slow-light propagation. As a result, nonlinearities in such structures can be considerably enhanced. Therefore, PCWs are really interesting for developing ultra-compact, low-power and very fast optical devices.

In order to investigate the nonlinear properties of the PCWs, we are developing both experimental and modeling tools. For instance, we have developed a very specific tunable Optical Parametric Oscillator (OPO) providing 10 ps pulses around 1550 nm [1]. By injecting light from the OPO into a GaAs PCW, we have been able to conduct the first quantitative experimental study of the nonlinearities enhancement due to light propagation in a slow mode waveguide [2]. This work has been conducted in collaboration with our colleagues of the Thales Research & Technologies (Palaiseau).





S. Combrié *et al.*, Opt. Lett., **33**, 16, (2008)

Research project :
The research project targets the next generation of all-optical on-chip devices, like optical buffer memories [3]. The achievement of extremely small mode volume microcavities and of slow mode waveguides enables a very strong enhancement of the nonlinearities [2,4] which benefits to the development of ultra compact with low command power devices.

The candidate will conduct a project towards the development of a new revolutionary concept. More precisely, fundamental aspects about the dynamics of transient microcavities will be explored. One of the specific functionality that will be addressed concerns the study of an optical buffer memory operating with an optical control of the time delay minimizing the

distortion of the stored information. This theoretical approach will drive the design of samples that will be fabricated in the join clean-room facilities of Thales RT-Institut d'Optique. These samples will be then characterized with advanced linear and nonlinear characterization facilities available in our laboratory.

The whole work will rely on our expertise in nonlinear photonic crystals [2,5-8] and on the competences of our collaborators from Thales R&T (Palaiseau) who have a strong expertise in the design, fabrication and characterizations of microcavities and PCWs in III-V semiconductors [9-11].

Qualified candidates should have backgrounds in photonics (Lasers, nonlinear optics, photonic crystals…) and more specifically experiences in optical characterizations of photonic crystals structures. Experience of clean room facilities will be appreciated.

Contact :

Please send a CV (including a list of publications) with names and contact information of at least 2 references to :

Nicolas Dubreuil
Tél.: +33 1 64 53 34 61
nicolas.dubreuil@institutoptique.fr
http://www.institutoptique.fr/

[1] A. Ryasnyanskiy et al. "*Fourier transformed ps synchronously pumped OPO without spectral filtering elements*", J. Europ. Opt. Soc. Rap. Public. 3, 08037 (2008)
[2] A. Baron et al. "*Light localization induced enhancement of third order nonlinearities in a GaAs photonic crystal waveguide*", Opt. Express, 17, 552 – 557 (2009)
[3] Shinya et al. "*All-optical on-chip bit memory based on ultra high Q InGaAsP photonic crystal*", Opt. Express, 16, 19382-19387 (2008)
[4] S. Combrié, et al., "*GaAs photonic crystal cavity with ultrahigh Q:microwatt nonlinearity at 1.55 μm*," Opt. Lett. 33, 1908-1910 (2008).
[5] R. Frey, Ph. Delaye, G. Roosen, *Nanophotonics*, H.Rigneault, J.-M. Lourtioz, C. Delalande, and A. Levenson, (Eds. ISTE, 2006), chapter 6.
[6] P. Delaye et al., "*Transfer-matrix modeling of four-wave mixing at the band edge of a one-dimensional photonic crystal*," J. Opt. Soc. Am. B 22, 2494-2504 (2005).
[7] L. Razzari et al. "*Kerr and four-wave mixing spectroscopy at the band edge of one-dimensional photonic crystals*," Appl. Phys. Lett. 86, 231106 (2005).
[8] M. Astic et al. "*Time resolved nonlinear spectroscopy at the band edge of 1D photonic crystals*," J. Phys. D: Appl. Phys. 41, 224005 (2008).
[9] S. Combrié et al. "*GaAs photonic crystal cavity with ultrahigh Q μwatt nonlinearity at 1.55 μm*", Opt. Lett., 33, 1908 (2008).
[10] Husko et al. "*Ultrafast all-optical modulation in GaAs photonic crystal cavities* " Appl. Phys. Lett. 94, 021111 (2009)
[11] M. Patterson et al. "*Disorder-Induced Coherent Scattering in Slow-Light Photonic Crystal Waveguides*" Phys. Rev. Lett. 102, 253903 (2009)