Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars 2010)

Proposition de stage pour l'année 2009-2010 (ne pas dépasser 1 page)

Date de la proposition : oct. 2009

Responsable du stage / *internship supervisor*:

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Nom du Laboratoire / *laboratory name*:

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Adresse / *address:* Campus Polytechnique-RD 128-91127 Palaiseau Cedex

Lieu du stage / *internship place*: Palaiseau

Titre du stage / *internship title*: **Raman lasers for biological applications**

Résumé / *summary*

Research Context : Life sciences need laser sources emitting at given wavelengths in the visible range for applications such as the excitation of fluorophores or detection of cancers in vivo. The existing lasers are expensive, cumbersome and difficult to use for non-specialists. The solution that we propose in our research group MANOLIA is to use stimulated Raman diffusion in non-linear liquids inserted in the holes of a hollow core photonic crystal fiber (HC-PCF) [1,2]. In these fibers the guidance is obtained by photonic bandgap effect and light can propagate in the core of the fiber even if the refractive index is smaller than the one of silica. This enables to use a wide variety of non-linear liquids or gazes to fill the fiber with small propagation losses. A research team at the University of Bath studies non-linear effects in HC-PCF filled with gazes, the index of refraction of gazes being near 1 [3]. For the targeted biological applications it is more interesting to work with liquids or liquid mixtures, the refractive indexes being higher than 1 and smaller than the one of silica. We can benefit from the different Raman shifts of various liquids to generate a wide range of visible wavelengths that are not easily achieved with other means starting from one pump wavelength. As the transmission band of a HC-PCF can be shifted thanks to the refractive index of the liquid that fills the holes of the fiber it can be used to filter certain wavelengths (the pump and a given Stokes order for example) and to eliminate unwanted wavelengths (the other Stokes orders for example). We have demonstrated this principle through stimulated Raman diffusion in a HC-PCF filled with ethanol. In the experiment we have stopped the Raman cascade at the first Stokes order of ethanol thanks to the shift of the transmission band of the fiber. This has enabled us to generate the first Stokes order of ethanol with a very high conversion efficiency (70%).

Research project : The demonstration of principle was made in the pulsed regime at 630 nm. It is interesting for many applications to be in the continuous-wave regime. The realization of a cw Raman laser based on a HC-PCF filled with a liquid is very challenging since it implies to use a cavity. The student will have to measure the amplification gain in a HC-PCF filled with a liquid and to design the cavity. He (or she) will realize the cw laser at 630 nm. He (or she) will also study a cw laser emitting on the second Stokes order of a Raman liquid at 595 nm (excitation of fluorescent proteins). This demonstration of a cw Raman laser working on a given Stokes order will open the way to a new family of fibered and versatile laser sources that can be used in many biological applications. These sources will be tested in a biological laboratory that has shown a great interest for them.

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

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

Si oui, financement de thèse envisagé/ *financial support for the PhD*: **ministère, BDI, région**

Lasers et matière	x	Lumière, Matière : Mesures Extrêmes	x
Optique de la science à la technologie	x	Physique des plasmas	

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