Postdoctoral position:

**Magneto-optical characterization of functional magnetic nanocomposite materials**

Hubert Curien Laboratory – UMR 5516- Lyon University – Saint-Etienne University
Optics, photonics and microwave Department / Micro &Nano Structuring Group
Magneto-optics and Magnetic Nanoparticles Team

Duration: 18 months

Keywords: magneto-optics; Faraday rotation; magnetic nanoparticles; magnetic hyperthermia; magneto-photonic crystal; sol-gel route

**Context**

The Magneto-optics and magnetic nanoparticles team is working for several years on the development of magneto-optical materials and components based on the use of a photo-polymerizable composite matrix doped with magnetic nanoparticles, for integration into optical devices such as isolators and circulators. The main features of these components lies in the polarization plane rotation of an electromagnetic wave. The phenomenon occurs once light passing through a magneto-optical material under the influence of a longitudinal applied magnetic field.

This postdoctoral project is a part of a collaborative project “PHOTOMAGNET” supported by the French National Research Agency. The scientific and technological objectives are the development and the characterization of three dimensional nanostructured materials. The materials consist on a matrix prepared by sol-gel route, doped with magnetic nanoparticles and patterned by two-photon stereo lithography. These structures have potentially magneto-optical and magneto thermic properties.

The challenge is to demonstrate the applications potentialities of these functional microstructured nanocomposites materials, based on 3D magneto-photonic crystals. This media provides a photonic-band gap due to the spatial periodicity. A large magneto-optic enhancement observed at the edge of the band-gap, would improve the performances of the aimed devices.

The nanocomposite way allows both adding magnetic properties to the materials and using the heating capacities of the nanoparticles when exposed to an AC magnetic field. The objective is, in this case, to produce controlled localized heating on biological analysis platforms, to study hyperthermia in cell phenomena.
Description of the position:

- In a first part, the candidate will achieve systematic characterization of different microstructures based on 2D/3D magneto-photonic crystals, to improve magneto-optic efficiency. A woodpile structure (figure 1) is used to highlight the 3D photo structuration of the material. To evidence the enhancement in terms of Faraday rotation and merit factor, the characterization will be performed using a spectral optical polarimeter.

- As a second part, she/he will study the magnetic hyperthermia of the nanoparticles embedded in a liquid (ferrofluid) or in a host matrix, under an AC magnetic field. The mechanisms of hyperthermia will be analyzed by the measurement of the specific temperature of the nanoparticles. Then, thermal activation of a micro pillars network will be highlighted by a localized measurement of the mean temperature of the composite material by optical time/ frequency domain reflectometry.

Research profile and skills:

- Large optical skills: in particular, a solid knowledge of light polarization phenomena and components used in anisotropic optics.

- Experimental skills on optical bench.

Start date: March 2019

Application procedure

Please send motivation letter, CV, list of publications and academic references to:

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