Call for candidates

Idex Scientific Breakthrough project "Incoherent light and Phonon management in micro-nanopatterned materials for efficient depollution and artificial PhOtosyNthesis"

PhD position:
Understanding thermal transport in advanded nanophotonic and nanophononic structures for photocatalytic systems.

Keywords: Optics and nanophotonics, phononics, thermal management, photocatalysis, depollution, green energy.

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Duration: 36 months

Contract/financing: net salary of ~1424.16 €/month

Locations/Research Institutes: Institut Lumière-Matière (ILM) – at Université Claude Bernard Lyon I, Institut des Nanotechnologies de Lyon (INL) – at Ecole Centrale de Lyon site, Laboratoire Hubert curien (Lab.HC) – at Université Jean Monnet, and

Subject:

The PhD position is open in the frame of the "IPPON" project ("Incoherent light and Phonon management in micro-nanopatterned materials for efficient depollution and artificial PhOtosyNthesis"), funded by the Lyon-Saint-Etienne IDEX "Scientific Breakthrough" program. It is an ambitious project including specialists in Physics, Chemistry and Engineering.

General context of the project:

In our modern society, one of the most urgent challenges is the need to reduce CO2 emissions and to live in a clean environment, making it crucial to develop novel concepts for efficient depollution and energy conversion and storage. Photocatalysis has recently arisen as the key approach to reach these objectives, based on the use of sunlight or inexpensive artificial light sources.
The objective of this PhD project is to participate to the development of novel concepts using advanced micro and nanostructuration for making photo/phononic materials, i.e. metamaterials, able to enhance the photocatalysis efficiency by both incoherent light confinement and thermal trapping (see Fig. 1). Funding is granted by the IDEX project "IPPON, Incoherent light and Phonon management in micro-nanopatterned materials for efficient depollution and artificial PhOtosyNthesis."

Objectives of the global project:

Photonics and phononics allow to control (guide, focus and filter) coherent waves – light or acoustic waves – through micro-structuration. Recently, incoherent waves control has been also addressed, with the successful realization of incoherent light trapping in solar cells. Despite the evident potential of solar light trapping for photocatalysis, the interest of micro-nanophotonics in this field has been

overlooked until now. While phononics has mostly focused on controlling acoustic waves, recently the reduction of the structuration lengthscale from micrometric to nanometric has been predicted to be able to control thermal waves, guiding the heat flux, and even trapping it.
A consortium of research centers from the University of Lyon (ILM, INL, IRCE, HC lab), gathering experts in nanostructuration, photocatalysis, photonics and thermal science, has recently proposed to use nano-structuration for exploiting advanced incoherent light trapping together with thermal wave confinement as an unexplored and original way for enhancing the photocatalysis efficiency.

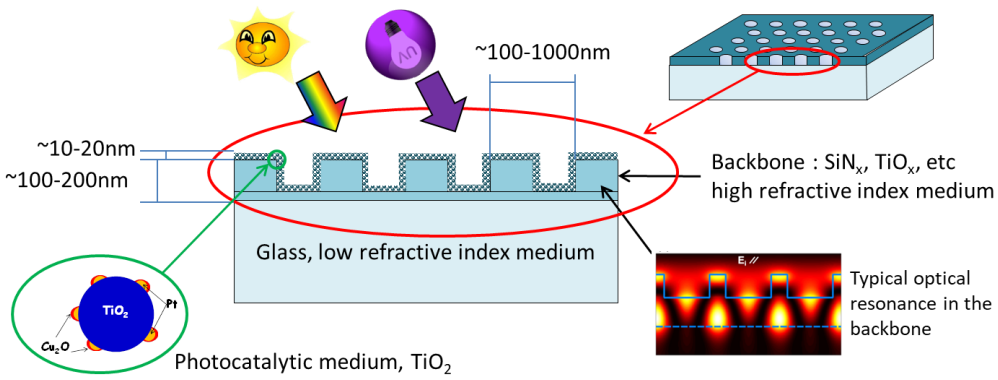

Fig.1: Schematic view of the micro-nanostructures: backbone and nanostructured active medium for photocatalysis.

Role of the PhD to be recruited:

The PhD student will work within this framework, and be responsible of the experimental study of the intrinsic thermal properties of the advanced photocatalytic metamaterials, with and without illumination. Understanding the effect of the nanostructuration on heat transport will lead to the identification of the best nanostructure, able to simultaneously optimize light trapping, local optical amplification, and the thermal trap for enhancing the photocatalysis efficiency. To this aim, he/she will perform a microscopic investigation of the phonon dynamics, phonons being the major heat carriers in these materials, through inelastic X ray scattering techniques at synchrotron sources and optical spectroscopy (Raman and Brillouin) at ILM. These measurements will be complemented with macroscopic measurements of the thermal conductivity by the thermoreflectance method, and an advanced luminescence technique for a spatially resolved thermal mapping of the metamaterials.
The PhD student will benefit of the frequent enrichening exchanges with an interdisciplinary consortium, spanning from chemists to physicists, including a strong theoretical component, able to model optic, photocatalytic and thermal properties of the studied metamaterials.

The candidate shall have a master degree or equivalent in physics or materials engineering, with a strong background in solid state physics, knowledge of the basics of phonons and thermal science. He/she shall have a good team work ability and independence, and be ready to travel to large scale facilities for performing the X ray inelastic scattering experiments, with a work time schedule more intense than in a normal laboratory.

Recruitment procedure:

Selection on dossier (CV, motivation letter, at least 1 recommendation letter) and interview.

Recruitment foreseen in October 2018, interviews from July to September 2018