Spécialité de Master « Optique, Matière, Paris »

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

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 15/10/2018

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Code d'identification : CNRS UMR 7645 – Inserm U696 — Organisme :Ecole Polytechnique

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Lieu du stage / *internship place*: Ecole Polytechnique (Palaiseau)

Titre du stage / *internship title*: **Quantitative *in vitro* and *in vivo* molecular monitoring of complex biological processes through lanthanide based nanoparticle imaging**

Résumé / *summary*

In order to monitor numerous pathologies, it is essential to develop technologies to quantitatively probe biological processes from the molecular to the organism scale, at high temporal and spatial resolutions. This is notably true for Reactive Oxygen Species (ROS)- dependent processes, for which the lack of efficient quantitative detection methods has hindered their understanding.

In this project, we propose to develop imaging methods using lanthanide-based luminescent nanoparticles to achieve fast ROS detection in cell systems and *in vivo*.

We already demonstrated that photoluminescent lanthanide based nanoparticles (YVO_4:Eu) can both be used as (i) labels for single receptors to probe their membrane organization and (ii) as nanosensors to probe the cell oxidative response. The luminescence of these particles is indeed controlled by oxidants and their imaging at the single particle level provides a quantitative ROS detection in living cells.

The first objective of this project is to develop spectrally resolved imaging of single multi-color nanoparticles in order to achieve unprecedented time resolution – typically a few 100 ms- and spatial accuracy –typically 20 nm- for ROS detection, in order to obtain a quasi-instantaneous ROS mapping in living cells . The further coupling of these nanoparticles to membrane ROS producing proteins, will then reveal how membrane nanorganization can shape local ROS production.

The second objective of this project is to implement these methods *in vivo*, in order to propose ratiometric ROS imaging under a macroscope in animal model systems (mice with topic inflammations or holding xenografted subcutaneous tumors). This will provide quantitative ROS measurements *in situ*, which will be correlated to clinical observations, in order to evaluate the diagnosis/prognosis relevance of ROS concentration.

Altogether, this project will pave the way for the elaboration of powerful tools (i) to accurately understand molecular signaling in normal and pathological situation and (ii) to elaborate strategies to non-invasively and quantitatively profile complex pathologies (tumor, auto-immune diseases,…), which are essential for the further conception of personalized treatments.

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***: Bourse ED/Financement Région**

Lumière, Matière, Interactions	**X**	Lasers, Optique, Matière	**X**

*Fiche à transmettre (fichier pdf **obligatoirement**) sur le site http://stages.master-omp.fr*