EMPLOYMENT PORTAL SECTION	CONTENT	Post-doctoral Researcher
Job Title	**Lanthanide nanocrystal probes for flow shear tomography in complex fluidic architectures**	
General information	***Workplace*** **:** LPMC – Ecole polytechnique, Route de Saclay, 91128 Palaiseau, FRANCE ***Date of publication :*** *9th Jan 2019* ***Contract period :*** *1 year (renewable for 2nd year)* ***Expected date of employment :*** *1st May 2019 (adjustable)* ***Proportion of work :*** *100%* ***Desired level of education :*** *PhD in physics, chemistry, materials science, or a discipline relevant to the project* ***Contact :*** *jong-wook.kim@polytechnique.edu* / *thierry.gacoin@polytechnique.edu*	
Context	Since 2000, our group have been developing diverse types of nanophosphors (ex. CdS:Mn,YVO_4:Ln, $LaPO_4$:Ln, YAG:Ce, nanodiamonds) and studying their structure-dependent photophysics [1]. One of their main applications is in the biomedical researches to label and track the biomolecular and cellular activities [2]. In this field of bio-imaging, the spatial resolution now reaches far below the optical diffraction limit thanks to the super-resolution fluorescence microscopy techniques [3]. However, most dynamic processes from molecular to cellular level still remain secret, because they involve non-translational motions such as rotation, twisting, and bending that cannot be observe with current nanophosphors. Moreover, cell functions are usually regulated by the external stimuli such as the mechanical stress that are thus to be systemically studied. Recently, we have developed new generation nanophosphors that can perform as orientation probes. They consist of anisotropic nanocrystals doped with lanthanides, which exhibit a peculiarly polarized luminescence precisely informing the 3D orientation of the nanocrystal [4]. When tagged with a target object, these new probes enable to monitor the complex rotational motion of the target by a simple spectroscopic measurement. Furthermore, the polarized spectra also inform the ensemble orientation (director and order parameter) of the nanocrystals when they are self-assembled or aligned by external forces. By combining this property with the nanocrystals' tendency to orient under flow, we developed a microfluidic *shear-tomography* [5] which is useful for biofluidics studies to understand cell functions and regulations. Our current studies focus on 1) fundamental photophysics of the polarization behaviour, 2) colloidal synthesis of the nanocrystal probes, and 3) bio- and bio-fluidic applications.	
Project	This post-doc project aims to develop the shear tomography as a new tool for understanding flow phenomena in complex fluidic architectures. In that context, we will focus on the medical diagnosis of the '*mucociliary clearance'*, a protection mechanism of human respiratory system. By their synchronized beating motion, *cilia* on bronchial epithelial cells carry away the breathed dusts and allergens. Failure of proper ciliary motion causes respiratory diseases such as *asthma*, sinusitis, etc. Shear stress near cilia was found to be a reliable index for characterizing the patients' pathologies. We are launching a large collaborative project together with medical doctors in order to develop a novel diagnosis tool based on the shear-tomography using the nanocrystal probes. The main tasks of the post-doc researcher are: 1) Optimize the colloidal synthesis and surface functionalization of the nanocrystal probes. 2) Achieve the spectroscopic analysis of the nanocrystals properties in relation with the application. 3) Develop shear-tomography with cells by using confocal-micro-spectroscopy 4) Design the microfluidic device for the diagnosis of ciliary dynamics The synthetic method has been developed already (LaPO4:Eu) [4,5], but further optimization, for instance, of the crystal phase, is promising to largely improve the luminescence property and the probe sensitivity [6]. Surface functionalization strategies have also been developed and are to be optimized specifically for the cell culture. Two optical microscopes (up-right polarization microscope and scanning confocal microscope equipped with excitation laser sources and spectrometers) are being used for the project. Microfluidics experiments are achieved in the lab and modeling studies are under collaboration with a fluid mechanics lab at our institution. (LadhyX [7], Dr. Charles Baroud & Dr. Sebastien Michelin).	
References	[1] Mialon et al, J. Phys. Chem. C. 113(43): 18699 (2009) - Mialon et al, ACS Nano. 2(12): 2505 (2008) - Revaux et al, Nanoscale. 3(5) 2015 (2011) - Fleury et al, Acs Nano. 8(3): 2602 (2014) – Vuillemin et al, Scientific Reports. 6, 29863 (2016) [2] Bouzigues et al, ACS Nano. 5(11) 8488 (2011) - Casanova et al, Nature Nanotech. 4(9) 585 (2009) - Casanova et al, J. Am. Chem. Soc. 129(42): 12592 (2007) – Abdesselem et al, Acs Nano. 8(11) 11126 (2014) [3] X. yang et al, ACS Photonics, 3 (9), 1611 (2016) [4] Kim et al, Adv. Funct. Mat. 22(23) 4956 (2012) [5] Kim et al, Nature Nanotech., 12, 914 (2017) [6] Chaudan et al, J. Am. Chem. Soc. 140(30) 9517 (2018) [7] https://www.ladhyx.polytechnique.fr/en	