LABORATOIRE DE CHIMIE ENS DE LYON

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ENS DE LYON

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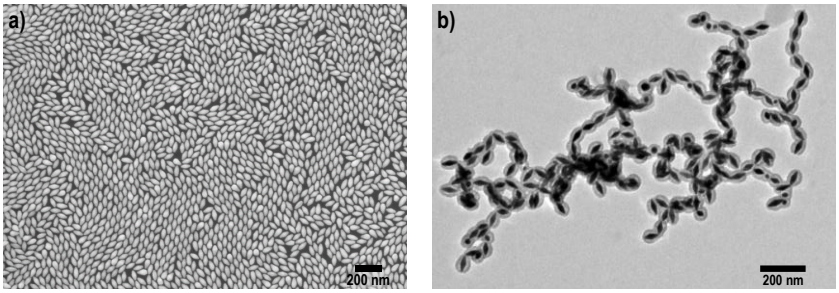
# Open PhD position in chemistry: "Colloidal assembly of anisotropic gold nanostructures and optical-plasmonic properties"

- **Key words:** **nanoparticle, core-shell, gold bipyramid, colloidal assembly, plasmonics, photonic materials**

- **Project:** Assembly of nanoparticles is a hot and challenging topic in (nano)materials chemistry field since it's a promising "bottom-up" approach to control micro- and macro-scale structures and properties of materials. We plan to explore this topic by using gold nanobipyramids (AuBPs) as original anisotropic building blocks and study the optical response of the assemblies. Such materials could find applications in SERS, (bio)sensing and catalysis fields but also in future optoelectronic devices for light manipulation and emission.

Firstly, AuBPs will be synthetized according to our established method leading to precise nanostructures exhibiting an intense and sharp plasmon resonance, easily tunable in the visible-NIR region.[1] Then, we will modify the AuBPs surface (ligand, polymer or $SiO_2$ shell) for controlling the next assembling step.[2] Two major methods are envisaged for colloidal assembling: (i) deposition of 2D films on a substrate by drop-casting or dip-coating –example a) and ref.[3]– and (ii) 3D self-assembling in solution by induced aggregation or in emulsion systems –example b). We will study optical and plasmonic properties of the obtained assemblies and notably the impact of the nano- and micro-structure (interparticle distances, packing density, anisotropy, degree of order and arrangement). Finally, by integrating luminophores in the materials, emission properties could be investigated, in particular metal enhanced fluorescence/light amplification/lasing or directionality/polarizability behaviors.




**Examples of AuBPs assemblies (preliminary results): a) SEM image of AuBPs deposited on a silicon substrate (drop-casting without any specific conditions) and b) TEM image of AuBPs self-assembled in solution and embedded in $SiO_2$ matrix.**

- **Lab & context:** The PhD work will be performed in the Chemistry Laboratory of ENS Lyon (UMR 5181) in the team « Functional Materials and Photonics ». The team develops research on **hybrid materials devoted to optical applications**. In particular the expertise lies in the design of original molecular systems, coupled with inorganic materials (semiconductors, plasmonic nanostructures…) and the characterization of optical interactions and responses (absorption, emission, nonlinear responses…). The applications are in the fields of optical protection, bioimaging, photocatalysis…

- **Skills/techniques:** Synthesis, surface modification and assembly of hybrid NPs - Spectroscopy (UV-vis-NIR absorption, fluorescence) - electron microscopy (SEM, TEM) - scattering techniques (DLS, SAXS, GISAXS).

- **Candidate profile:** The candidate should have a Master's degree or equivalent for registration to a PhD program, with a high academic and scientific level in general chemistry, materials chemistry or physical chemistry of materials. In addition, he/she should be highly motivated by experimental work, curious and comfortable with bibliography and resources.

- **Starting date:** **Sept./Oct. 2018**
- **Application deadline:** **March 2018**

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- **References:**

**[1]** D. Chateau, A. Liotta, F. Vadcard, J. R. G. Navarro, F. Chaput, J. Lermé, F. Lerouge, S. Parola, *Nanoscale*, **2015**, 7, 1934.
**[2]** D. Chateau, A. Liotta, D. Gregori, F. Lerouge, F. Chaput, A. Désert, S. Parola, *J Sol-Gel Sci Technol.*, **2016**, 81, 147.
**[3]** Q. Shi, K. J. Si, D. Sikdar, L. W. Yap, M. Premaratne, W. Cheng, *ACS Nano*, **2016**, 10, 967.