LABORATOIRE DE CHIMIE ENS DE LYON

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ENS DE LYON

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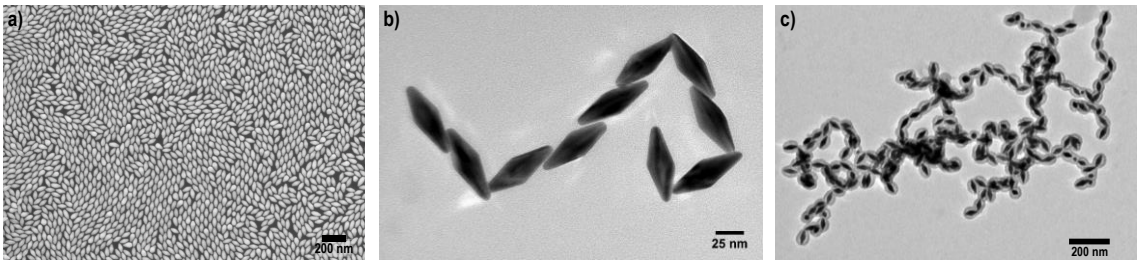
Open PhD position in chemistry:
"Colloidal assembly of anisotropic gold nanostructures and optical-plasmonic properties"
"Assemblage colloidal de nanoparticules d'or anisotropiques et propriétés plasmoniques et optiques"

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

- **Project:** Assembly of nanoparticles (NPs) 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.[1] Non-spherical and anisotropic NPs [2] and plasmonic systems [3] are of particular interest to reach new kind of assemblies with unique optical properties. We plan to explore this topic by using gold nanobipyramids (AuBPs) as original anisotropic building blocks and study the optical response of the assemblies, in particular polarized light interaction and plasmonic circular dichroism. Such materials could find applications in (bio)sensing or catalysis fields but also in future optoelectronic devices.

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.[4] Then, we will modify the AuBPs surface (ligand, polymer or SiO_2 shell) for controlling the next assembling step.[5] As a first approach, original 2D arrangements by solvent evaporation onto substrate could be obtained (fig. a and [6]). Then, self-assembly in suspension will be explored. As a starting point for the study, linear assemblies can be prepared by using simple amino acids and can be embedded in silica matrix (fig. b-c). By varying the conditions and the nature of the ligand we expect to control the AuBPs arrangements (linear chains or side-by-side aggregates, number of units…) and thus their optical properties. To go further, the chirality of the ligands and specifically designed ligands will be studied to generate original assemblies and plasmonic circular dichroism.



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 and the characterization of optical interactions and responses (absorption, emission, nonlinear responses…). The applications are in the fields of optical protection, bioimaging, photocatalysis… Synthesis of specific ligands and advanced optical characterizations will be performed in internal and external collaborations.

- **Skills/techniques:** Synthesis, surface modification and assembly of hybrid NPs - Spectroscopy (UV-vis-NIR absorption, circular dichroism and fluorescence) - electron microscopy (SEM, TEM)

- **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.

- **Starting date:** **Sept./Oct. 2019**
- **Application deadline:** **March 2019**

- **Contact:** **Dr. A. Désert** (anthony.desert@ens-lyon.fr) **Prof. S. Parola** (stephane.parola@ens-lyon.fr)

- **References:**

[1] M. A. Boles, M. Engel, D. V. Talapin, *Chem. Rev.*, **2016**, 116, 11220.
[2] T. Hueckel, S. Sacanna, Chapter 4, 105-130, *Anisotropic Particle Assemblies*, Elsevier, **2018**, doi:10.1016/B978-0-12-804069-0.00004-6; X. Bouju et al., *Advanced Materials*, **2018**, 30, 1706558; S.-Y. Zhang et al., *Chem. Soc. Rev.*, **2014**, 43, 2301–2323.
[3] S.-W. Hsu et al., *Chem. Rev.*, **2018**, 118, 3100–3120; S. Gwo et al., *Chem. Soc. Rev.*, **2016**, 45, 5672-5716.
[4] D. Château et al., *Nanoscale*, **2015**, 7, 1934.
[5] D. Chateau, *J Sol-Gel Sci Technol.*, **2016**, 81, 147.
[6] Q. Shi et al., *ACS Nano*, **2016**, 10, 967.