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Master 2 project in chemistry: "Chirality of plasmonic hybrid nanomaterials"

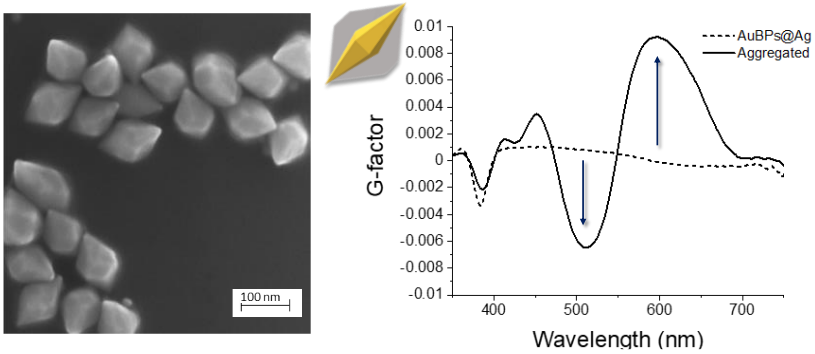
▸ **Key words:** **metal nanoparticle, seed-mediated growth process, colloidal assembly, sol-gel, plasmonics, chirality**

▸ **Project:** If chemists traditionally deals with chirality for organic molecular compounds, the community is more and more interested in chiral inorganic nanostructures and more particularly plasmonic chiral nanostructures.[1] Indeed, such nano-objects lead to unique properties of materials –e.g. high chiroptical activity like circular dichroism (CD) response– with concrete applications in the fields of catalysis, (bio)sensing, photonics… However, easily fabricating such nanostructures is currently a huge challenge.

Recently in the team, we have developed a colloidal synthesis of chiral plasmonic nanoparticles.[2] This synthesis is based on the controlled growth of gold or silver onto gold nanobipyramids (AuBP) in the presence of cysteine. The obtained AuBP@Au and AuBP@Ag nanoparticles exhibit circular dichroism response (see figure). Chiroptical properties can be tuned by nanoparticle size and shape, but also by aggregation. Indeed we have shown that new CD bands can emerge for aggregated AuBP@Ag NPs, while the CD response can disappear for chiral AuBP@Au system.[3]

Current efforts are focused on understanding the origin of chirality in such systems, which is highly discussed in literature, but also on the preparation of chiral hybrid materials. For instance, we are able to incorporate plasmonic NPs into a hybrid glass using a sol-gel process, while preserving the optical properties. In the present M2 project we will pursue this strategy by tuning the aggregation state of NPs within the matrix, in order to control optical properties.

Figure - SEM image and CD spectra of AuBP@Ag nanoparticles (stable suspension and aggregated)



▸ **Lab & context:** The study 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…). Local collaboration with ILM (Lyon) is planned for optical and CD characterizations. This M2 work is part of an ANR Project. Opportunity to continue with a PhD thesis.

▸ **Skills/techniques:** Synthesis, surface modification and assembly of gold NPs – sol-gel process
optical characterizations (UV-vis absorption, circular dichroism spectroscopy) – electron microscopy (SEM, TEM).

▸ **Profile:** The M2 candidate should have 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.

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[1] W. Wu, M. Pauly, *Mater. Adv.* **2022**, *3* (1), 186. doi: 10.1039/D1MA00915J
G. Zheng et al., *Chem. Soc. Rev.* **2021**, *50* (6), 3738. doi: 10.1039/C9CS00765B
[2] A. Carone et al., *ACS Nano* **2022**, *16* (1), 1089. doi: 10.1021/acsnano.1c08824
[3] A. Carone et al., *Advanced Optical Materials* **2023**, *11* (18), 2300119. doi: 10.1002/adom.202300119