

'Physique et Chimie des Matériaux' – ED 397 – année 2020

PhD project for funding (max 1p), to send to

nadine.witkowski@sorbonne-universite.fr under PDF form « acronyme labo_nom encadrant.pdf »

Research unit (full name + acronym) : Laboratoire de Réactivité de Surface (LRS)

Team if applicable :

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Number of PhD under supervision : 1.5

Participation to supervisor training? no Year

Co-supervisor name : Juliette BLANCHARD

HDR ? yes

Research unit : LRS

International co-supervision ? No

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Keyword 1 : Plasmonic

Keyword 2 : Nanoparticles

Keyword 3 : Nanoconfinement

Keyword 4 : Colloidal synthesis

Select co-funding programme if applicable : select

Project title : Multifunctional NanoComposites Confined within Plasmonic Shells

Project Description (~4000 characters, font 11 min):

Spatially controlled reactions at the nanoscale have attracted increasing interest for fundamental chemistry and for the engineering of novel functional materials. In this respect, plasmonic nanoparticles, based mainly on gold and/or silver assemblies, play a major role due to their unique optical features that originate from the Localized Surface Plasmon Resonance (LSPR), a phenomenon that results in a very intense absorption band in the visible range which wavelength can be monitored by UV-Visible spectroscopy, and depends, among other factors, on the nature of the metal and the nanoparticles' shape. The LSPR phenomenon is widely utilized in several applications including biomedical devices. In addition to this outstanding property they show on their own, plasmonic assemblies have proven to be efficient in enhancing, up to several orders of magnitudes, the responses of other functional materials. Therefore, huge effort has been devoted to their controlled combination with such materials.

In our group, we have developed an expertise in engineering a large panel of plasmonic nanoparticles ranging from spherical Gold or Silver, Hollow NanoShells, Gold Nanorods, Core-shell Gold Silver and Silver Gold. We have recently demonstrated that Gold Hollow NanoShells (HNSs), can be used as nanoreactors to run confined chemical reactions. Importantly, these plasmonic nanoreactors offer opportunities to spatially control chemical reactions by nanoconfinement effects as exemplified by the controlled growth of Silver nanoparticles exclusively at the inner walls HNSs.

In this project, we intend to use these Hollow shells to encapsulate functional particles and explore the input of plasmonic enhancement to their intrinsic properties. The particles we target herein are UpConverting Nanoparticles (UCNs), Quantum Dots (QDs), and NanoDiamonds (NDs). All three kinds have in common an external hydrophobic shell allowing for similar chemical pathways when it comes to their functionalization and further growth of plasmonic nanoshells at their surfaces. We intend to explore various parameters such as the shell thickness and porosity. Then, through established collaborations, with INRS (Montreal, Canada) for UCNs, LCP (Orsay) and ITODYS (Paris) for QDs, and UTT (Troyes) for NDs, we will run an in-depth exploration of the enhancement resulting from these nanocages to the intrinsic activities of the encapsulated nano-objects and we do expect a wealth of information on the mechanism plasmonic enhancements by these nanocapsules.

Ref: <http://www.lrs.upmc.fr/en/nanosurf-nanomaterials-surfaces-biointerfaces/publications.html>