Quantum Charge Effects in Nanoparticulate Plexcitonic Systems

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Gold and silver nanoparticles (NPs) have been studied extensively in the last decades for their localized plasmonic properties ranging in the UV/visible spectral range of the electromagnetic spectrum. It is thus well known that the size and shape of the NPs are critical for plasmonic effects. Far less knowledge is yet available about near-field interparticle interactions in ordered assemblies of plasmonic NPs (Fig. 1) that generally trigger additional and often dominant collective effects (metamaterials, photonic crystals, …). The field of nanoparticle plasmonics is now ready to advance by coupling of the plasmon resonances with excitons originating from light irradiated semiconductor materials, in particular QDs such as CdE (E = S, Se, Te,…), ZnO or CuO nanoparticles, etc. In fact, hybrid metal NPs-semiconductor materials are the subject of active experimental and theoretical investigations [1]. The present project aims at bringing new insights into excitonic/plasmonic interactions in large assemblies of bi-particulate NP-QD networks.

The project has two major objectives. The first is to investigate the electronic distribution in QDs in interaction with plasmonic NPs. This is to be done with both macroscopic (UV-Vis, photoemission…) and near-field microscopy approaches (coll. M.V. Rastei). A particular attention will be payed to systematically couple the QDs and the mNPs through a precise chemical synthesis and functionalization of both the NPs and the QDs [2]. The project therefore includes experimental and theoretical aspects, and notions of chemistry of materials, solid-state physics, optics, and electronic effects are needed. We are thus searching for a motivated student with knowledge in physics and chemistry of materials, oxide films, and/or metal or semiconductor nanoparticles.

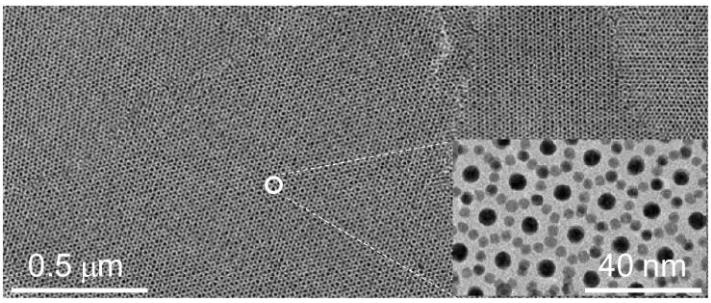

Figure 1. An example of our binary particulate networks

[1] K. Tanaka, E. Plum, J.Y. Ou, T. Uchino, and N. I. Zheludev, Phys. Rev. Lett. 105, 227403 (2010).
[2] B. Donnio et al. Adv. Mater. **19**, 3534 (2007); Nanoscale **5**, 1507 (2013); J. Am. Chem. Soc. **137**, 10728 (2015); J. Am. Chem. Soc. **138**, 10508 (2016).