Controlled assembly of metal colloids on dielectric materials to tune the photophysical properties of organic molecules.

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The use of plasmonic nanomaterials is a challenging strategy to control radiation and radiation-induced processes at nm-scale.[1] The localized surface plasmons of metal nanoparticles have been shown to affect the efficiency of a variety of radiative[2] and non-radiative processes[3] occurring in organic molecules.

The enhancement of radiative processes has been achieved by a tight control of the distance between the metal surface and the reporting units; recently the overlap between the absorption spectra of the organic dyes and the surface plasmon frequency has been demonstrated to be another important parameter to consider. [2]

The hierarchical assembly of plasmonic noble metal colloids on dielectric templates, such as silica or titania, offers the advantage to progressively increase the concentration of metal colloids and hence the coupling of their plasmon frequencies. This incremental approach allows the detailed investigation of the progressive effects of plasmonic particles on the photophysical behavior of organic molecules. In order to control the relative distance between the chromophores and metal colloids, the latter can be covalently or electrostatically bond to the dielectric matrix.

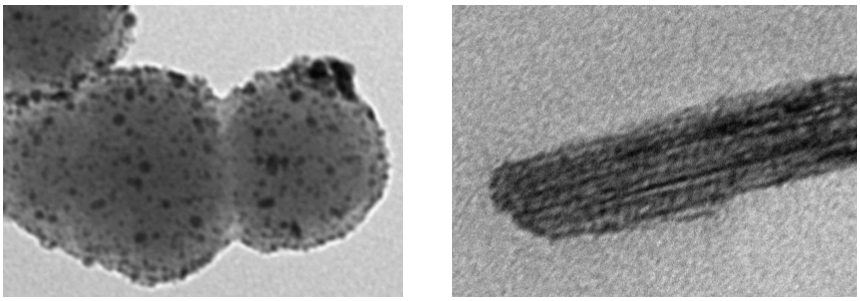

Figure 1. TEM images of hierarchical assembly of plasmonic gold nanoparticles on silica (left) and titania (right).

In this work, the interactions of organic chromophores with plasmonic nanostructures are going to be presented. In particular, the photophysical properties of chromophoric units, either entrapped or superficially linked to silica or titania matrices, have been studied upon addition of colloidal gold or silver nanoparticles, which were prepared with different morphologies and capping agents in order to tune the frequency of their surface plasmon resonances and

their surface chemical behavior. The impact of increasing concentrations of metal colloids on the radiative and non-radiative deactivation processes of the dyes has been investigated by use of steady state and time resolved methods. The collected data will be reviewed and discussed to define the nature of the interaction between plasmon nanoparticles and dyes and outline a mechanism that may be used for the preparation of nanodevices based on multifunctional materials.

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