Hybrid colloidal materials based on plasmonic nanoparticles

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Plasmonics has become one of the most active fields in nanophotonics. In the last several years, there has been a rapid increasing activity within this field as its wide application field ranging from sensing and biomedicine to imaging and information technology.

In our study, silver nanowires with controllable length (1 - 4 μm) and diameter (30-100 nm) have been successfully synthesized via a two-step injection polyol route. A homogeneous silica shell has been coated on the silver nanowires through a modified Stöber method, employing sodium hydroxide to replace ammonia solution. In addition, the silica shell can be further functionalized by fluorescent molecules based on perylenediimide (PDI). The optical properties of the silica-coated silver nanowires with incorporated dye molecules have been investigated by dark field spectroscopy, which is combined with atomic force microscopy and fluorescence studies with a confocal microscope on the same individual particles. [1] Such system is a perfect candidate for the chiral sensor application, in which the silver nanowire with PDI doped silica shell serves as the waveguide for surface plasmon polaritons. [2]

More recently, we have selectively decorated the gold nanorods with Pd clusters using the information provided by zeta-potential on the residual surfactant remained on the Au NRs [3]. The composite Au-Pd dumbbell-shaped nanostructures can be further stabilized with a PDA or TiO_2 coating. The particles serve as photoreactor with synergistic properties, combing the catalytic ability of Pd with extremely efficient plasmon-based photoheating. Compared to the Au-Pd NRs, the coatings lead to a remarkable improvement of the photothermal conversion effect. We have applied the high photothermal conversion to accelerate the reduction reaction of 4-nitrophenol (4-NP) by $NaBH_4$, demonstrating the synergistic properties of these particles. This work presents a photoreactor based on Au-Pd nanorods with an optimized photothermal conversion, which gives a good example on effectively utilizing the photo-generated heat to increase the rate of Pd-catalyzed reactions.

Reference:

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