Functionalization of gold nanoparticles with hydrophobic polymer ligands: Concepts for plasmon-emitter coupled systems

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Metal nanoparticles can be functionalized with polymer ligands to improve colloidal stability, enhance the compatibility with matrix materials in nanocomposites or to introduce new functionality to the particles. There are several synthetic routes to prepare polymer decorated nanoparticles, including grafting-to and grafting-from approaches. Depending on the type of particles and ligands used, the ligand exchange is carried out either in a single-phase system or as a phase transfer process. [1, 2] The preparation method can have a significant impact on the properties of the nanoparticles and choosing a suitable approach for a certain purpose may be challenging.

We demonstrate different grafting-to approaches for the transfer of gold nanoparticles from aqueous dispersion to an organic phase using α,ω-functionalized polystyrene ligands. We compare advantages and limitations of these methods in terms of simplicity, particle stability, and the structure of the grafted polymer brush. We further highlight the influence of molecular weight and end group functionality of the polymer ligands. "Clickable" polymer end groups can be used to reliably attach fluorophores to the polymer brush enabling the investigation of plasmon-emitter interactions. The emitter-particle separation, which is crucial for energy transfer, [3] can be tuned by the variation of the ligand length or solvent quality induced conformational changes of the polymer chains.

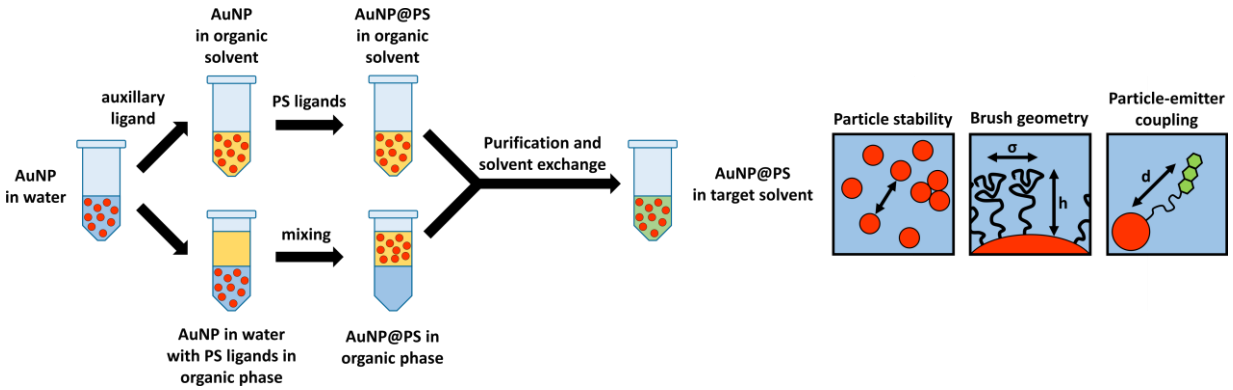

Figure 1. Schematic depiction of the functionalization of gold nanoparticles (AuNP) with polymer ligands and the general properties investigated for this work.

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