Colloidal Nanoparticle Clusters for Efficient Conversion of Light into Chemical Energy

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The assembly of plasmonic metal nanostructures can efficiently merge the reactivity and energy harvesting abilities with enhanced plasmonic performance for visible light photocatalysis. In this presentation, I will introduce the influence of the presence of electromagnetic hotspots in the ability of plasmonic colloidal structures to induce efficient energy transfer for plasmonic catalysis. We reported a novel synthetic strategy for the fabrication of colloidally assembled nanoparticles (NPs) in aqueous solution through fine controlled galvanic replacement between Ag nanoprisms and Au precursors.[1-4] Colloidally assembled nanostructures, e.g. Au particle-in-a frame and bimetallic assembled Au@M (M=Pd, Pt) nanostructures with catalytically active metals exhibited superior performance over their constituent nanostructure counterparts in plasmonic sensing, surface-enhanced Raman scattering (SERS), and plasmonic catalysis.[1-4] Recently, I successfully synthesize colloidal Au and Au@M (M=Pd, Pt) NP trimers with remarkable structural stability in various solutions.[1] These model systems allow us to study the synergy effect of hot spots and bimetallic composition in plasmonic catalysis. The plasmonic properties of NP trimers show that core-shell bimetallic NPs with hot spots can induce efficient light-to-chemical energy conversion as an increment of non-radiative plasmon decay to the catalyst surface. We monitored the plasmon-mediated reduction of 4-nitrobenzenethiol (4-NBT) using SERS for studying hot electron-induced chemical conversion. Core-shell bimetallic NP trimers show distinguishable photo-induced reduction of 4-NBT compared to their monomer or monometallic counterparts due to their efficient energy transfer. I expect that the present study can provide a new direction for the development of efficient photocatalysts.

References

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