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Efficient Plasmon-Induced Hot Electron Transfer and Photochemistry in Semiconductor-Au Nanorod Heterostructures

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In recent years, it has been shown that excitation of plasmons in metal nanostructures can lead to the injection of hot electrons into semiconductors and enhanced photochemistry. This novel plasmon-exciton interaction mechanism suggests that plasmonic nanostructures can potentially function as a new class of widely tunable and robust light harvesting materials for photo-detection or solar energy conversion. However, plasmon-induced hot electron injections from metal to semiconductor or molecules are still inefficient because of the competing ultrafast hot electron relaxation (via ultrafast electron-electron and electron-phonon scattering) processes within the metallic domain. In this paper we discuss a recent study on the plasmon-exciton interaction mechanisms in colloidal quantum-confined epitaxially-grown semiconductor-gold plexcitonic nanorod heterostructures. Using transient absorption spectroscopy, we show that optical excitation of plasmons in the Au tip leads to efficient hot electron injection into the semiconductor nanorod. In the presence of sacrificial electron donors, this plasmon induced hot electron transfer process can be utilized to drive photoreduction reactions under continuous illumination. Ongoing studies are examining how to further improve the plasmon induced hot electron injection efficiency through controlling the size and shape of the plasmonic and excitonic domains.