

Recent Developments Related to Plasmon-Induced Charge Separation

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Metal nanoparticles including gold, silver, and copper nanoparticles absorb visible and near infrared light due to localized surface plasmon resonance (LSPR). We found plasmon-induced charge separation^{1,2} at the interface between plasmonic metal nanoparticles and semiconductor such as TiO₂ and applied it to photocatalysis,² photovoltaic cells,^{2,3} multicolor photochromism,^{1,4} infrared photochromism,⁵ single particle multicolor changes,⁶ and photomorphing gells.⁷

We coated a transparent ITO electrode with a TiO₂ film, and deposited gold or silver nanoparticles on TiO₂. In an electrolyte containing a redox species, it exhibited anodic photocurrents.² Next we deposited nanoparticles on ITO, and coated with TiO₂. In this case, reversed electron flow, namely cathodic photocurrents were observed.⁸ Thus we concluded that electrons transfer from LSPR-excited metal nanoparticles to TiO₂. Since the photocurrent action spectra fit the plasmon-based absorption spectra, the electron transfer is triggered by the plasmon resonance. The photoelectrochemical process is induced or promoted by the localized electric field (optical near field) around the metal nanoparticle.⁹

In the paper, recent developments related to the plasmon-induced charge separation including mechanistic studies, chemical sensing, and morphology control of plasmonic nanoparticles would be presented.

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