Electronic Supplementary Information

Synthesis of Au@TiO$_2$ core-shell nanoparticles with tunable structures for plasmon-enhanced photocatalysis

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Additional data and figures

Fig. S1 UV-vis absorption spectra of Au NRs@TiO$_2$ NPs with different TiO$_2$ shell thickness.

The result shows that a red shift is observed when the TiO$_2$ shell becomes thicker. The redshift of the plasmon band after TiO$_2$ coating is caused by the increase of the refractive index of the surrounding medium. However, a visible light with a wavelength ranging from 420 to more than
700 nm has been used in the photocatalytic reaction. Such an excitation light covers the plasmon band of all these core-shell nanoparticles. Therefore, we believe that the influence of the light-absorbing property of the core-shell nanoparticles with different shell thicknesses on the photocatalytic performance is negligible.

Fig.S2  Photocatalytic degradation of methylene blue by TiO$_2$ and annealed Au@TiO$_2$ nanoparticles with a shell thickness of 50 nm under visible light.

We prepare Au@TiO$_2$ core-shell nanoparticles with a shell thickness of 50 nm. With such a thick shell, the SPR effect of Au is almost negligible, and the core-shell nanoparticles should display similar properties with that of pure TiO$_2$. Therefore, the photodegradation efficiencies of TiO$_2$ before and after thermal treatment were compared using the Au@TiO$_2$-50 nm nanoparticles. As shown in Fig. S2, the activity is only slightly improved after the thermal treatment (from ~2% to ~3%). This means that the improved performance of Au@TiO$_2$ does not result from the structural transformation of TiO$_2$. Instead, we believe that the annealing process facilitates the transportation of hot electrons to the crystalline TiO$_2$ shell.