Supporting information

A hybrid photoelectrode with plasmonic Au@TiO$_2$ nanoparticles for enhanced photoelectrochemical water splitting

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**Fig. S1** SEM images and inset digital images of (a) FTO/TiO$_2$-1 wt% Au@TiO$_2$ (b) FTO/Cu$_2$O photoelectrodes. (Scale bars: 100 nm)

**Fig. S2** Light absorption spectra of (a) FTO/TiO$_2$-1 wt% Au@TiO$_2$ (b) FTO/ TiO$_2$-1 wt% Au@TiO$_2$/Al$_2$O$_3$/Cu$_2$O photoelectrodes with different sizes of Au metal cores.
Fig. S3 (A) Optical transmittance spectra and (B) Measured incident-photon-to-current efficiency (IPCE) spectra of (a) FTO/TiO$_2$-P25 and (b) FTO/TiO$_2$-1 wt% Au@TiO$_2$ (120nm) photoelectrodes.
**Fig. S4** Amperometric I-t curves collected at -0.2 V vs. Ag/AgCl for (a) FTO/TiO$_2$-P25 and FTO/TiO$_2$-1 wt% Au@TiO$_2$ photoelectrodes with different particle size of Au metal core (b) 37 nm (c) 70 nm (d) 100 nm and (e) 120 nm under AM 1.5G,100 mWcm$^{-2}$.

**Fig. S5** Amperometric I-t curves collected at -0.2 V vs. Ag/AgCl for electrodes (a) FTO/TiO$_2$-1 wt% Au@TiO$_2$/Cu$_2$O and (b) FTO/ TiO$_2$-1 wt% Au@TiO$_2$/Al$_2$O$_3$/Cu$_2$O with different particle sizes of 1 wt% Au@TiO$_2$ metal core under AM 1.5G,100 mWcm$^{-2}$.
Fig. S6 Dark cyclic voltammograms of the FTO/Cu₂O and FTO/TiO₂-1 wt % Au@TiO₂ (120 nm)/Al₂O₃/Cu₂O photoelectrodes before (a), (c) and after 1 h PEC stability measurement (b), (d) under AM 1.5 light irradiation in presence of 0.1 M Na₂SO₄ (Inset photos indicate FTO/Cu₂O (left) and FTO/TiO₂-1 wt% Au@TiO₂ (120 nm)/Al₂O₃/Cu₂O (right)).