Supplementary Information

A solar-driven photocatalytic fuel cell with dual photoelectrode for simultaneous wastewater treatment and hydrogen production

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Pretreatment of FTO

FTO sheets, cut into samples of size 1.5cm · 5cm, were degreased by immersed into piranha solution for 30 min. Then rinsed by deionized water and dried in the air.

Preparation of TiO_2 NTs/Ti

Ti sheets, cut into samples of size 1.5cm * 5cm, were degreased by sonicating in acetone, ethanol, deionized water in turn after polished, then dried in the air. The Ti sheets sample was etched in the HCl (SCRC, AR, 36.0-38.0%) solution (6mol L^{-1}) for 20 min then electrochemical anodized by using a DC power supply (Sovotek, E5200-3) to control the experimental voltage and current. The anodization was divided into 2 steps. The first is to anodize in 0.5wt% HF (SCRC, AR, ≥40.0%) solution using a platinum foil counter electrode at room temperature and a voltage of 20V for 1h. The second is to anodize in the glycol solution (NH_4F (SCRC, AR, ≥96%): H_2O: $Et(OH)_2$ (SCRC, AR, ≥99.7%)=1:4:400,wt%) at the same conditions for 2h. After that, it was annealed in air atmosphere for 3h with the heating and cooling rates of 5℃min^{-1}.

Preparation of CdSe NPs/FTO

Electrodeposition was carried out in a three-electrode configuration with FTO, Platinum wire and $Hg/HgCl_2$, as working electrode, counter electrode and reference electrode, respectively. The electrodeposition bath solution contained 0.1 mol L^{-1} $CdSO_4$ (SCRC, AR, ≥99.0%), 0.1 mmol L^{-1} SeO_2 (SCRC, AR), and 0.1 mol L^{-1} Na_2SO_4 (Aladdin, AR, 99.0%). The applied potential was -1.1V vs SCE and the deposition time is 2 h. The CdSe NPs/FTO were rinsed thoroughly and annealed at 300 ℃ in N_2 atmosphere for 3 h.

Preparation of CdS NPs/FTO

Electrodeposition was carried out in a three-electrode configuration with FTO, Platinum wire and $Hg/HgCl_2$, as working electrode, counter electrode and reference

electrode, respectively. The electrodeposition bath solution contained 0.2 mol L^{-1} $CdCl_2$ (Aladdin, AR, ≥99.0%) and 0.05 mol L^{-1} $Na_2S_2O_3$ (Enox, AR, ≥99.0%) with adjusting the pH value to 2.1 by HCl solution (0.1 mol L^{-1}). The electrochemical configuration was placed in a thermostatted bath where the temperature was 70℃. The applied potential was -0.65 V vs SCE and the deposition time is 1000 s. Then the CdS NPs/FTO were rinsed and annealed at 500 ℃ in N_2 atmosphere for 6 h with the heating and cooling rates of 5℃min^{-1}.

Preparation of Cu_2O NPs/FTO

A standard three-electrode system was used for Cu_2O nanoparticles deposition. An Ag/AgCl electrode in a saturated KCl (SCRC, AR, ≥99.5%) solution was used as a reference electrode, a FTO as a work electrode and a platinum coil as a counter electrode. The electrolyte solution consisted of 0.4 mol L^{-1} cupric sulfate (SCRC, AR, ≥99.0%) and 3 mol L^{-1} lactic acid (Aladdin, AR, ≥85.0%), then its pH was adjusted 9.0 by 4 mol L^{-1} NaOH (Aladdin, AR, 96.0%) solution with continuous stirring. The electrochemical deposition was performed potentiostatically with a potential of −0.3 V (versus Ag/AgCl) for 30 min and the temperature of the electrolyte was kept at 60℃ by water bath.

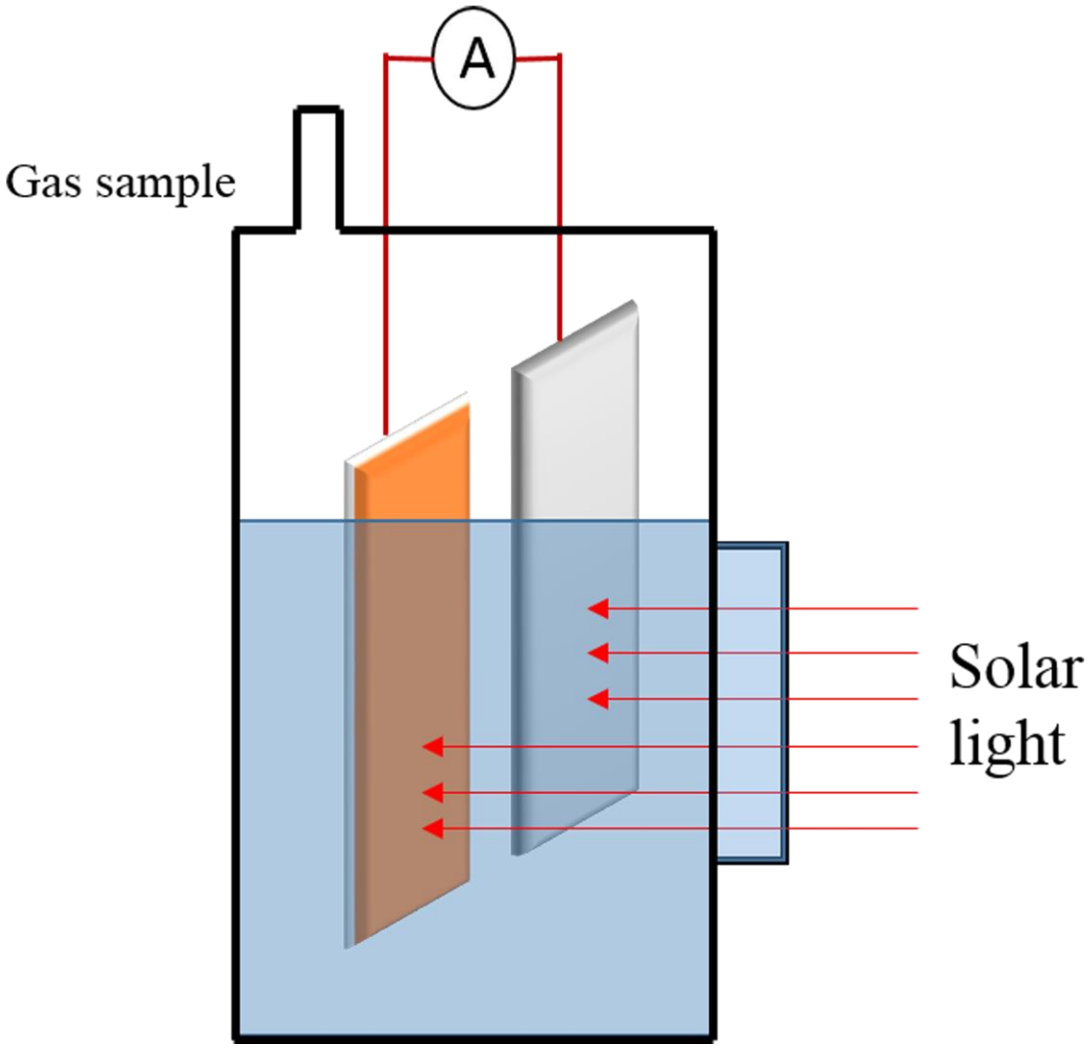

Fig. S1 The reactor of the PFC.

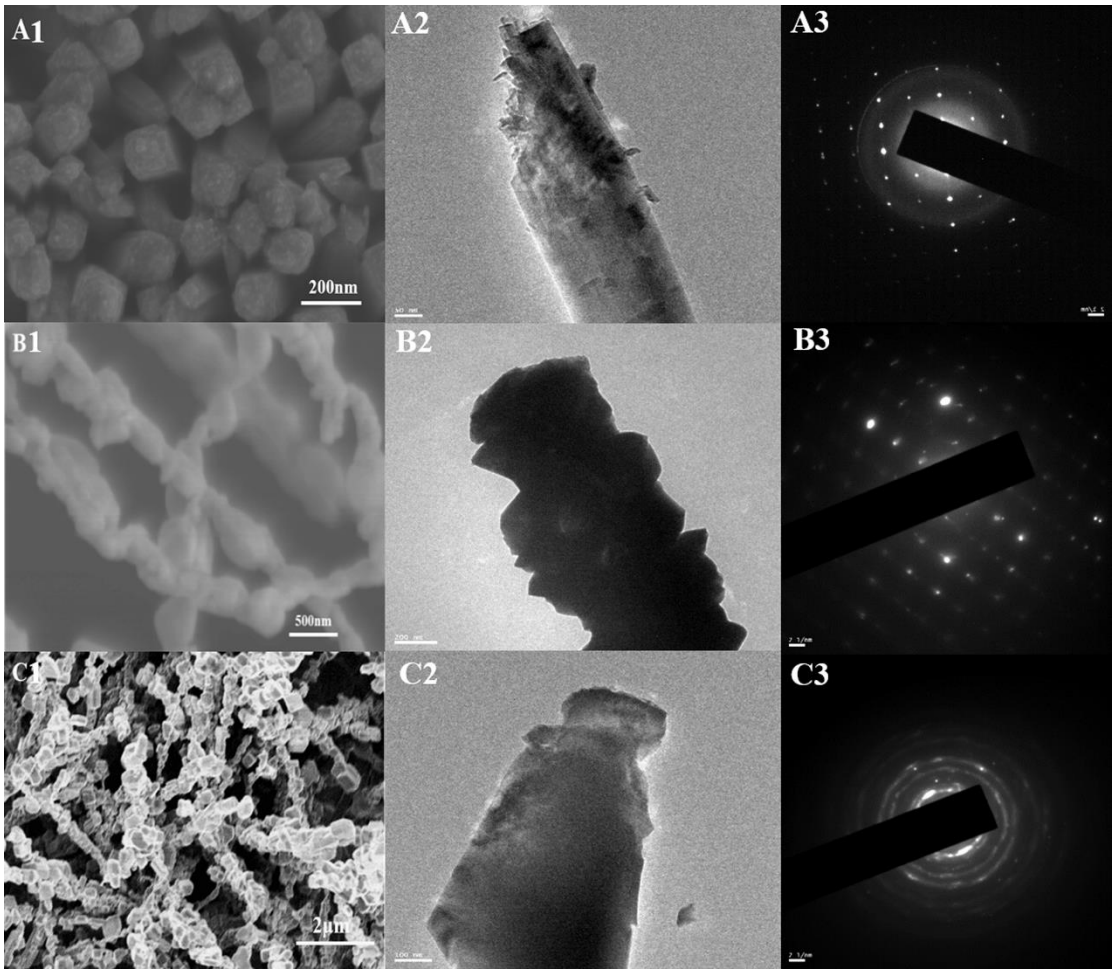

Fig. S2 The SEM image, TEM image of TiO_2 NRS/FTO (A1-A3); Cu_2O NWAs/Cu mesh (B1-B3) and C/ Cu_2O NWAs/Cu mesh (C1-C3).

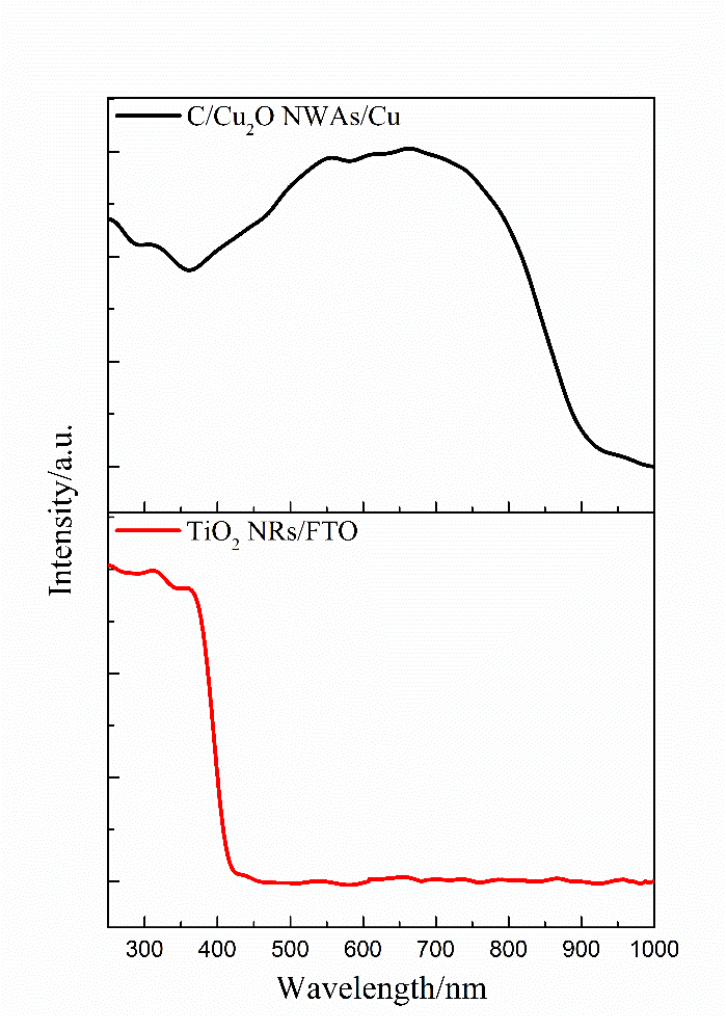

Fig. S3 The UV-Vis absorption spectra of the $C/Cu_2O/Cu$ and TiO_2 NRs/FTO

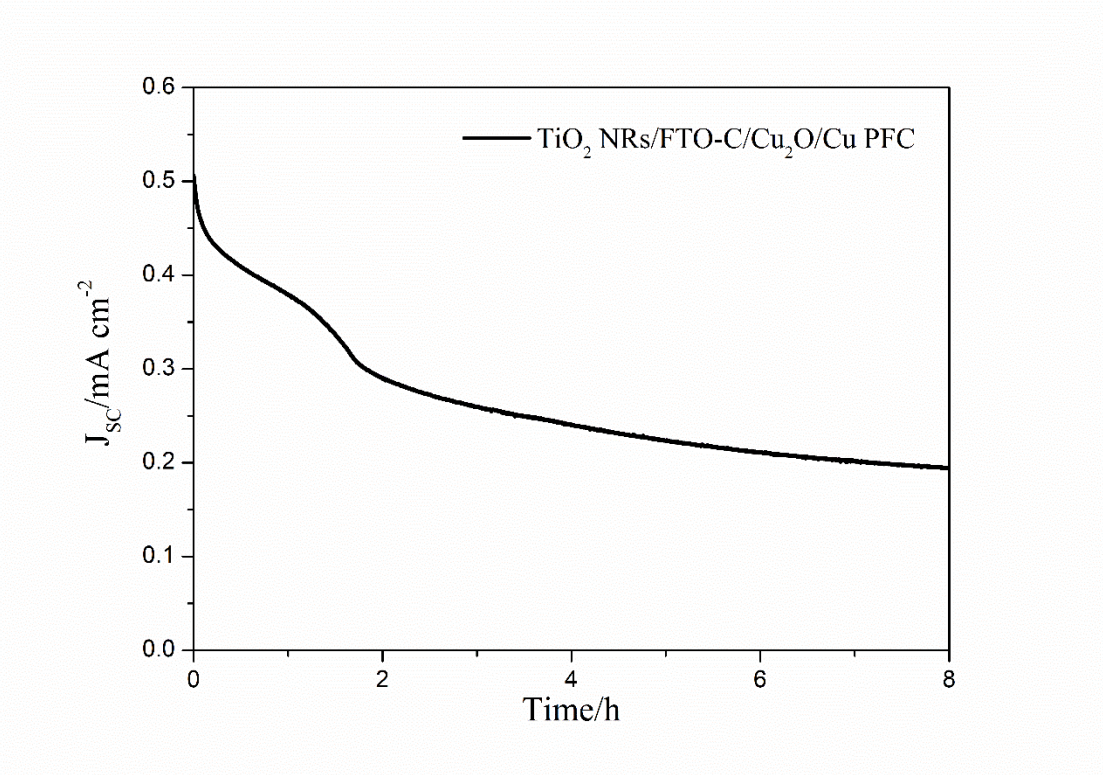

Fig. S4 Variation of the J_{SC} of TiO_2 NRs/FTO-C/Cu_2O/Cu PFC in 8 h.

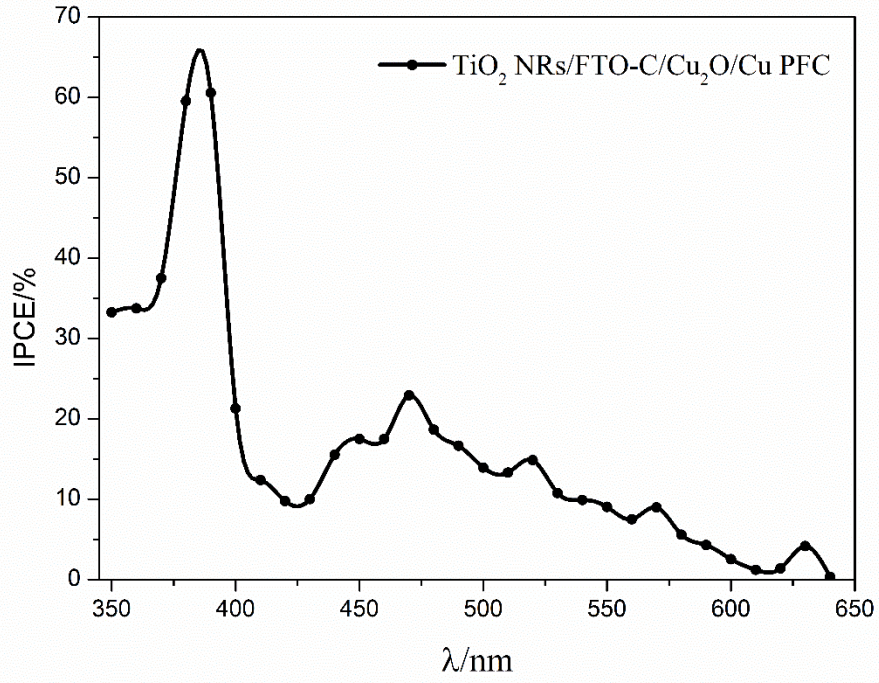

Fig. S5 The IPCE of the TiO_2 NRs/FTO-C/Cu_2O/Cu PFC.

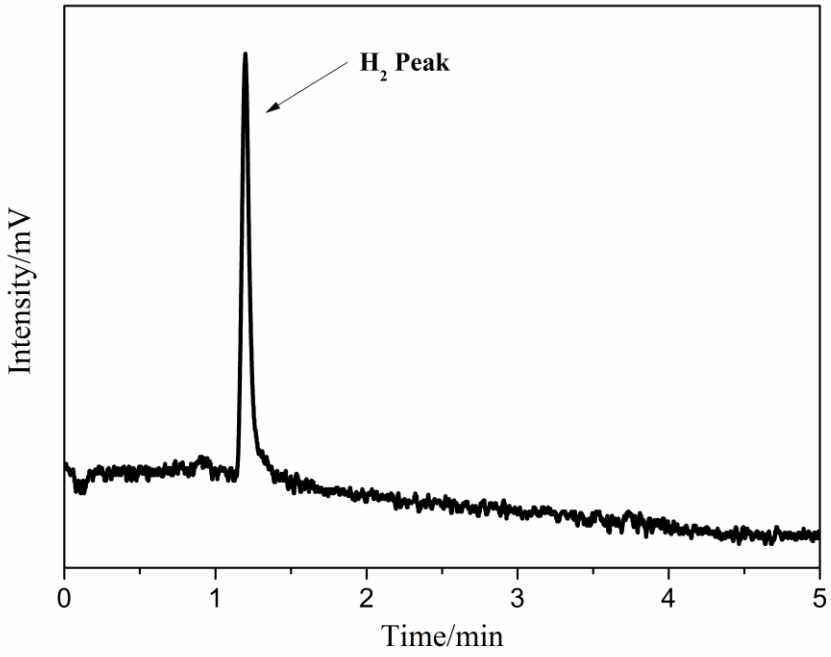

Fig. S6 The gas-chromatography spectra of standard H_2 peak.