Supporting Information

Interfacial Electronic Modulation in Au–Tungstic Acid for Enhanced PEC Performance

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Details of supporting information

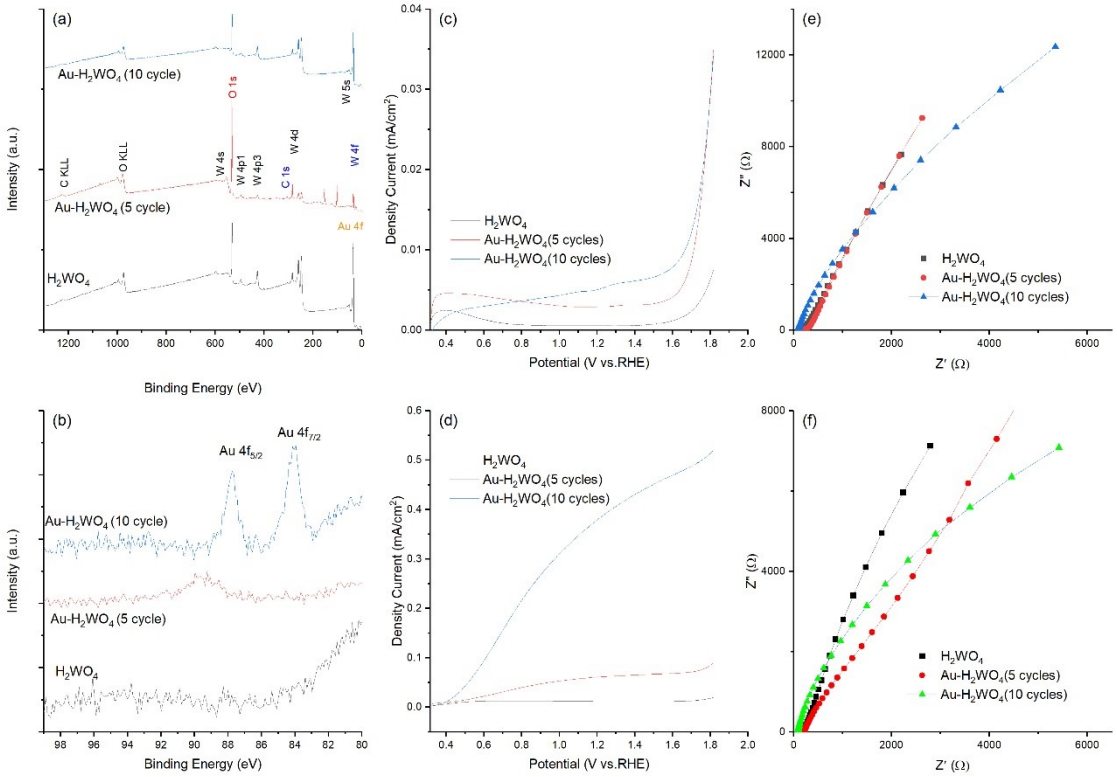

Fig. S1. (a) XPS survey spectra of H_2WO_4, Au–H_2WO_4 (5 cycles), and Au–H_2WO_4 (10 cycles). (b) High-resolution Au 4f spectra confirming the presence of metallic Au in Au–H_2WO_4 samples. (c,d) Current density–potential (J–V) curves measured under dark and illuminated conditions, respectively. (e,f) Corresponding Nyquist plots obtained from EIS measurements under dark and light conditions.

Structure and photoelectrochemical characteristics of H_2WO_4 and Au–H_2WO_4 films produced with varying photoreduction cycles are compared in Figure S1. XPS spectra (Fig. S1a,b) show that Au was successfully incorporated, with the Au signal increasing with deposition cycles, indicating increased Au loading. The J–V curves (Fig. S1c,d) reveal that Au inclusion increases photocurrent, and that the number of cycles from 5 to 10 increases it further. This shows that Au improves charge separation and electron extraction at the electrode/electrolyte interface. EIS (Fig. S1e,f) shows that interfacial resistance decreases but not proportionally to Au loading. Au–H_2WO_4 has a lower impedance than pure H_2WO_4, although the difference between 5- and 10-cycle samples is less significant. This suggests that incomplete surface coverage or nanoparticle aggregation at higher loadings prevent charge transmission from improving with Au loading. Based on these results, the sample with 10 photoreduction cycles was chosen for future analysis as a representative condition within the examined range.

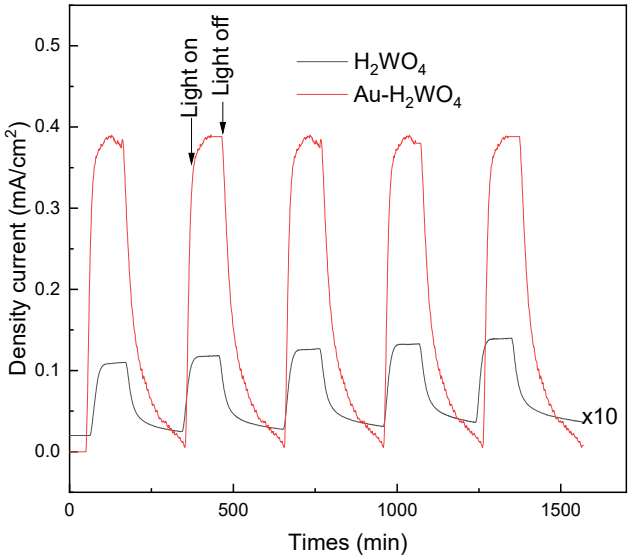

Fig. S2. Transient photocurrent responses of H_2WO_4 and Au–H_2WO_4 photoanodes measured at 1.2 V vs. RHE under chopped illumination. *The current density of H_2WO_4 is multiplied by 10 for clarity.*

The sharp photocurrent rise and stable plateau suggest efficient charge separation, while the higher response of Au–H_2WO_4 reflects accelerated interfacial charge transfer and reduced recombination.