Supporting Information

Au-mediated charge transfer process of ternary $Cu_2O/Au/TiO_2$-NAs nano-heterostructures for improved photoelectrochemical performance

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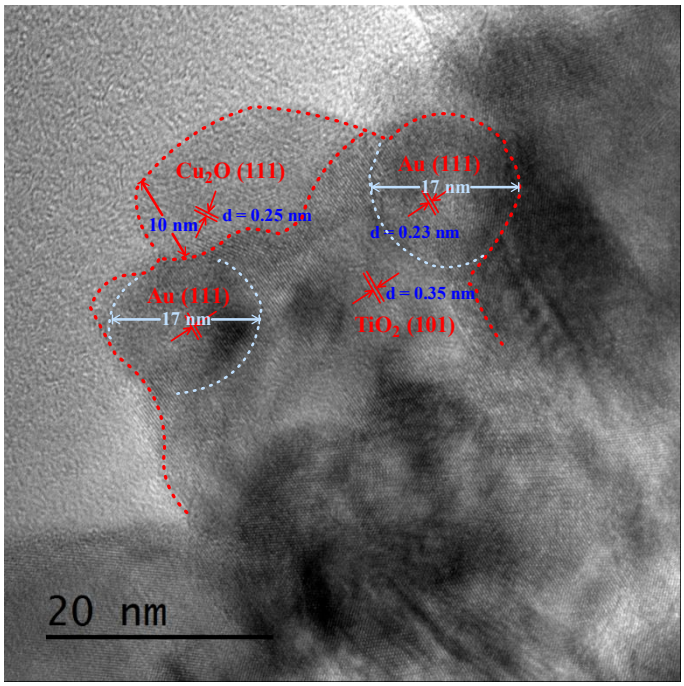

Figure S1. An high-resolution transmission electron microscopy (HRTEM) image of the $Cu_2O/Au/TiO_2$-NAs with Cu_2O depositing time 40s ternary nano-heterojunction interface.

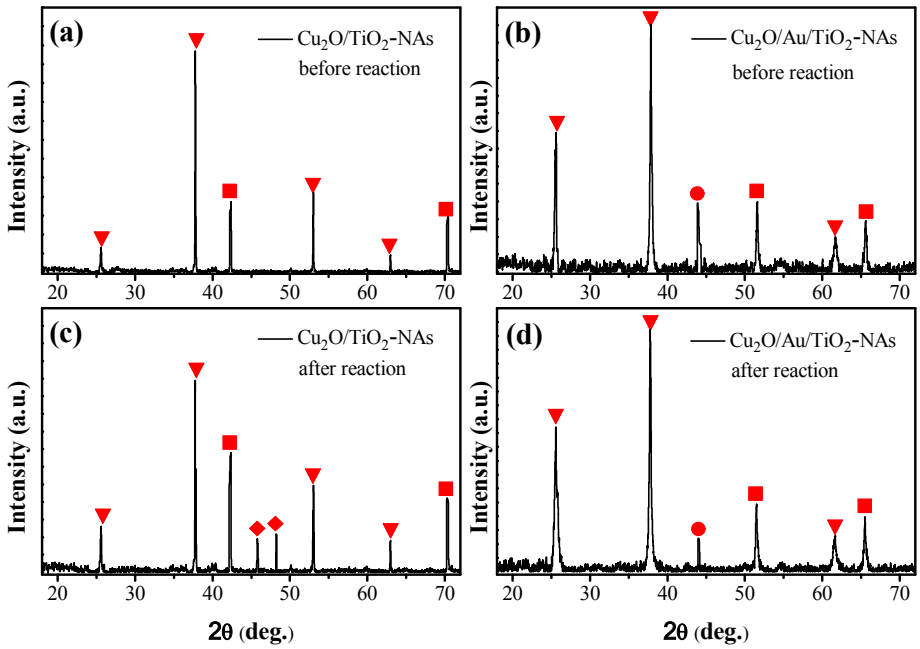

Figure S2. (a)-(d) X-ray diffraction (XRD) patterns of Cu_2O/TiO_2-NAs and $Cu_2O/Au/TiO_2$-NAs (Cu_2O deposition time is 20s), respectively; (a)-(b) before photodegradation reaction; (c)-(d) after photodegradation reaction.

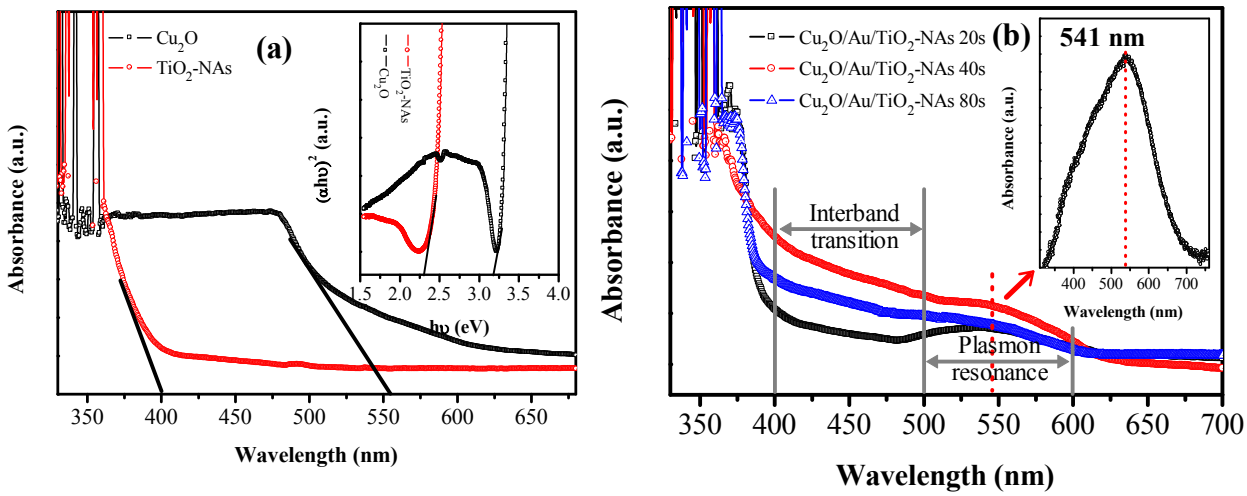

Figure S3. (a) UV-vis light absorbance spectra of pristine TiO_2-NAs and pure Cu_2O, the inset is derived Tauc plots; and (b) are light absorbance spectra for binary Cu_2O/TiO_2-NAs nanohybrids and ternary $Cu_2O/Au/TiO_2$-NAs nanocomplex, the inset plot shows localized surface plasmon resonance (LSPR) peak of Au NPs deposited on glass with time 30s annealed at 450°C.

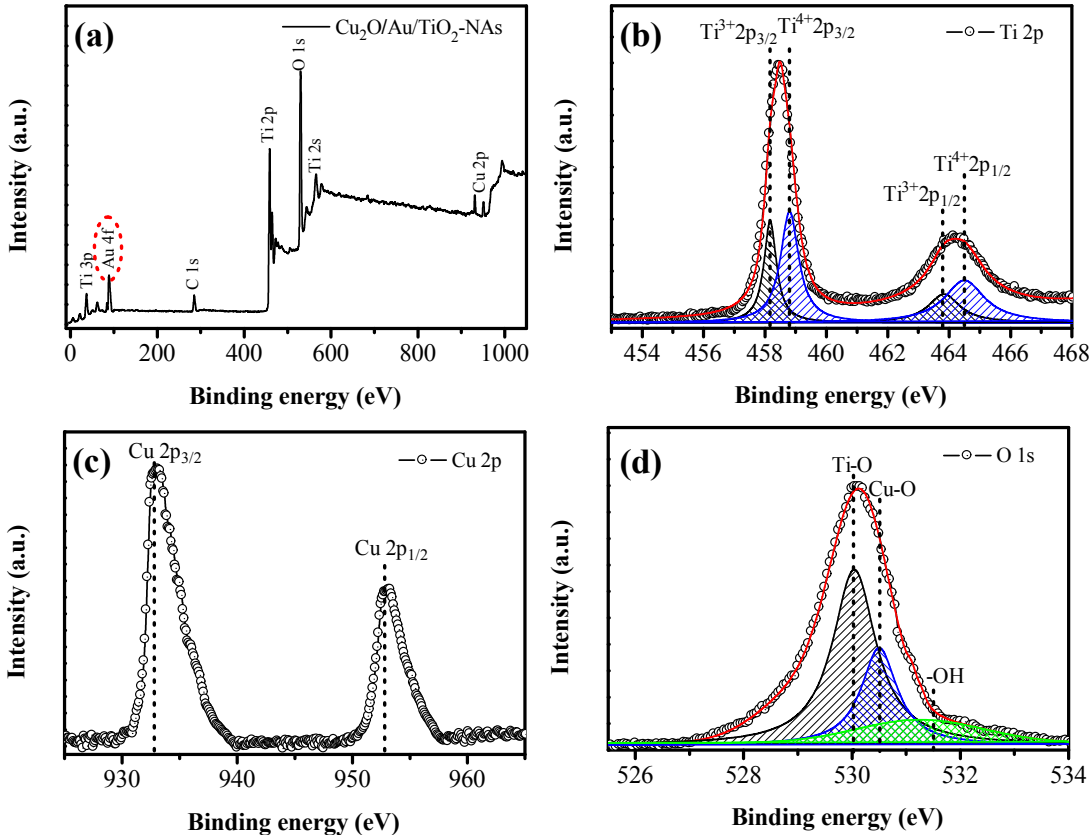

Figure S4. High-resolution X-ray photoelectron spectroscopy (XPS) characterizations for as-prepared ternary $Cu_2O/Au/TiO_2$-NAs nanoheterojunctions: (a) XPS survey spectrum, (b) Ti 2p, (c) Cu 2p, and (d) O 1s, respectively.

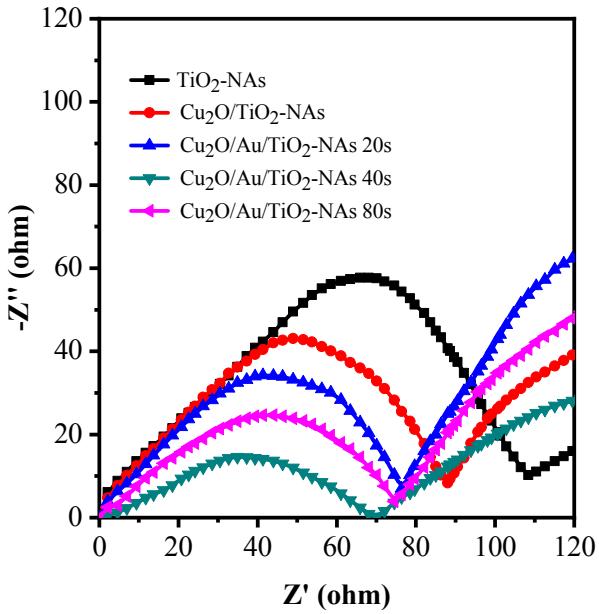

Figure S5. The electrochemical impedance spectra (EIS) presented as Nyquist plots of pristine TiO_2-NAs, Cu_2O/TiO_2-NAs, and $Cu_2O/Au/TiO_2$-NAs nanoheterojunctions with different Cu_2O electrochemical deposition time (20s, 40s, and 80s). Inset is the corresponding equivalent circuit.

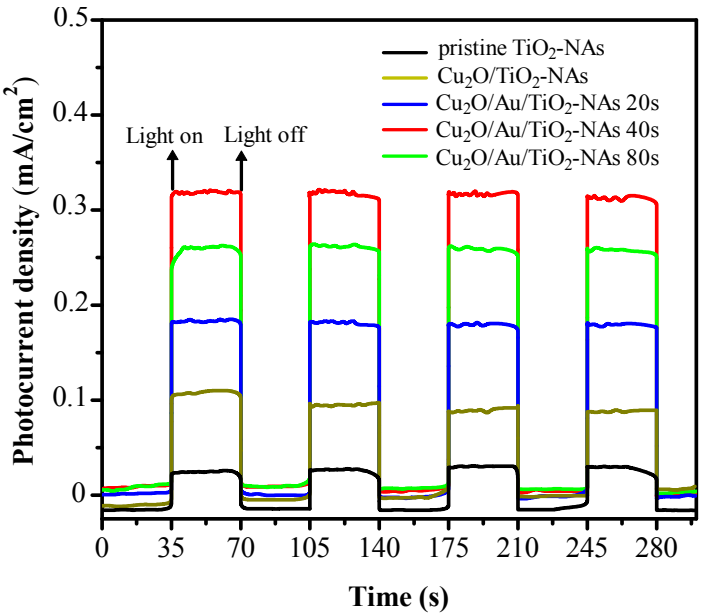

Figure S6. Photocurrent density versus testing time curve of pure TiO_2-NAs, type-II Cu_2O/TiO_2-NAs nano-heterojunctions, and ternary nano-sized $Cu_2O/Au/TiO_2$-NAs heterojunction films deposited Cu_2O under different times 20s, 40s, and 80s, respectively.

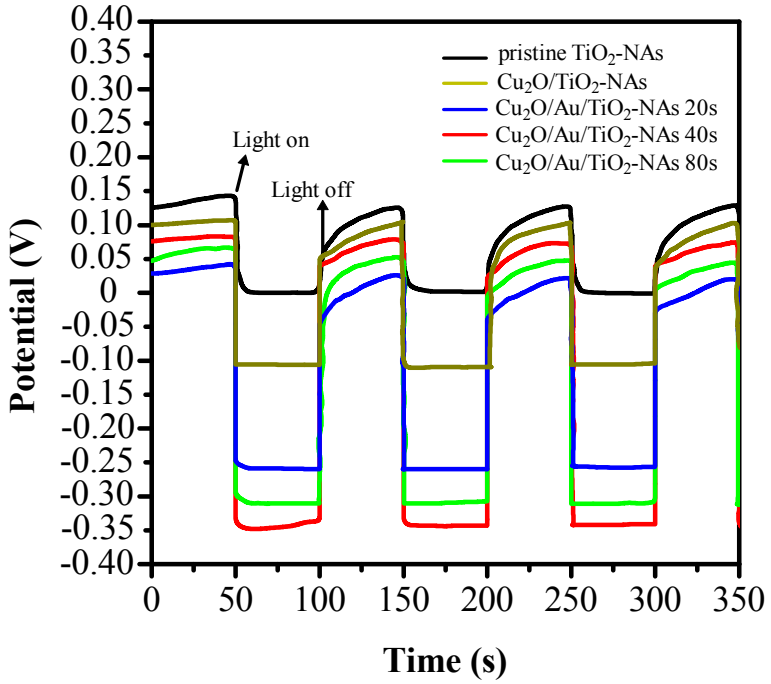

Figure S7. The open circuit potential versus time curves of pristine TiO_2-NAs, type-II Cu_2O/TiO_2-NAs nano-heterojunctions, and ternary nano-sized $Cu_2O/Au/TiO_2$-NAs heterojunction films deposited Cu_2O with different times 20s, 40s, and 80s, respectively.

Table S1. Quantitative analysis of as-formed ternary nanoheterojunctions catalyst.

Sample	Cu (wt%)	Ti (wt%)	Au (wt%)
Au/TiO_2-NAs	-	90.71	6.75
$Cu_2O/Au/TiO_2$-NAs 20s	4.36	86.75	4.98
$Cu_2O/Au/TiO_2$-NAs 40s	7.88	81.23	3.21
$Cu_2O/Au/TiO_2$-NAs 80s	14.63	71.36	1.23