Supporting Information

Construction of ternary TiO_2/CdS/IrO_2 heterostructure photoanodes for efficient glycerol oxidation coupled with hydrogen evolution

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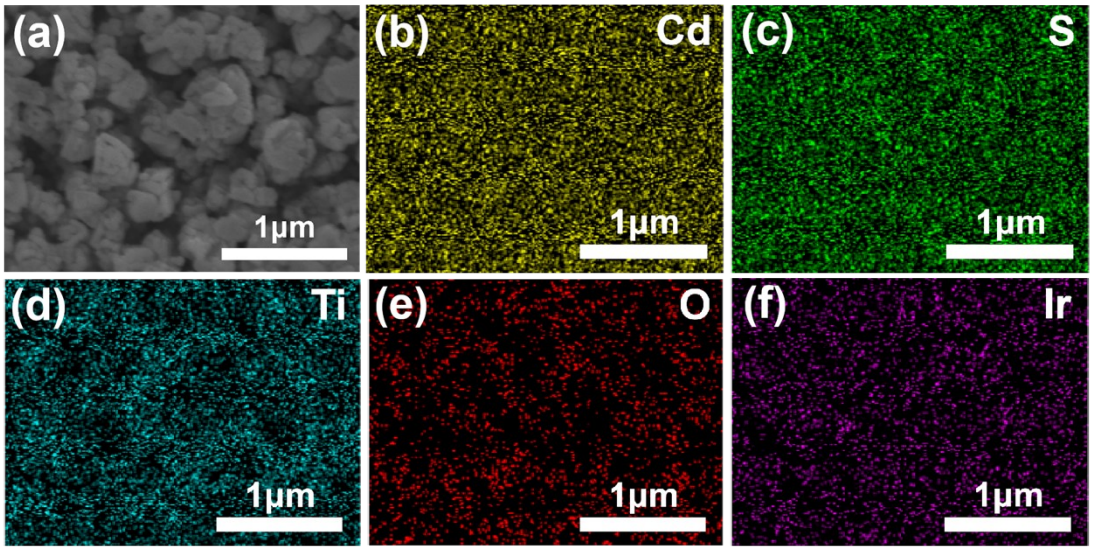

Fig. S1. (a) The SEM image of TiO_2/CdS/IrO_2, and the corresponding elemental mapping images of (b) Cd, (c) S, (d) Ti, (e) O and (f) Ir.

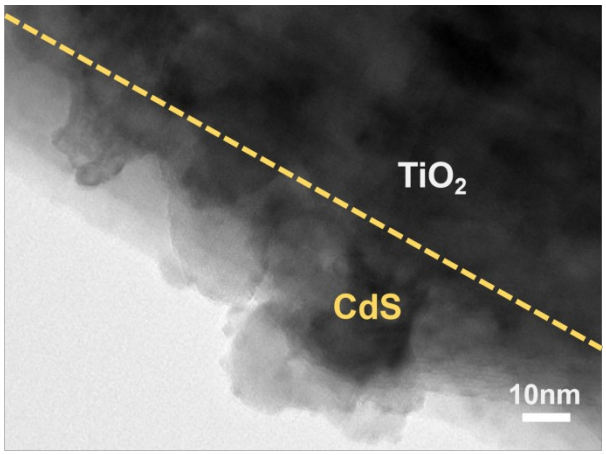

Fig. S2. The TEM image of TiO_2/CdS

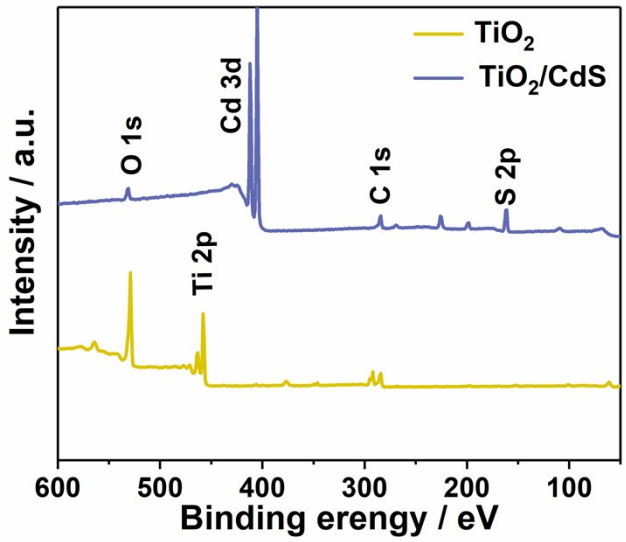

Fig. S3. The survey XPS spectra of the TiO_2 and TiO_2/CdS.

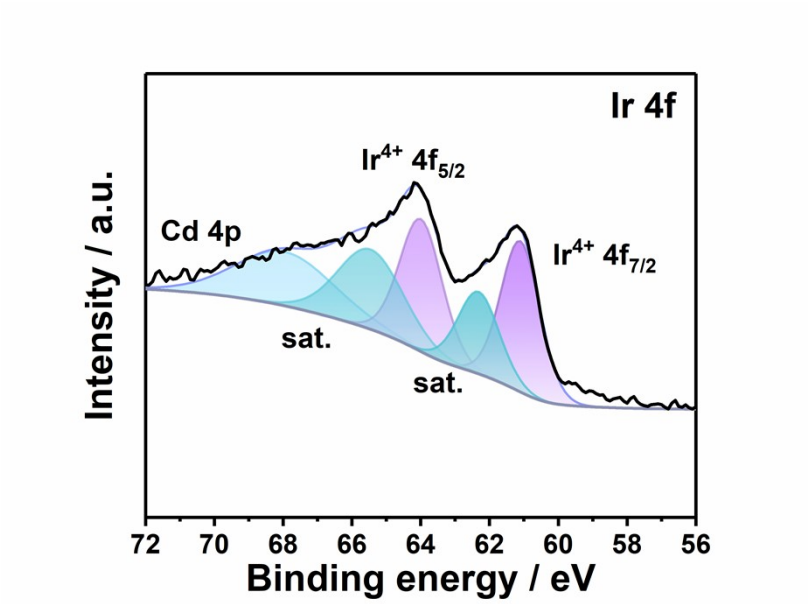

Fig. S4. The Ir fine XPS spectrum of TiO_2/CdS/IrO_2.

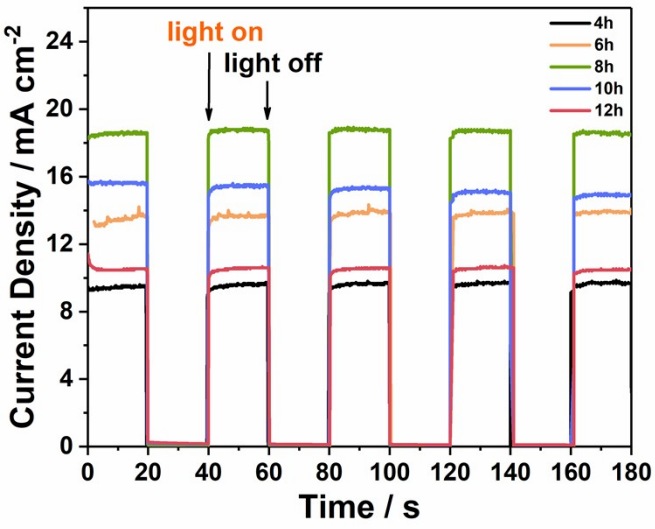

Fig. S5. Chopped *I-t* curves of the TiO_2/CdS photoanodes synthesized with different hydrothermal times.

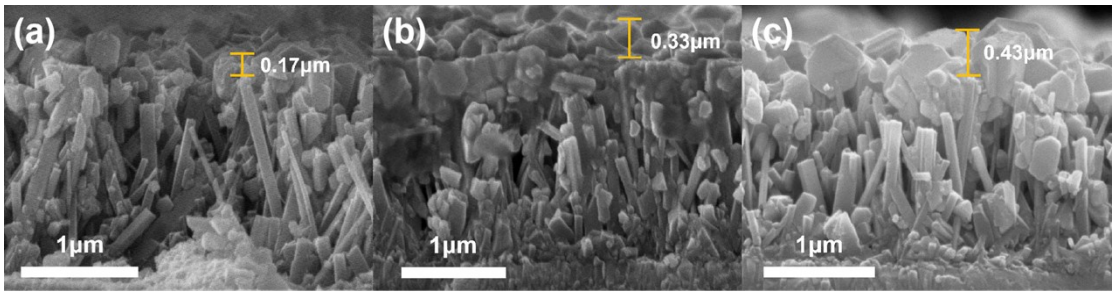

Fig. S6. SEM images of TiO_2/CdS with different hydrothermal reaction times: (a) 4 h, (b) 8 h, (c) 12 h.

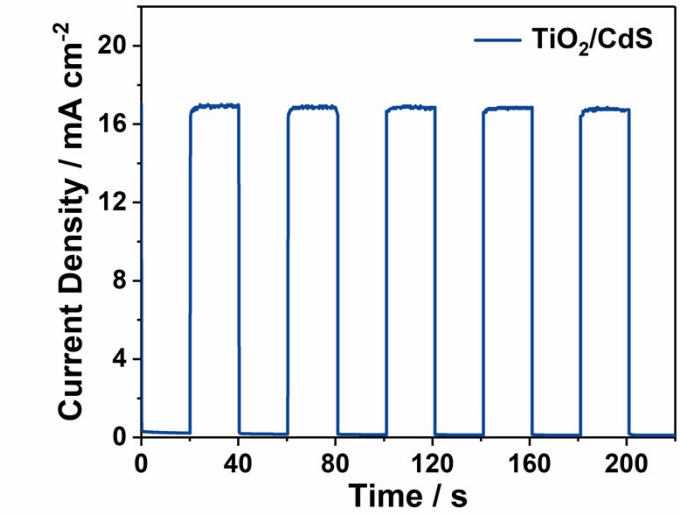

Fig. S7. Chopped *I-t* curve under bias-free condition.

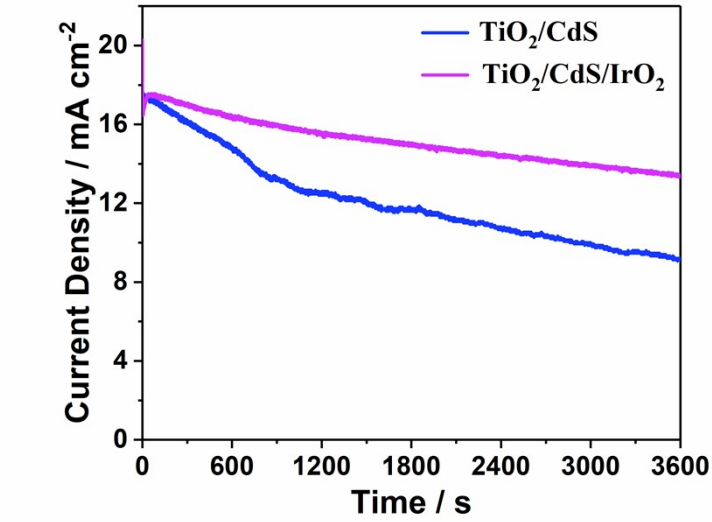

Fig. S8. Photocurrent density stabilities of TiO_2/CdS, TiO_2/CdS/IrO_2 photoanodes measure in 1 M KOH and 0.3 M glycerol solution under AM 1.5G sunlight (100 mW cm^{-2}).

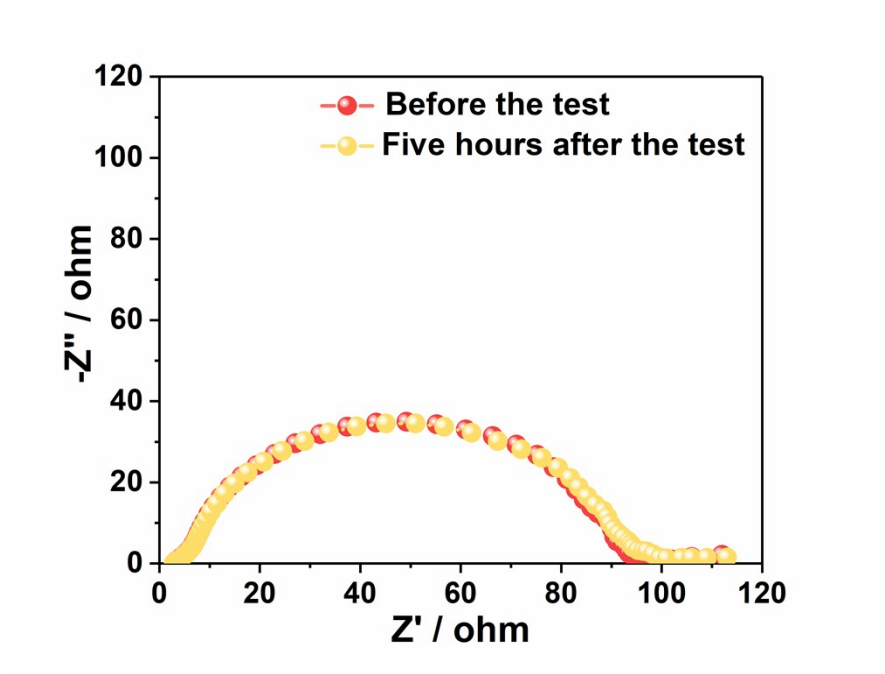

Fig. S9. Electrochemical impedance spectra of TiO_2/CdS before and after 5h stability test.

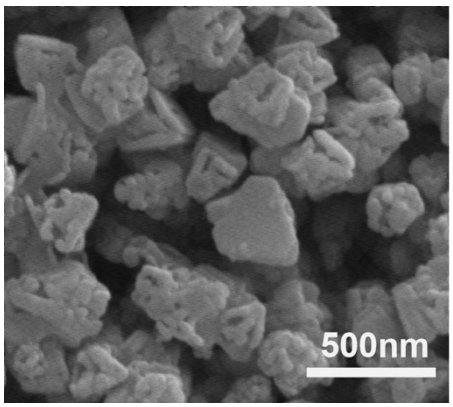

Fig. S10. SEM image of the TiO_2/CdS photoanode after long-term PEC measurement.

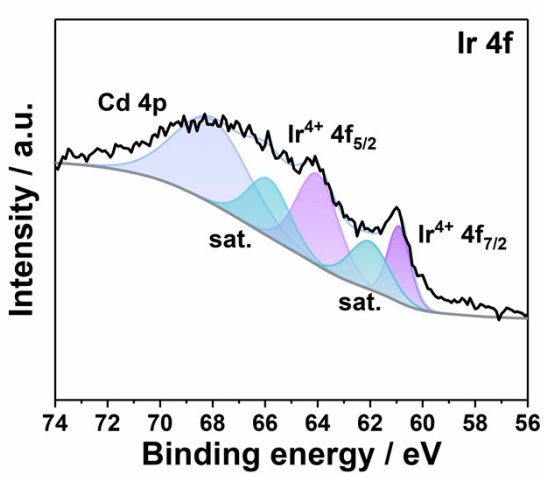

Fig. S11. XPS spectra of Ir of TiO_2/CdS/IrO_2 after 1h reaction.

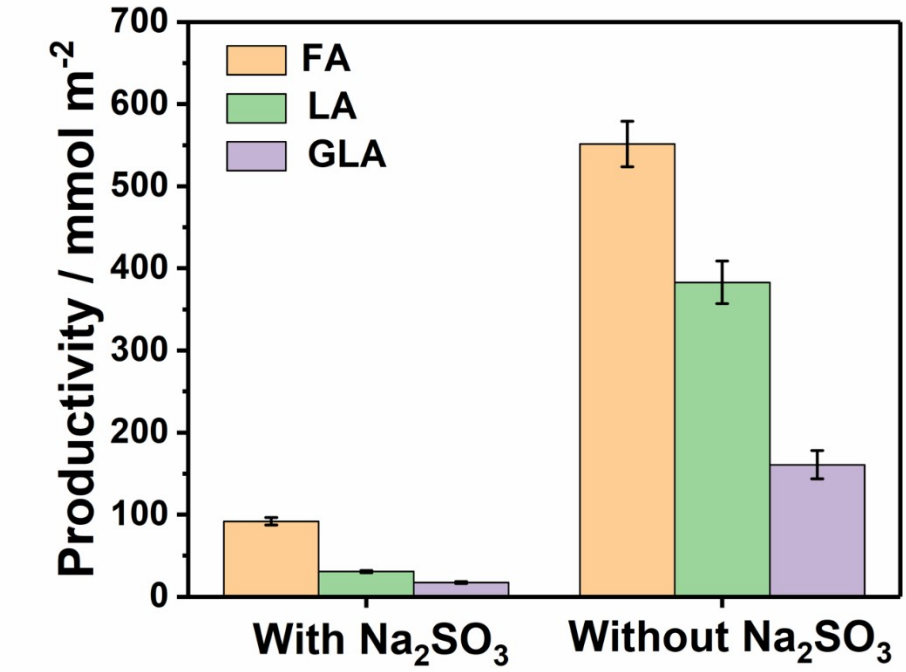

Fig. S12 The production rate of PEC glycerol oxidation products over TiO_2/CdS/IrO_2 photoanode with and without the addition of 5 mM Na_2SO_3.

Table S1. Equivalent circuit analysis of EIS spectra for TiO_2, CdS, TiO_2 /CdS and TiO_2/CdS/IrO_2

	Rs (Ω)	Rct (Ω)
TiO_2	5.358	1048
CdS	3.853	275.7
TiO_2/CdS	5.36	87.12
TiO_2/CdS/IrO_2	5.526	75.02

Table S2. Comparison of H_2 evolution rate among various membrane electrodes.

Photocatalysts	Light Source	Sacrificial reagent	Rate of H_2 evolution
CdS/Ag/TiO_2-NRs[1]	Xe lamp 100mw/cm^2 (λ > 420 nm)	30 mg L^{-1} nitrobenzene/ 0.5 M Na_2S+Na_2SO_3 (pH 13.64)	0.09 mmol h^{-1} cm^{-2} at 0.5 V vs. Ag/AgCl
TiO_2-NR/CdS-NiOx[2]	AM 1.5 G	0.5 M Na_2S+0.5 M Na_2SO_4	1.3 mmol h^{-1} cm^{-2} at 0 V vs. Ag/AgCl

TiO_2/CdS/TiN NRA[3]	300 W Xe lamp	0.35 M Na_2S+0.25 M Na_2SO_3	129.6 μmol cm^{-2} h^{-1} at 0 V vs. Ag/AgCl
CdS/H-3D-TiO_2/Pt-wire[4]	300 W Xe lamp	0.5 M Na_2S+0.5 M Na_2SO_3	18.42 mmol cm^{-2} h^{-1} at 0.55 V vs. Ag/AgCl
Cu_2S-TiO_2/TiO_2 NPs[5]	100 W Xe lamp (100 mW/cm^2)	1 M KOH	55 μmol cm^{-2} h^{-1} at 0.5 V vs. RHE
CdS/ZnS[6]	300 W Xe lamp (λ > 420 nm)	0.5 M Na_2S-Na_2SO_3	137 μmol cm^{-2} h^{-1}
WO_3/$BiVO_4$/Bi[7]	AM 1.5 G （100 mW cm^{-2}）	0.5 M Na_2SO_4+0.1 M glycerol	328.8 mmol m^{-2} h^{-1} at 1.2 V vs. RHE
TiO_2/$B_{i2}O_3$[8]	AM 1.5G (100 mW cm^{-2})	0.5 M Na_2SO_4+0.1 M glycerol	108.75μmol cm^{-2} h^{-1} 1.0 V vs. RHE
TiO_2/CdS (this work)	300 W Xe lamp	1M KOH+0.3 M glycerol	1574.5 mmol m^{-2} h^{-1} at 1.23 V vs. RHE
TiO_2/CdS/IrO_2 (this work)	300 W Xe lamp	1M KOH+0.3 M glycerol	2345.2 mmol m^{-2} h^{-1} at 1.23 V vs. RHE

Table S3. The selectivity of glycerol oxidation products over TiO_2/CdS and TiO_2/CdS/IrO_2 photoanodes for 2 h reaction.

Catalyst	Selectivity of FA /%	Selectivity of LA /%	Selectivity of GLA /%
TiO_2/CdS	49.84	35.78	14.38
TiO_2/CdS/IrO_2	53.22	32.82	13.96

References

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