Electronic Supplementary Information

Integrating Metallic Nanoparticles of Au and Pt with MoS_2–CdS Hybrids for High-Efficient Photocatalytic Hydrogen Generation via Plasmon-Induced Electron and Energy Transfer

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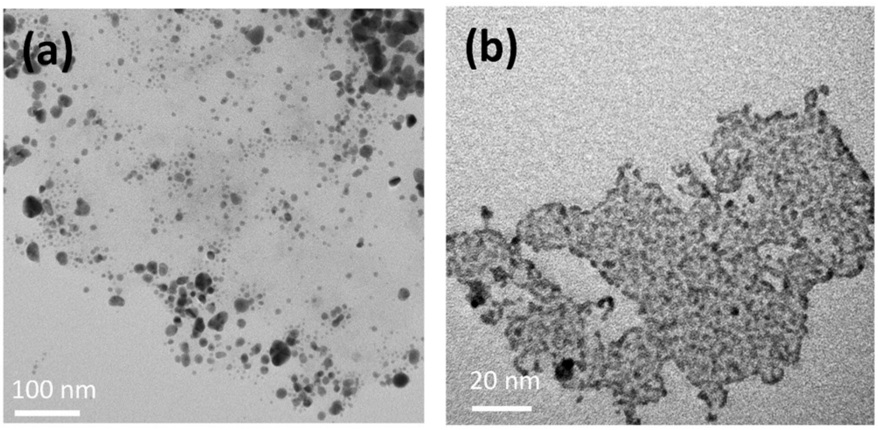

Figure S1. TEM images of MoS_2/Au (a) and MoS_2/Pt (b) hybrids.

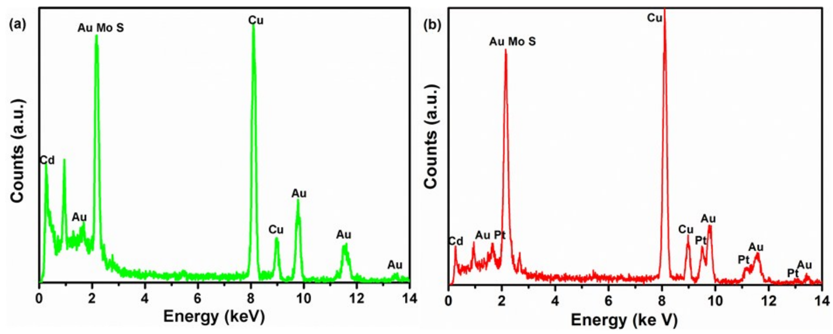

Figure S2. EDX spectra of (MoS_2–CdS)/Au (a) and Pt/MoS_2–CdS/Au (b) hybrids and the contents ratio of the Pt, MoS2 and Au is about Pt: MoS2: Au = 2: 1: 17 .

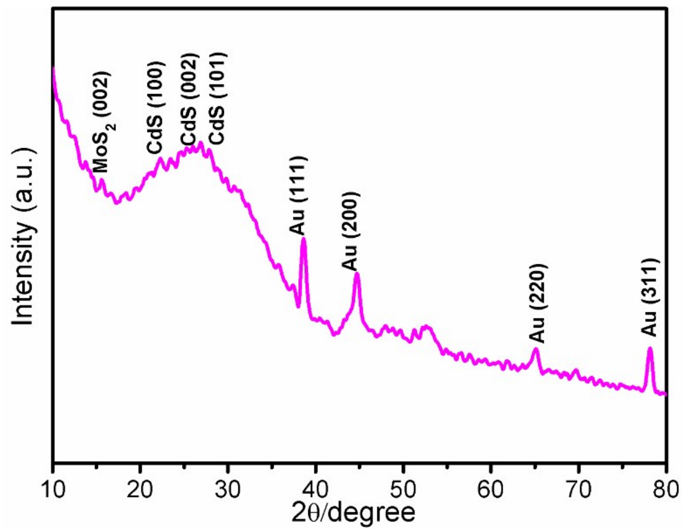

Figure S3. XRD pattern of (MoS_2–CdS)/Au hybrids.

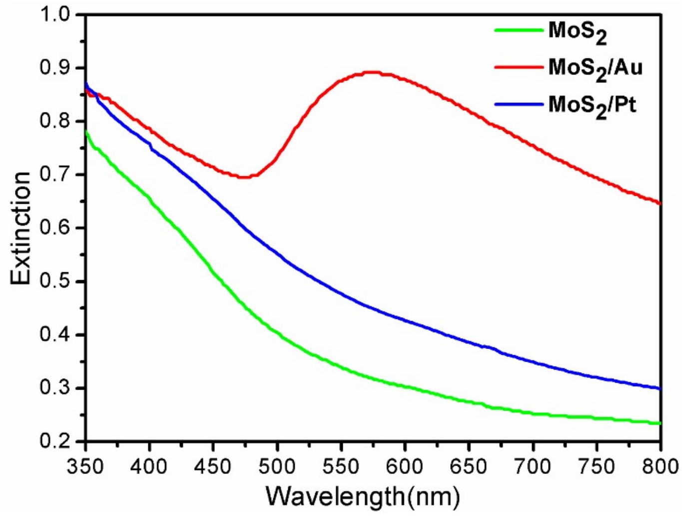

Figure S4. Extinction spectra of the as-synthesized samples of monolayer MoS_2 nanosheets, MoS_2/Au and MoS_2/Pt hybrids.

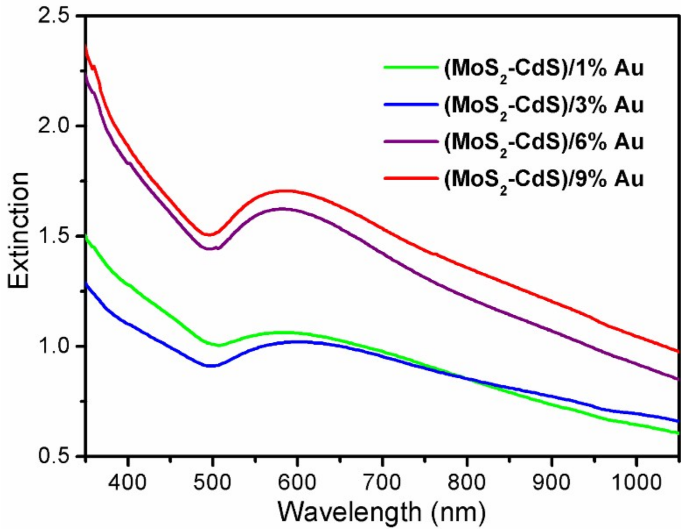

Figure S5. Extinction spectra of (MoS_2-CdS)/Au hybrids with different quality percentages of Au.

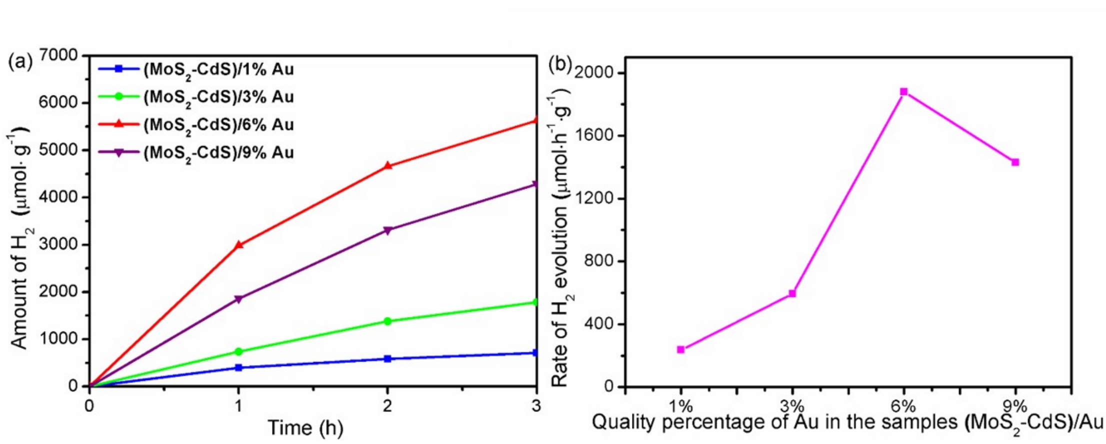

Figure S6. (a) Time-dependent photocatalytic H_2 evolution for (MoS_2-CdS)/Au hybrids with different quality percentages of Au. (b) Comparison of the H_2 evolution rate under visible light irritation for (MoS_2-CdS)/Au hybrids with different quality percentages of Au.

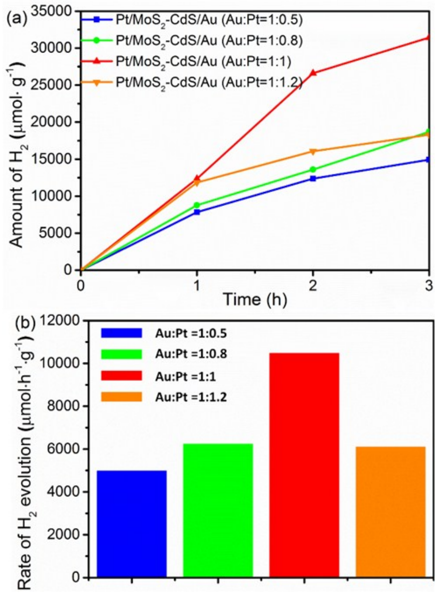

Figure S7. Photocatalytic activity of the as-synthesized samples for H_2 evolution reaction. Time-dependent photocatalytic H_2 evolution for different loading ratio of Pt and Au in the obtained Pt/MoS_2-CdS/Au hybrid structures (a); Comparison of the average H_2 evolution rate in 3 hours under visible light irritation for different loading ratio of Pt and Au in the obtained Pt/MoS_2-CdS/Au hybrid structures (b).

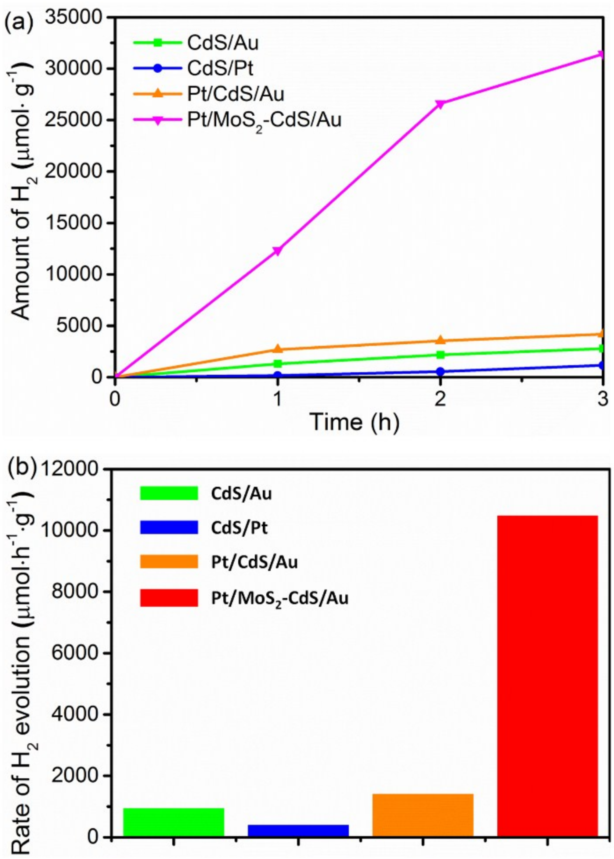

Figure S8. Photocatalytic activity of the as-synthesized samples for H_2 evolution reaction. Time-dependent photocatalytic H_2 evolution for CdS/Au, CdS/Pt, Pt/CdS/Au and Pt/(MoS_2–CdS)/Au heterostructures (a); Comparison of the average H_2 evolution rate in 3 hours under visible light irritation for CdS/Au, CdS/Pt, Pt/CdS/Au and Pt/(MoS_2–CdS)/Au heterostructures (b).

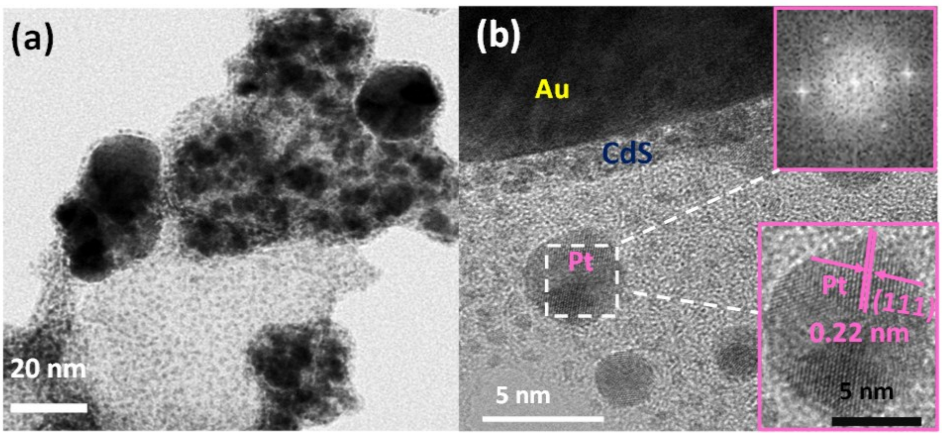

Figure S9. TEM (a) and HRTEM (b) images of Pt/MoS_2-CdS/Au heterostructure.

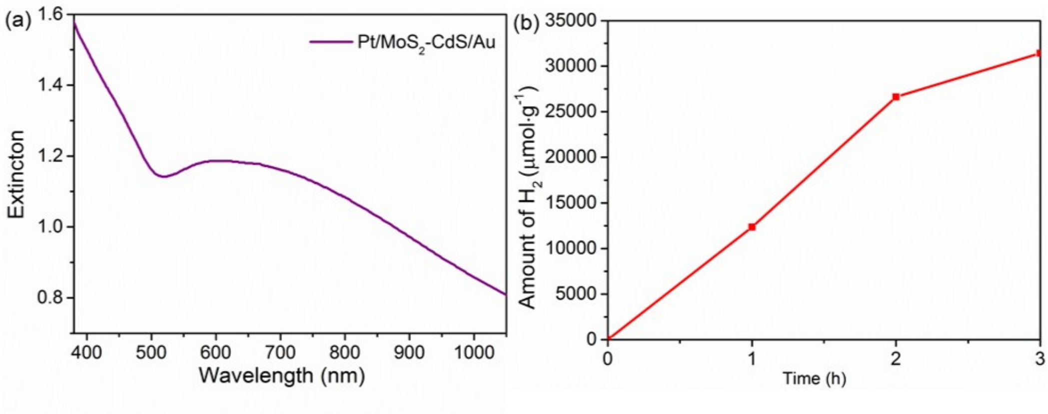

Figure S10. Extinction spectra (a) and Time-dependent photocatalytic H2 evolution (b) for Pt/MoS_2-CdS/Au heterostructure.

The expression of enhancement factors:

$$EF_{\mathrm{Au}}=\frac{\mathrm{HER\_rate}[(MoS_2-CdS)/Au]}{\mathrm{HER\_rate}[MoS_2-CdS]}=\frac{e_{\mathrm{P}}\alpha_{CdS}k_{CdS\to MoS_2}+\alpha_{Au}(k_{Au\to CdS}k_{CdS\to MoS_2}+k_{Au\to MoS_2})}{\alpha_{CdS}k_{CdS\to MoS_2}}$$

$$=e_{\mathrm{P}}+\frac{\alpha_{Au}(k_{Au\to CdS}k_{CdS\to MoS_2}+k_{Au\to MoS_2})}{\alpha_{CdS}k_{CdS\to MoS_2}}=e_{\mathrm{P}}+EF_{\mathrm{Hot\_Sulfide}},$$

where $EF_{\mathrm{Hot\_Sulfide}}=\dfrac{\alpha_{Au}(k_{Au\to CdS}k_{CdS\to MoS_2}+k_{Au\to MoS_2})}{\alpha_{CdS}k_{CdS\to MoS_2}}$.

$$EF_{\mathrm{Pt}}=\frac{\mathrm{HER\_rate}[(MoS_2-CdS)/Pt]}{\mathrm{HER\_rate}[MoS_2-CdS]}=\frac{\alpha_{CdS}k_{CdS\to MoS_2}+\alpha_{CdS}(k_{CdS\to Pt}+k_{CdS\to MoS_2}k_{MoS_2\to Pt})}{\alpha_{CdS}k_{CdS\to MoS_2}}$$

$$=1+\frac{\alpha_{CdS}(k_{CdS\to Pt}+k_{CdS\to MoS_2}k_{MoS_2\to Pt})}{\alpha_{CdS}k_{CdS\to MoS_2}}.$$

$$EF_{\mathrm{Au+Pt}}=\frac{\mathrm{HER\_rate}[Pt/MoS_2-CdS/Au]}{\mathrm{HER\_rate}[MoS_2-CdS]}$$

$$=\frac{e_{\mathrm{p}}\alpha_{CdS}k_{CdS\to MoS_2}+e_{\mathrm{p}}\alpha_{CdS}(k_{CdS\to Pt}+k_{CdS\to MoS_2}k_{MoS_2\to Pt})}{\alpha_{CdS}k_{CdS\to MoS_2}}+\frac{\alpha_{Au}(k_{Au\to CdS}k_{CdS\to MoS_2}+k_{Au\to MoS_2})(1+k_{MoS_2\to Pt})+\alpha_{Au}k_{Au\to Pt}}{\alpha_{CdS}k_{CdS\to MoS_2}}$$

$$=e_{\mathrm{p}}+\frac{e_{\mathrm{p}}\alpha_{CdS}(k_{CdS\to Pt}+k_{CdS\to MoS_2}k_{MoS_2\to Pt})}{\alpha_{CdS}k_{CdS\to MoS_2}}+\frac{\alpha_{Au}(k_{Au\to CdS}k_{CdS\to MoS_2}+k_{Au\to MoS_2})}{\alpha_{CdS}k_{CdS\to MoS_2}}$$

$$+\frac{\alpha_{Au}(k_{Au\to CdS}k_{CdS\to MoS_2}+k_{Au\to MoS_2})k_{MoS_2\to Pt}+\alpha_{Au}k_{Au\to Pt}}{\alpha_{CdS}k_{CdS\to MoS_2}}$$

$$=e_{\mathrm{p}}EF_{\mathrm{Pt}}+EF_{\mathrm{Hot\_Sulfide}}+EF_{\mathrm{Hot\_Pt}}$$

$$=EF_{\mathrm{Au}}+e_{\mathrm{p}}(EF_{\mathrm{Pt}}-1)+EF_{\mathrm{Hot\_Pt}},$$

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here $EF_{\mathrm{Hot\_Pt}}=\dfrac{\alpha_{Au}(k_{Au\to CdS}k_{CdS\to MoS_2}+k_{Au\to MoS_2})k_{MoS_2\to Pt}+\alpha_{Au}k_{Au\to Pt}}{\alpha_{CdS}k_{CdS\to MoS_2}}$