

## Supporting Information

### **Cobalt Lactate Complex as Hole Cocatalyst for Significantly Enhanced Photocatalytic H<sub>2</sub>-Production Activity over CdS Nanorods**

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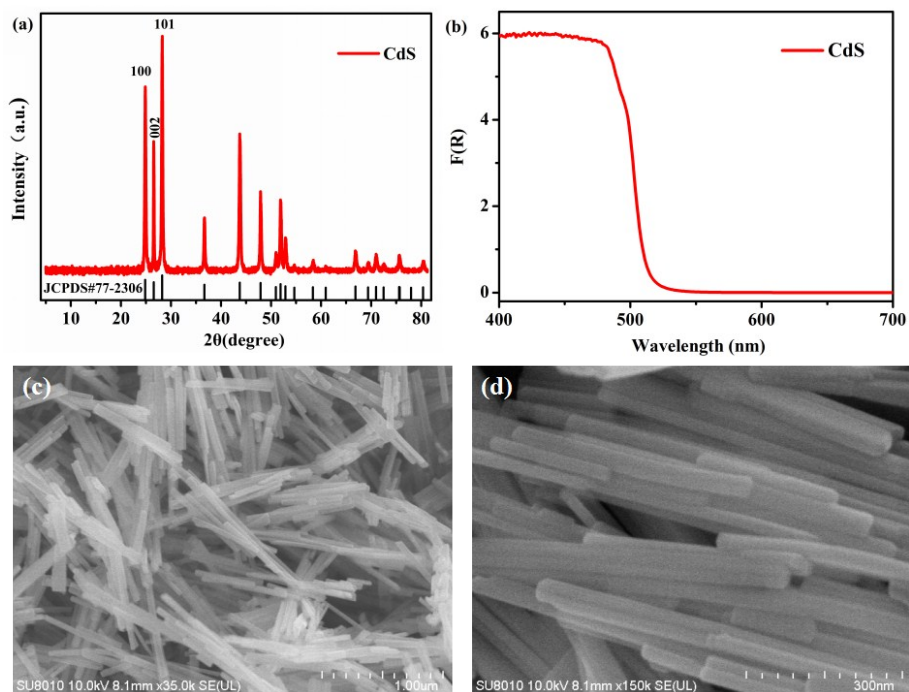


Fig. S1 XRD pattern (a), UV-Vis absorption spectrum (b) and SEM images (c and d) of CdS sample.

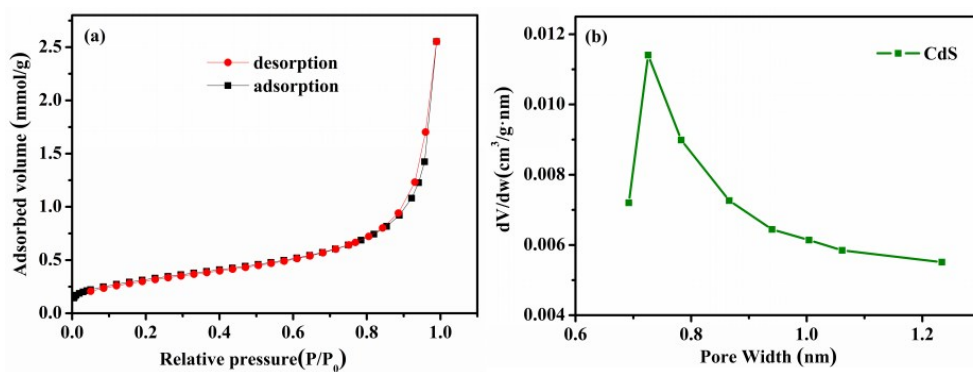


Fig. S2 N<sub>2</sub> adsorption - desorption isotherm (a) and the pore size distribution (HK) curve (b) of CdS sample.

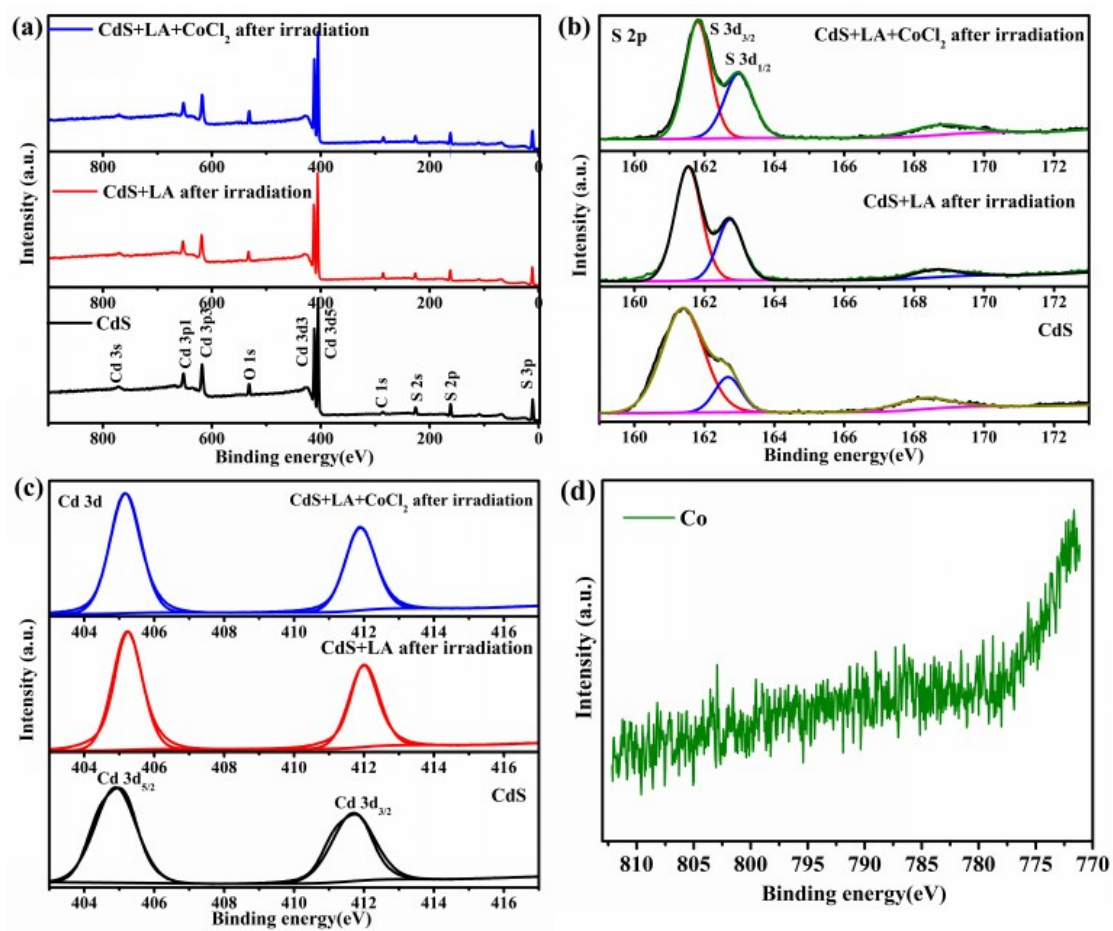


Fig. S3 XPS spectra of the CdS and CdS in the presence/absence of  $\text{CoCl}_2$  after irradiation.

(a) survey spectrum, (b) S 2p, (c) Cd 3d, (d) Co.

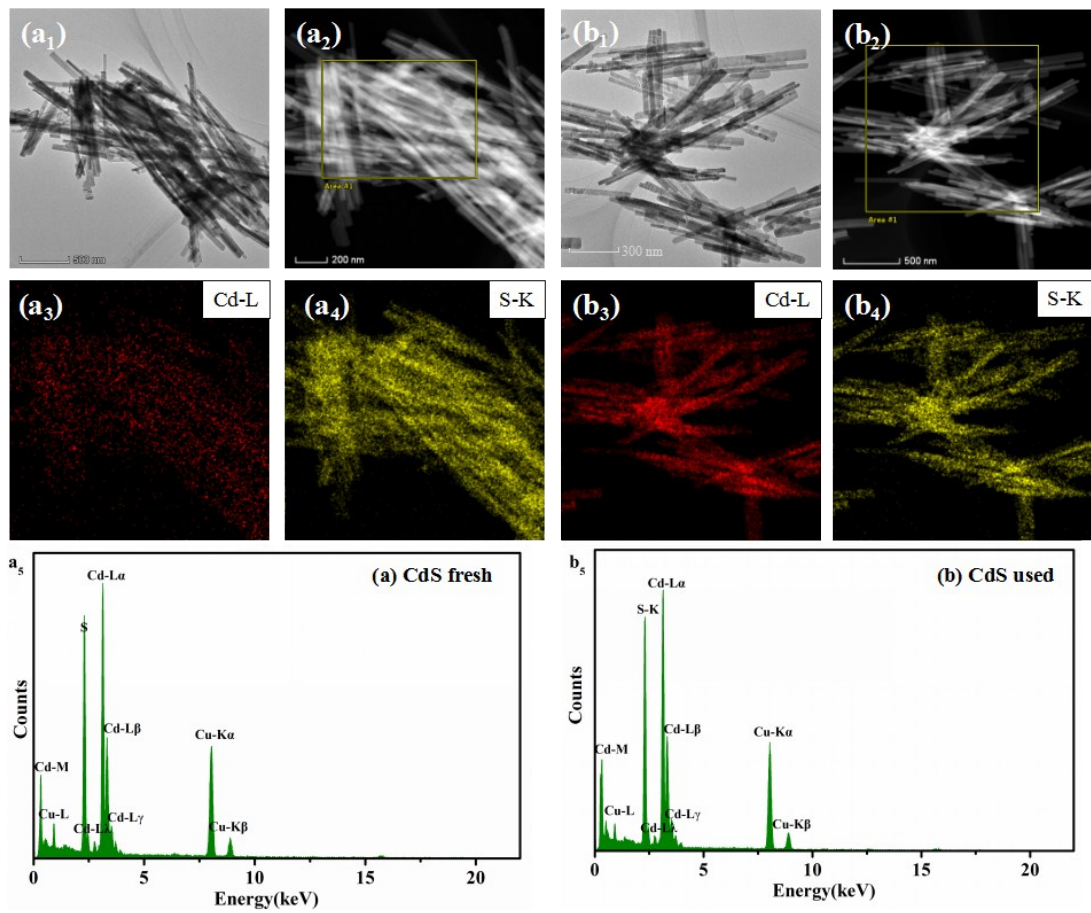


Fig. S4 TEM images, EDX-mappings and EDS spectra of the fresh (a<sub>1</sub> - a<sub>5</sub>) and the used (b<sub>1</sub> - b<sub>5</sub>) CdS samples.

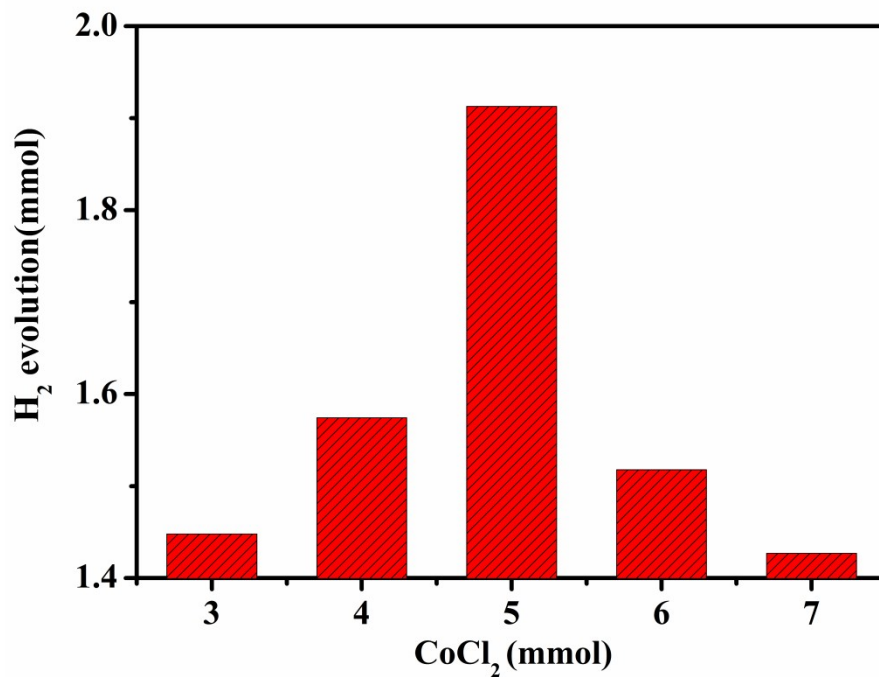


Fig. S5 The effect of the amount of CoCl<sub>2</sub> on the yield of H<sub>2</sub> in the photoreduction system.

Table S1 The H<sub>2</sub> production performance under different reaction conditions.

dispersions	H <sub>2</sub> evolution (mmol)		
	1h	2h	3h
CdS+LA+CoCl <sub>2</sub>	0.61	1.85	2.34
CdS+LA	0.07	0.25	0.41
CdS	-	-	-
LA+CoCl <sub>2</sub> solution	-	-	-
LA solution	-	-	-
CoCl <sub>2</sub> solution	-	-	-
No visible light	-	-	-

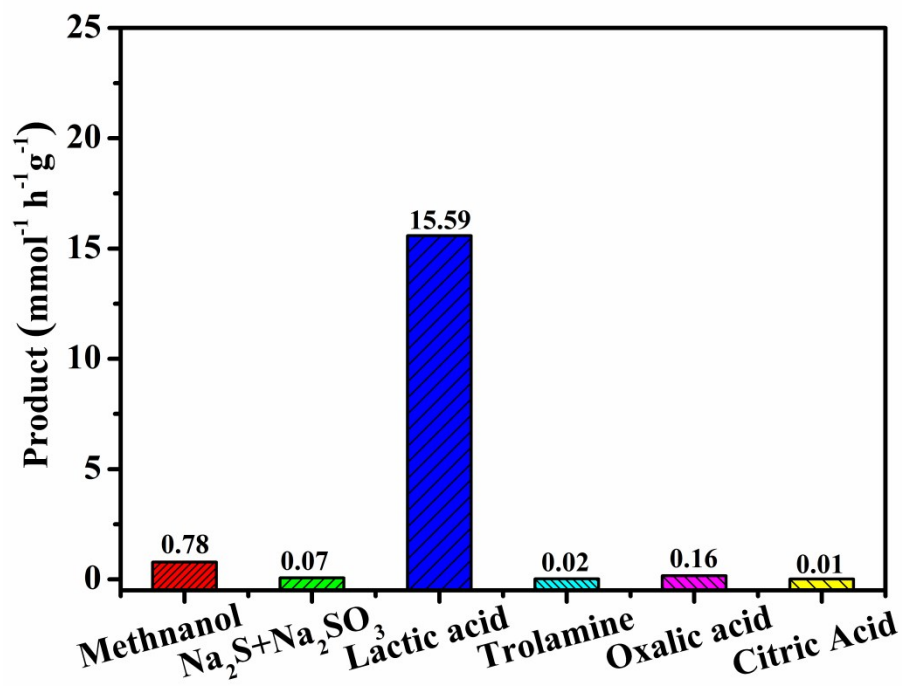


Fig. S6 The effects of sacrificial agents on the hydrogen production rate over CdS in  $\text{CoCl}_2$  solution.

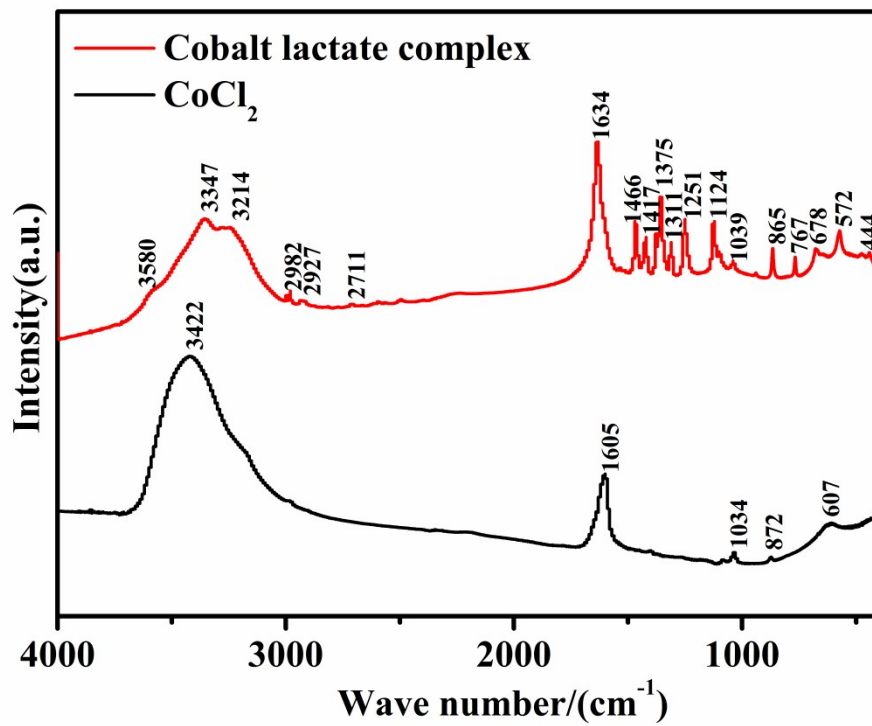


Fig. S7 The FT-IR spectra of cobalt lactate complex and  $\text{CoCl}_2$ .

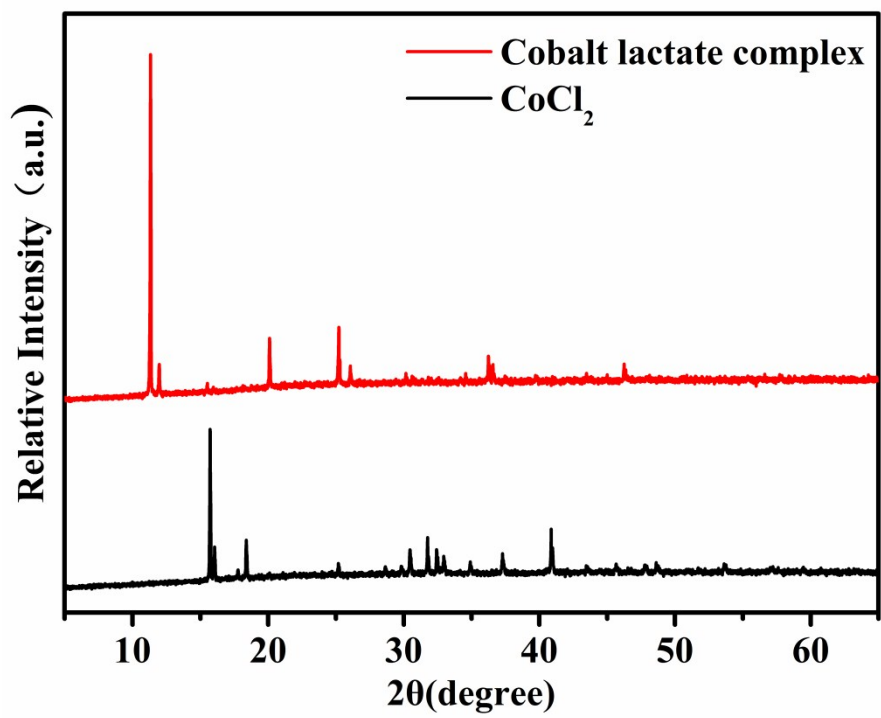


Fig. S8 The XRD patterns of cobalt lactate complex and CoCl<sub>2</sub>.



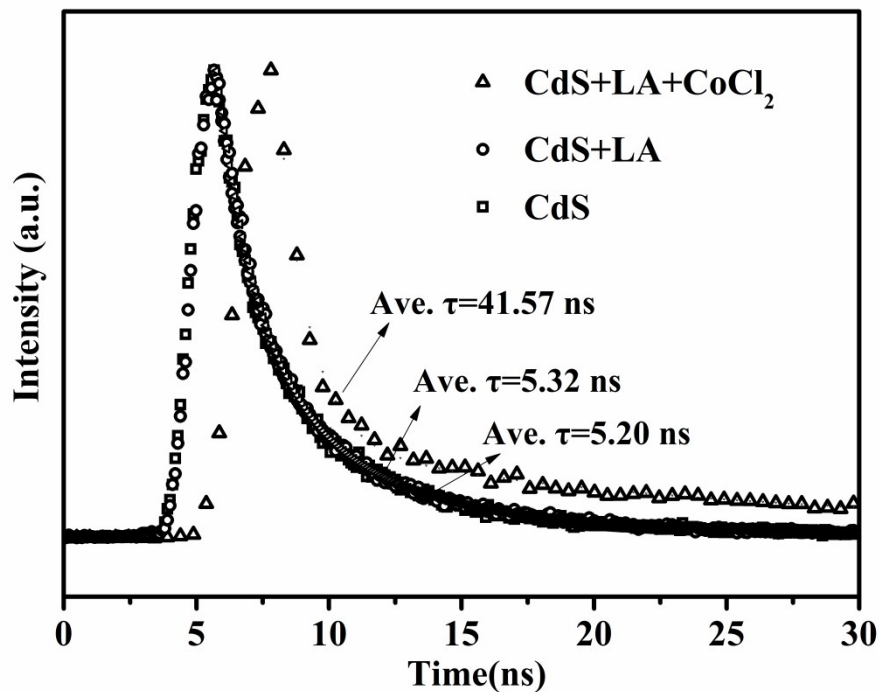


Fig. S9 The time-resolved PL spectra under 375 nm excitation.

Table S2 The data of time-resolved fluorescence.

Sample	$\tau_1$ (ns)		$\tau_2$ (ns)		$\tau_3$ (ns)		Ave. $\tau$ (ns)
	Value/ns	Rel%	Value/ns	Rel%	Value/ns	Rel%	
CdS+LA+ CoCl <sub>2</sub>	1.137	15.86	13.2	32.73	72.12	51.41	41.57
CdS+LA	1.435	25.51	4.143	52.67	12.71	21.83	5.32
CdS	1.145	17.06	3.62	58.75	11.92	24.19	5.20

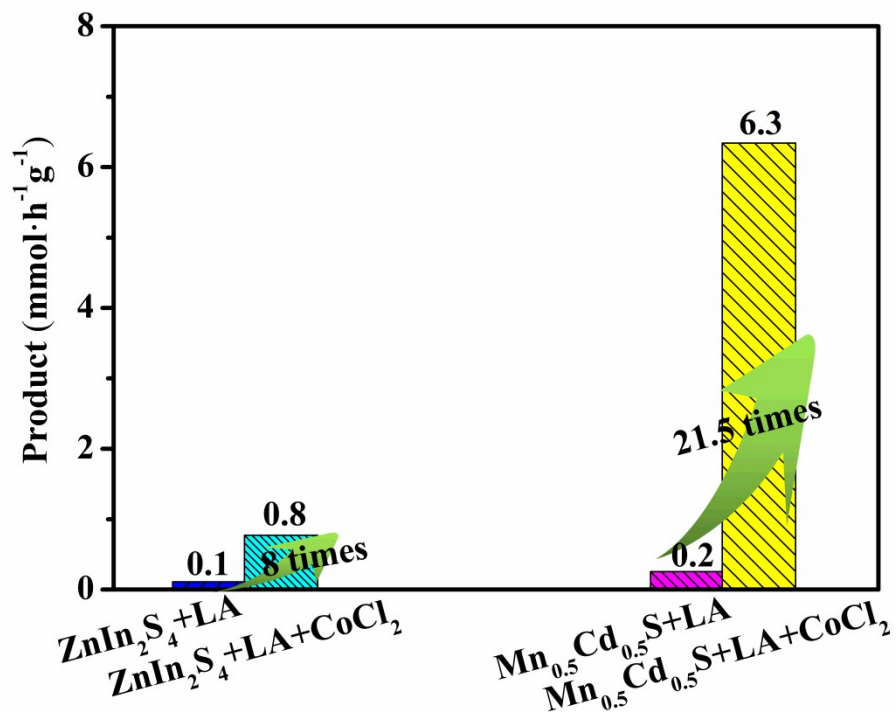


Fig. S10 The effects of cobalt lactate complex on the photocatalytic property of various catalysts.

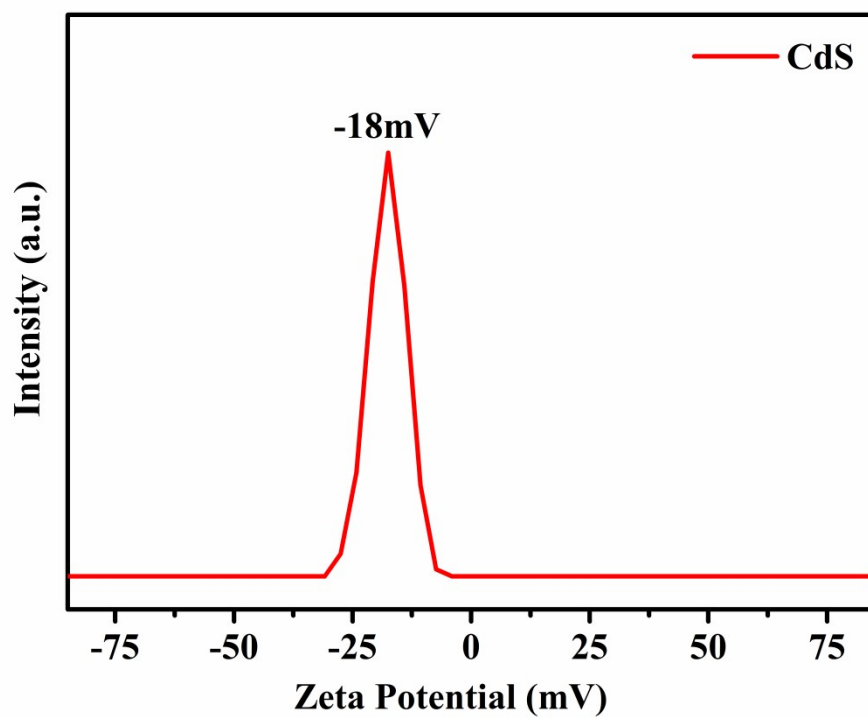


Fig. S11 Zeta potential ( $\xi$ ) of CdS aqueous dispersion.

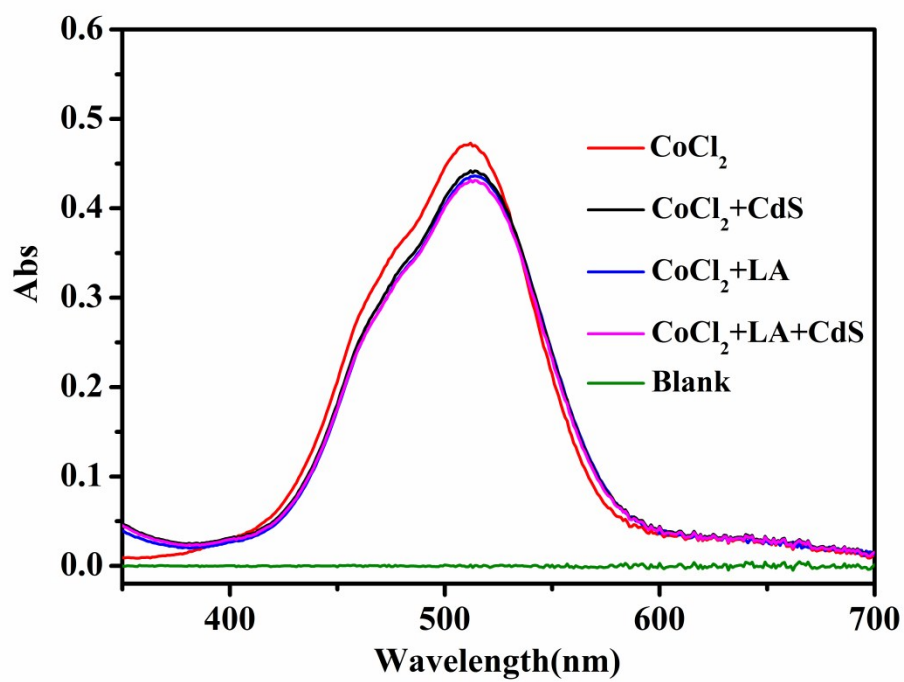


Fig. S12 The UV-vis absorption spectra of CoCl<sub>2</sub> solution before and after adding LA and CdS in the darkness.