Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Supporting Information

Highly Efficient Proton-Assisted Photocatalytic CO_2 Reduction over 3-Mercaptopropionic Acid-Capped CdS Quantum Dots

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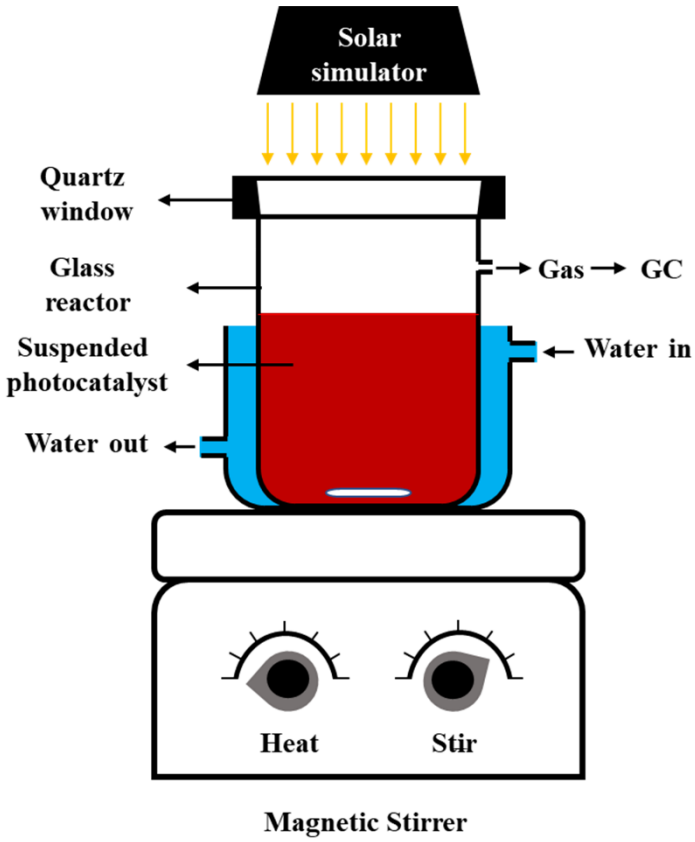

Fig. S1. Schematic illustration of the photoreactor for photocatalytic CO_2 reduction [1]

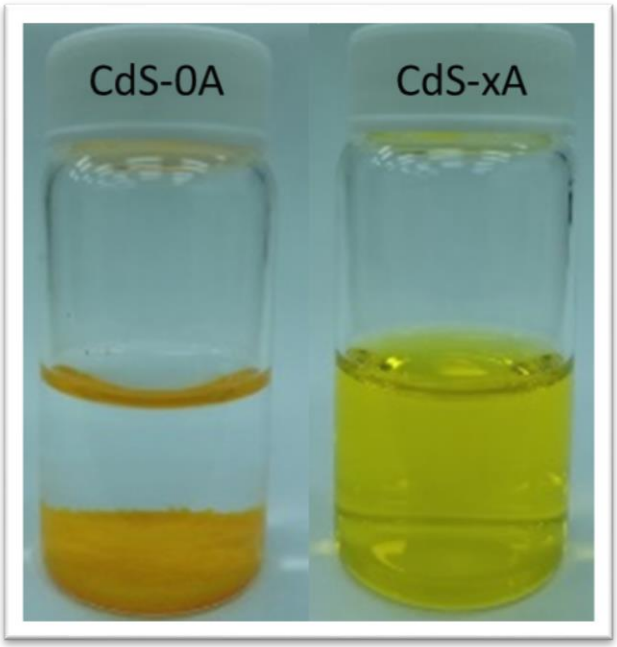

Fig. S2. Pictorial images of aqueous CdS-xA QDs. Excepting that CdS-0A is insoluble in water, other CdS-xA QDs (x =1-4) exhibit good solubility and stability in water

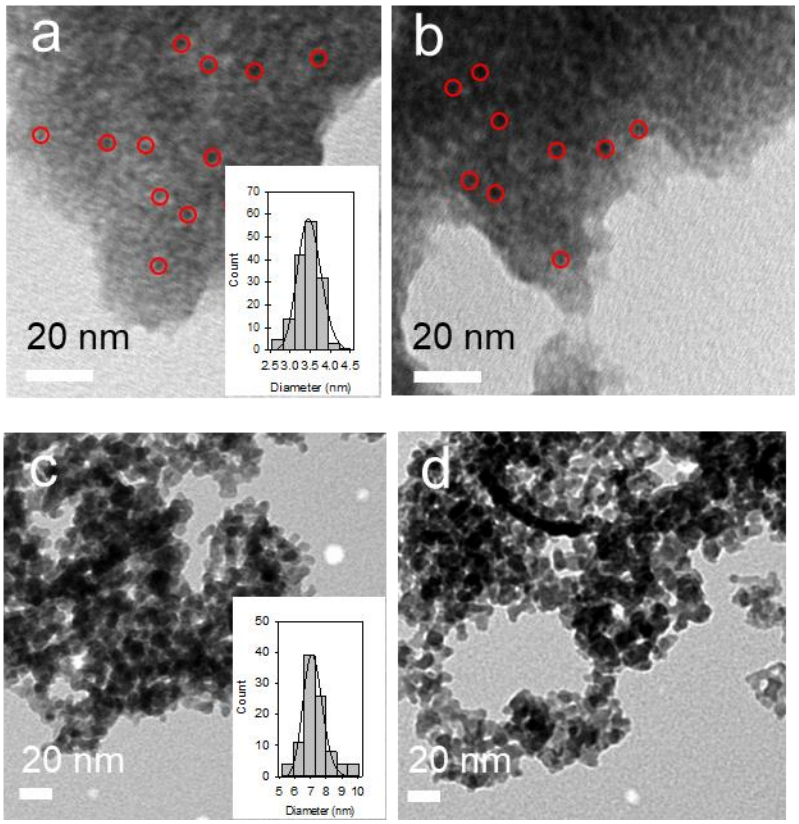

Fig. S3. The TEM images of CdS-1A quantum dots (a-b) and CdS-0A quantum dots (c-d)

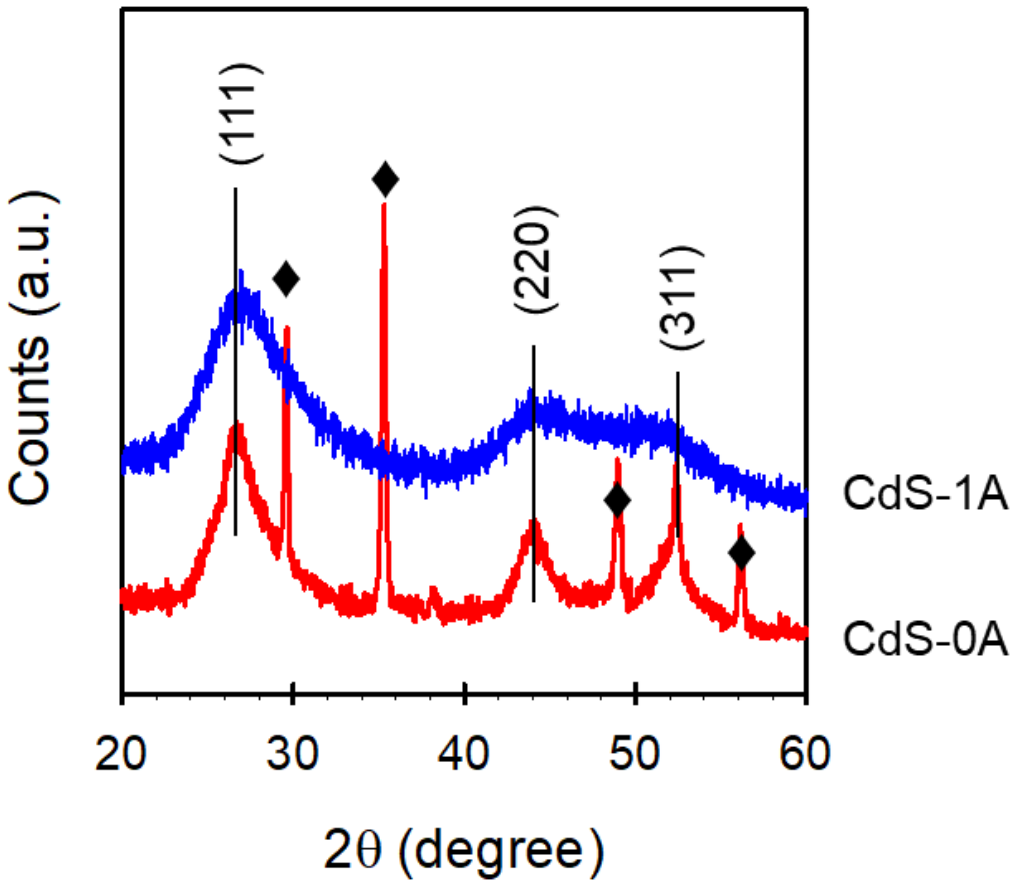

Fig. S4. The XRD spectra of CdS-0A and CdS-1A quantum dot (♦ indicate the presence of chracteristic $Cd(OH)_2$ peaks)

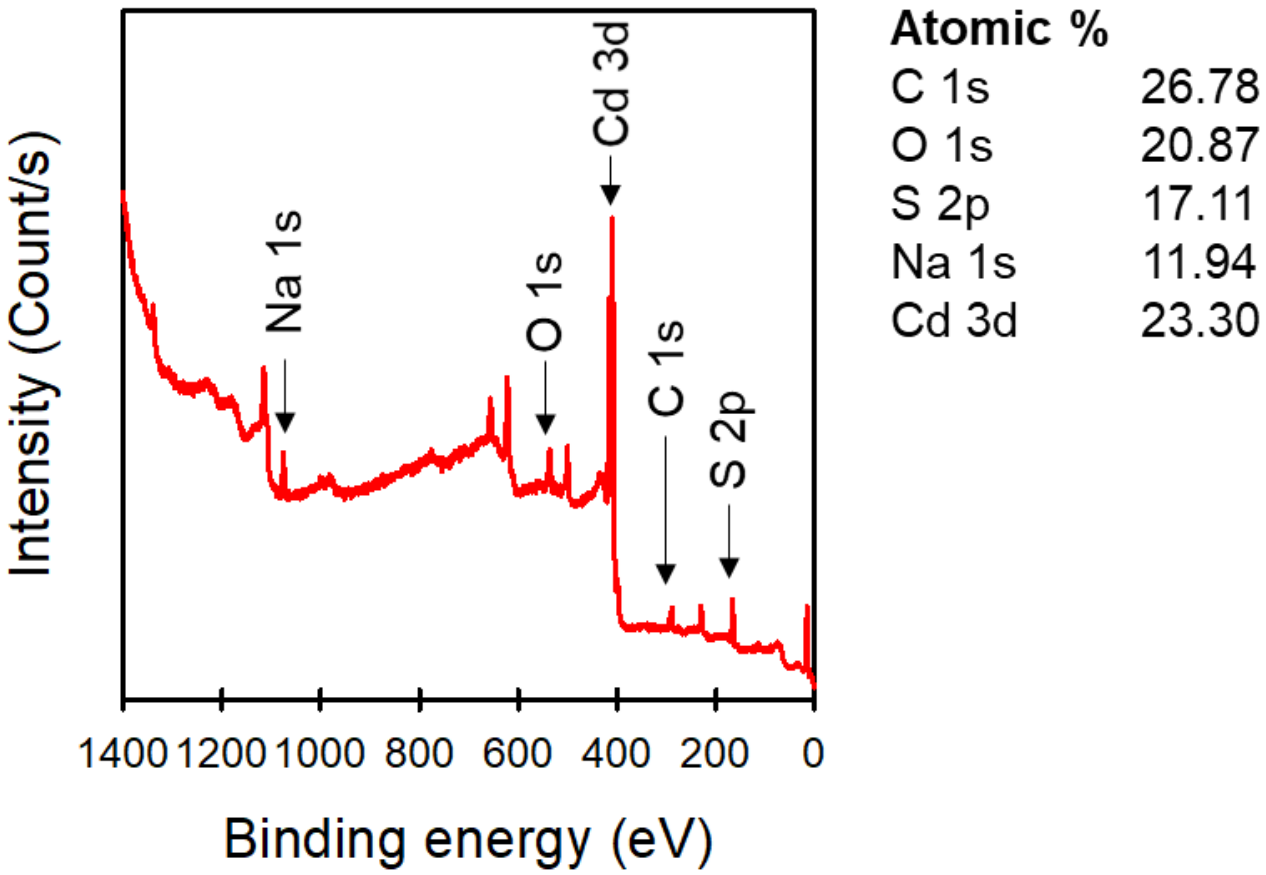

Fig. S5. The survey XPS spectra of CdS-1A quantum dot

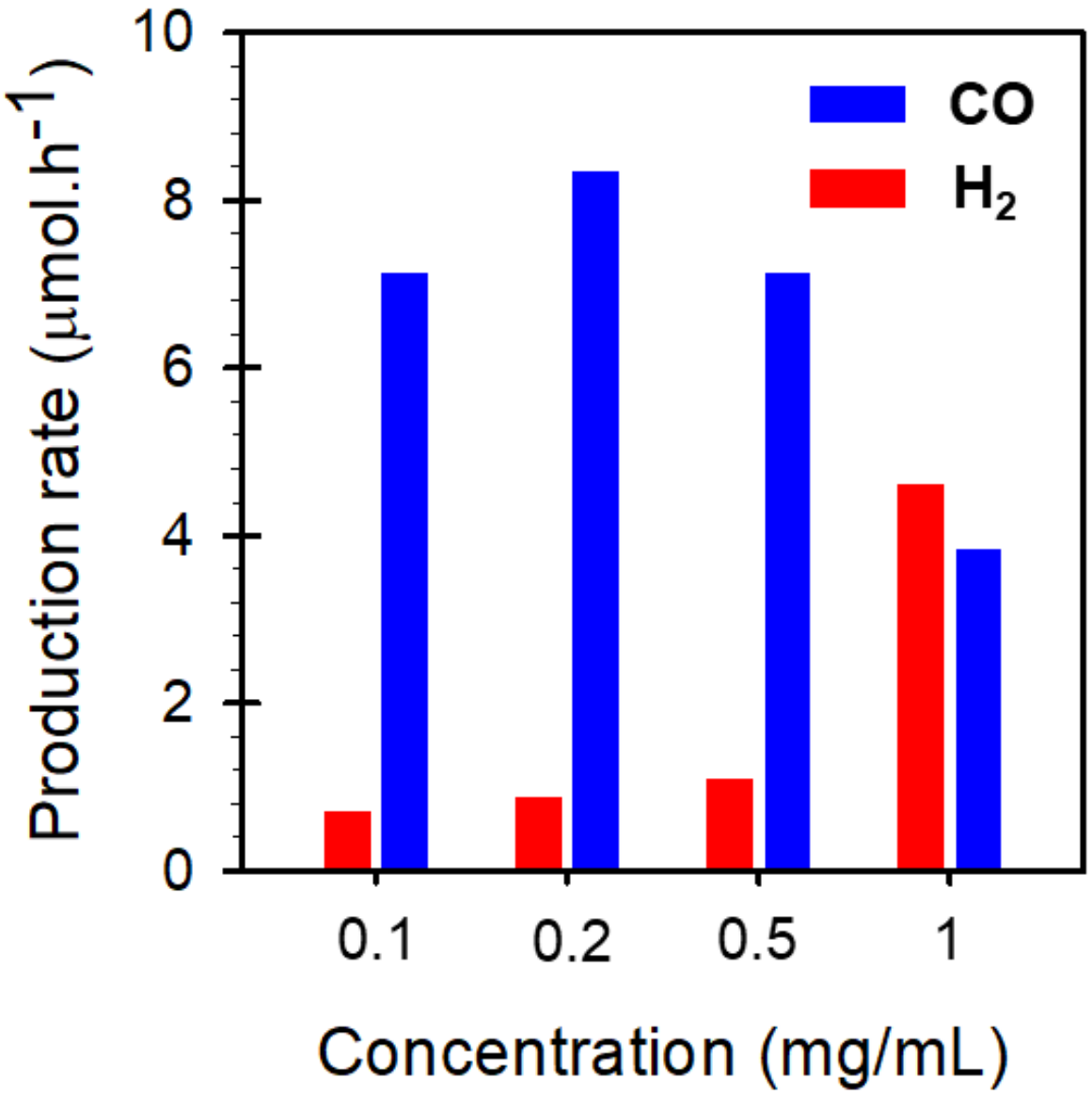

Fig. S6. The optimization of CdS-0.5A concentration for the photocatalytic CO_2 reduction

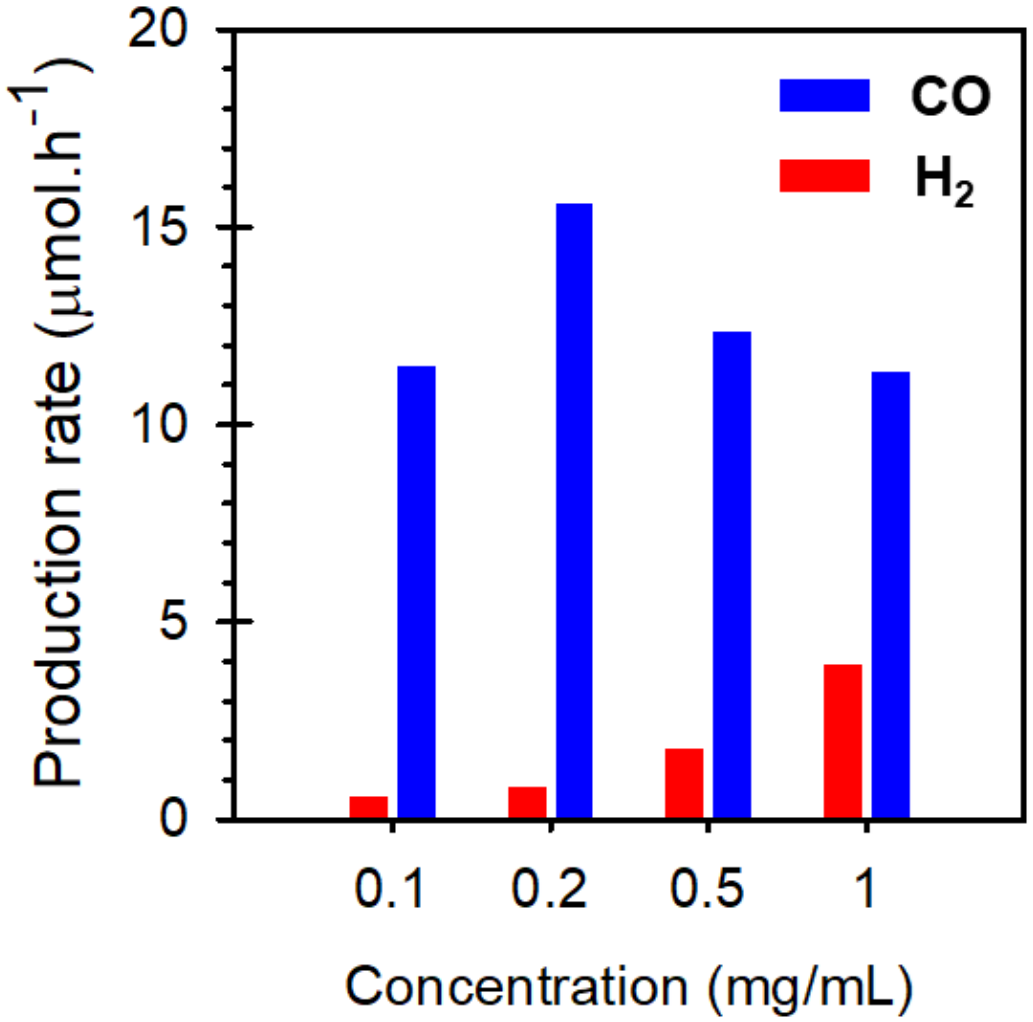

Fig. S7. The optimization of CdS-1A concentration for the photocatalytic CO_2 reduction

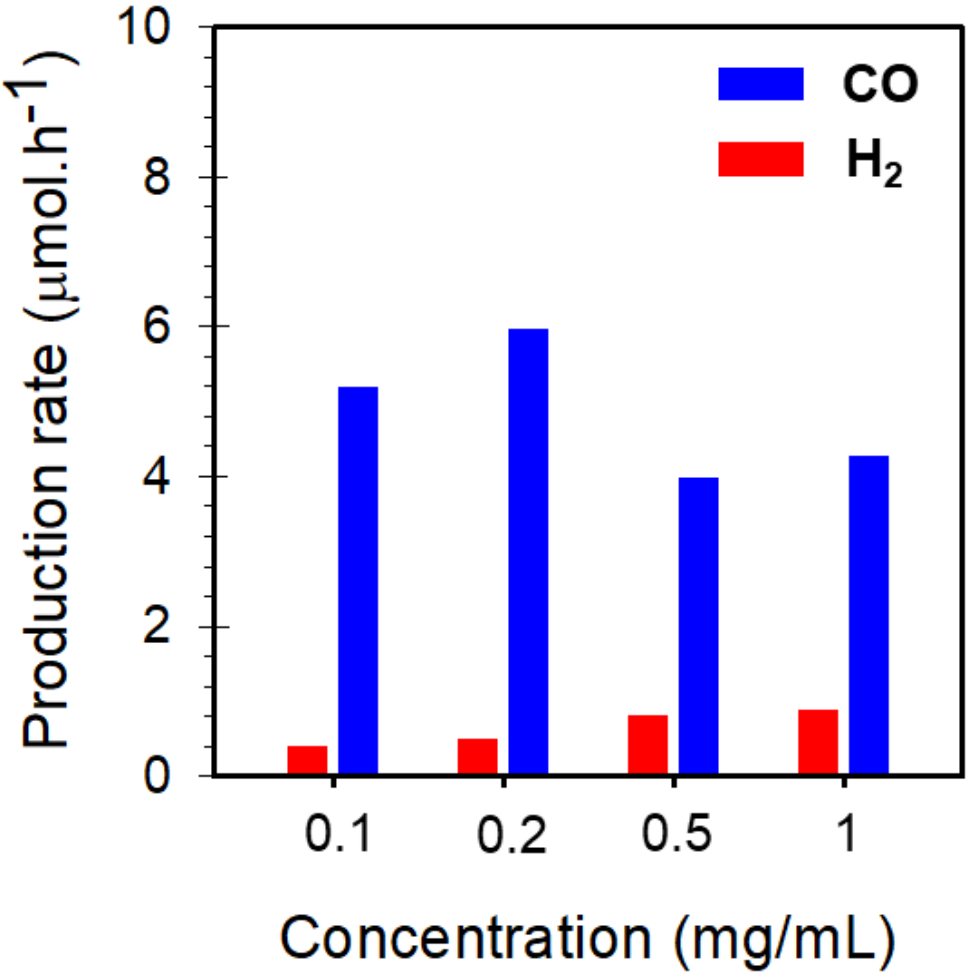

Fig. S8. The optimization of CdS-2A concentration for the photocatalytic CO_2 reduction

Table S1. Control experiments for the photocatalytic CO_2 reduction

Entry	H_2	CO
1	No	No
2	No	No
3	No	No
4	H_2(trace)	No

[1] without photocatalyst; [2] in the dark; [3] without TEA; [4] using Ar instead of CO_2

Table S2. The comparison in the Apparent Quantum Yield of CdS-1A in the photocatalytic CO_2 reduction with the reported photocatalyst in the literature

Catalyst	Light source	Co-catalyst	Sacrificial agent	AQE (%)	Ref.
CdS-1A	**150 W Xe lamp**	**No**	**TEA**	**4.17% (420 nm)** **0.32% (460 nm)**	**This work**
N-doped graphene/CdS hollow sphere	350 W Xe lamp,…	No	H_2O	0.9% (420 nm)	[2]
tetra-coordinated Co(II) modified CdS	300W Xe lamp	–	Na_2SO_3	2.2% (420 nm)	[3]
$Au_{(25)}$@CdS HMCHPs	300W Xe lamp	$Co(bpy)_3^{2+}$	TEOA	0.61% (420 nm)	[4]
CdS-WO_3	300W Xe lamp	No	No	0.4% (420 nm)	[5]
Co-ZIF-9/$[Ru(bpy)_3]Cl_2$.6 H_2O	500W Xe lamp	Co-ZIF-9	TEOA	1.48% (420 nm)	[6]
rGO-MoS_2	300 W Xe lamp, AM 1.5 G, 1 Sun	No	H_2O	0.3% (523 nm)	[7]
Co-ZIF-9/CdS	300W Xe lamp	Co-ZIF-9	TEOA	1.93 % (420 nm)	[8]
g-C_3N_4/Co-ZIF-9	Xe lamp (intensity not available)	Co-ZIF-9	TEOA	0.9% (420 nm)	[9]

Ru complex/C_3N_4	400W Hg lamp	Ru complex	TEOA	5.7 % (400 nm)	[10]
Carbon layer coated Cu_2O	300W Xe lamp	No	H_2O	2.07 % (400 nm)	[11]
Polymeric carbon nitride/$ZnIn_2S_4$	300W Xe lamp	$Co(bpy)_3^{2+}$	TEOA	2.4% (420 nm)	[12]
Ni metal-organic framework (MOF) monolayers	5W white LED light	-	TEOA	2.2 % (420 nm)	[13]
Cu_2O/WO_3-001	400W Xe lamp	-	H_2O	0.503 % (420 nm)	[14]
Triazine-based conjugated microporous polymers	300W Xe lamp	$Co(bpy)_3^{2+}$	TEOA	1.75 % (405 nm)	[15]
Mixed MPA,MUA-capped CdS QDs	LED (λ = 400 nm)	No	TEOA	HCOOH: 23.2 % (400 nm) CO: 0.4 % (400 nm) CH_4: 0.2 % (400 nm)	[16]

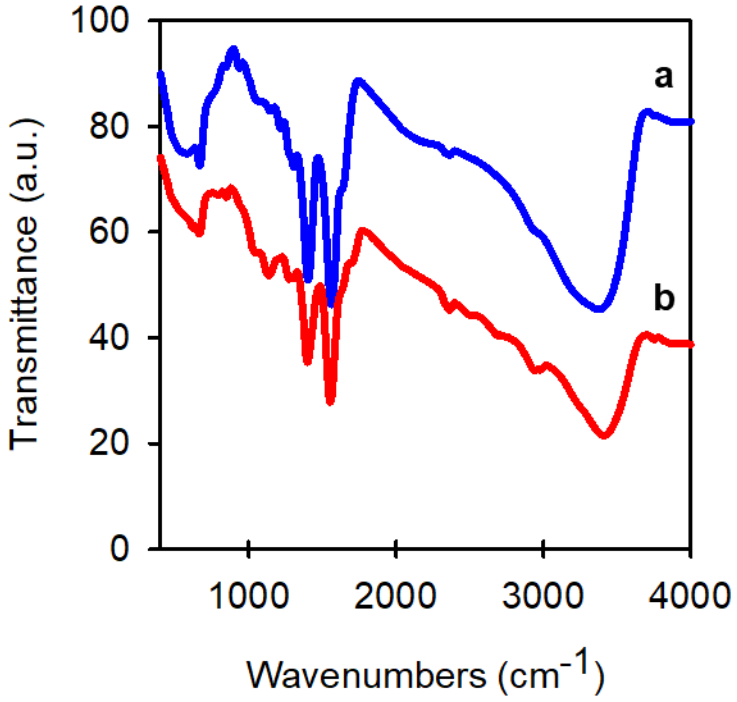

Fig. S9. The FTIR spectra of CdS-1A QDs before (line a) and after 4 cycles test (line b)

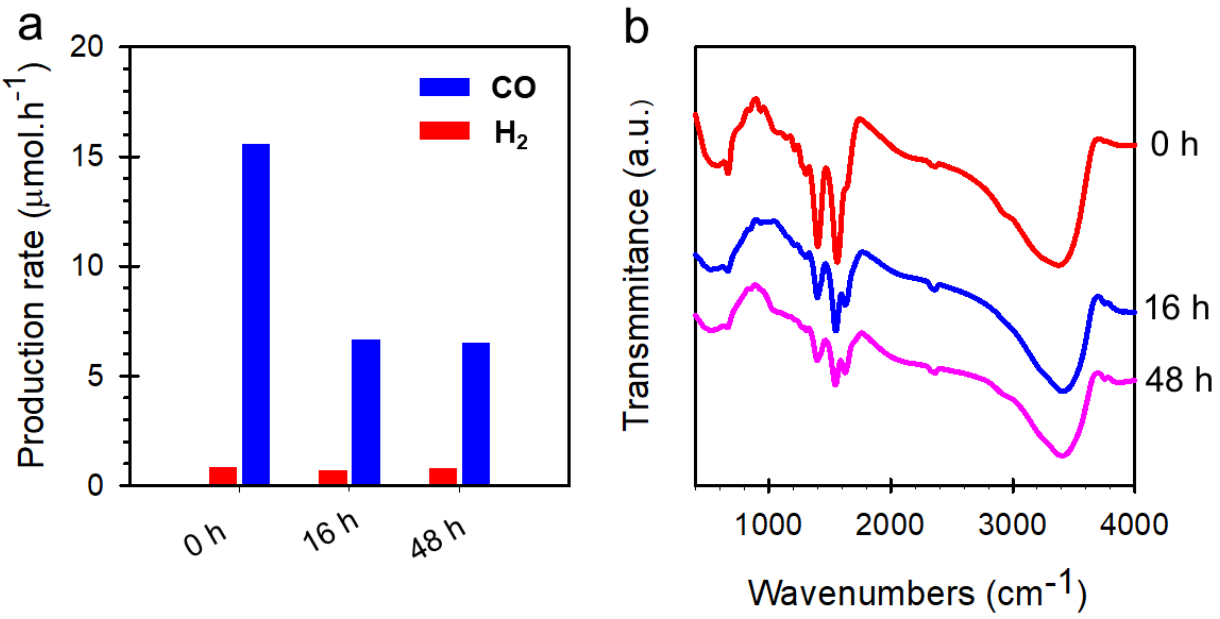

Fig. S10. (a) The photocatalytic activity of CdS-1A after ligand stripping by treating CdS-1A with HCl 1M at pH=4 at different durations of time (0, 16, and 48 hours), and (b) their corresponding FTIR spectra

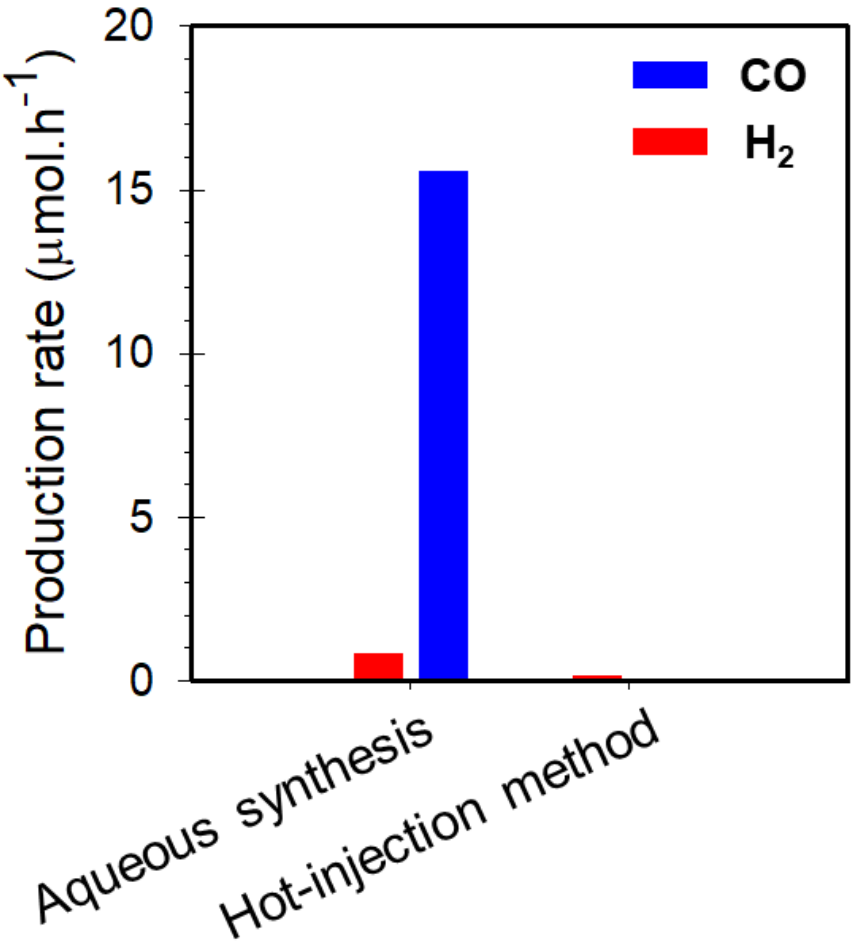

Fig. S11. The comparison between the photocatalytic activity of CdS QDs synthesized by the aqueous synthesis (CdS-1A) and hot-injection method (CdS-1LE)

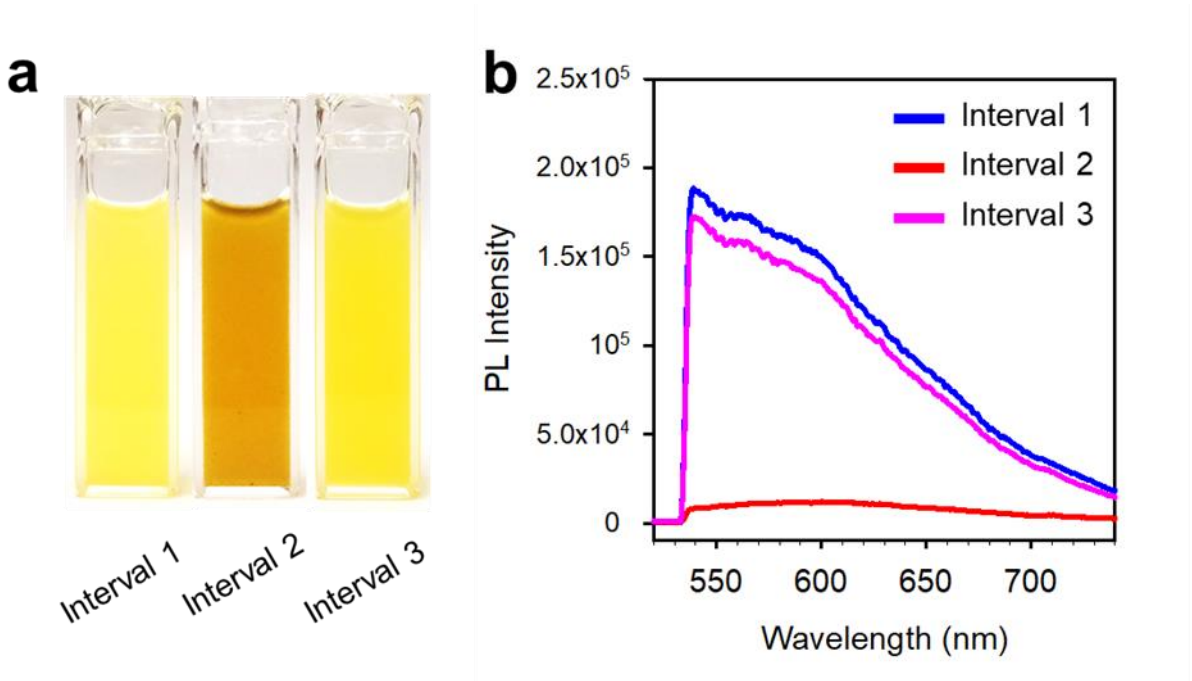

Fig. S12. (a) The color of CdS-1A QDs in 9/1 v/v DMSO/TEA at three different intervals during the photocatalytic CO_2 reduction, and (b) its corresponding PL spectra (*Interval 1*: before solar-light irradiation, no CO_2 purging; *Interval 2*: solar-light irradiation for 2 hours, with saturated CO_2 solution; *Interval 3*: solar-light irradiation off, with desaturated CO_2 solution).

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