Supporting Information

Photoreduction of Carbon Dioxide of Atmospheric Concentration with Water to Methane over CoAl-Layered Double Hydroxide Nanosheets

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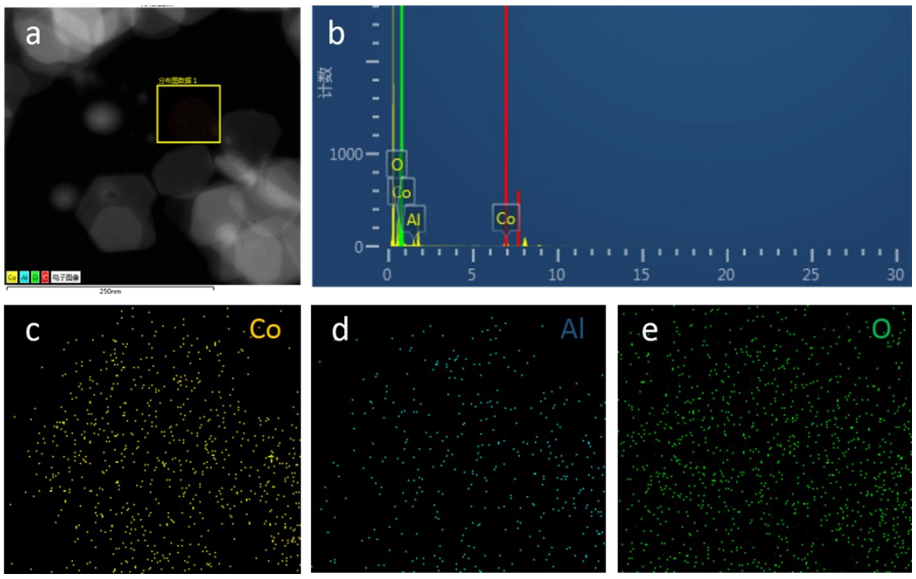

Figure S1. (a) TEM image of CoAl-LDH; (b) EDS profile of CoAl-LDH in selected area of (a); (c-e) Elemental mappings of Co, Al, and O, respectively in selected area of (a).

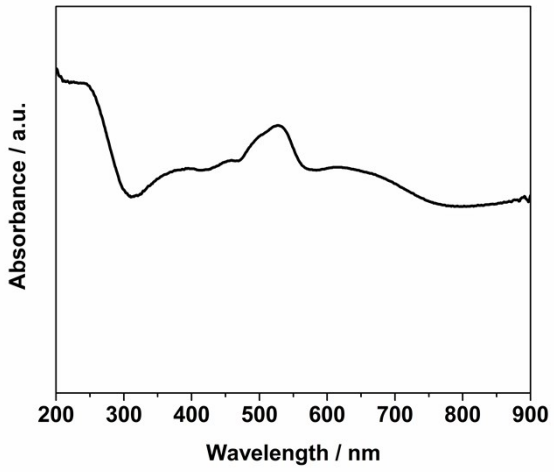

Figure S2. UV-visible absorption spectrum of CoAl-LDH.

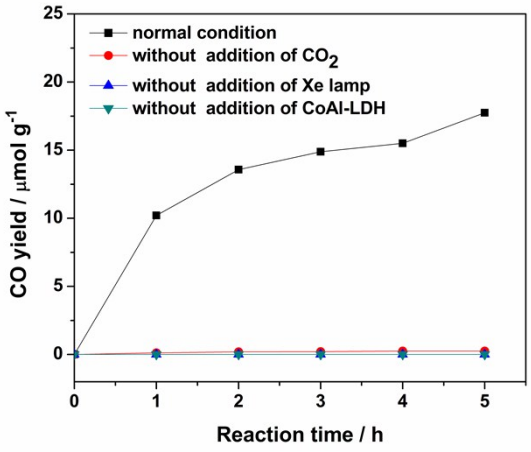

Figure S3. Time course of CO evolution under normal condition, without addition of CO_2, Xe lamp irradiation, or CoAl-LDH.

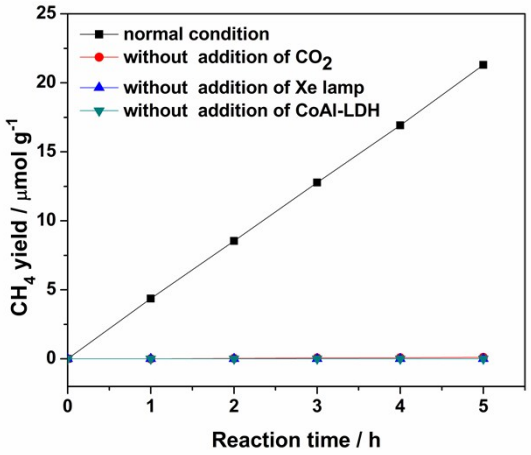

Figure S4. Time course of CH_4 evolution under normal condition, without addition of CO_2, Xe lamp irradiation, or CoAl-LDH.

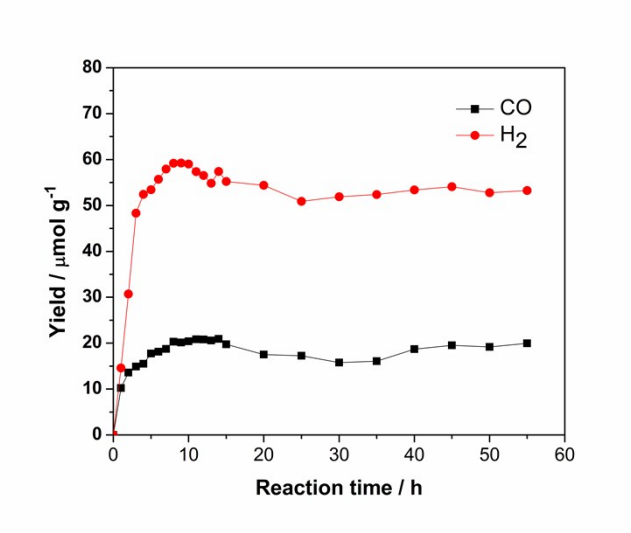

Figure S5. Time courses of CO and H_2 evolution for CoAl-LDH in the photocatalytic conversion of CO_2 with water.

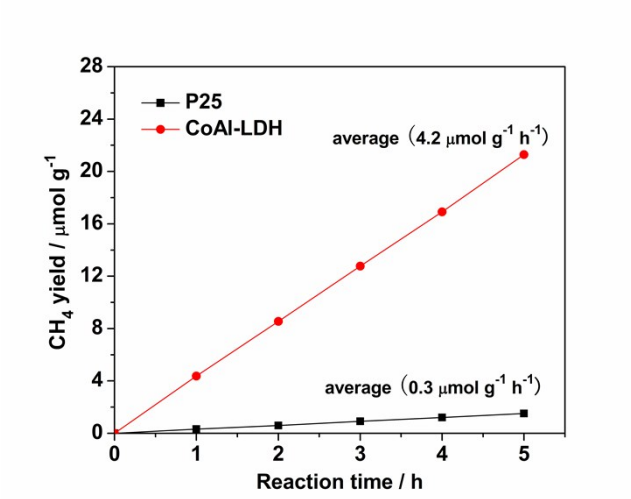

Figure S6. Time courses of CH_4 evolution for CoAl-LDH and P25 in the photocatalytic conversion of CO_2 with water.

Table S1. LDHs and other types of photocatalysts towards CO_2 reduction into hydrocarbons and CO reported in the literature [1]

Photocatalyst	Mass [mg]	cocatalyst	Reactant CO_2	Reducing agent	Light source	Wavelength [nm]	Temperature [K]	Products	Amounts [μmol/(g*h)]	ref
NiM-LDH (M=Al, Ga, In)	100	---	500 μmol	0.4 mL H_2O	200 W Hg-Xe	---	RT	CO	1.9, 3.1, 3.6	[2]
MgM-LDH (M=Al, Ga, In)	100	---	500 μmol	0.4 mL H_2O	200 W Hg-Xe	---	RT	CO	2.4, 2.6, 1.6	[2]
ZnM-LDH (M=Al, Ga, In)	100	---	500 μmol	0.4 mL H_2O	200 W Hg-Xe	---	RT	CO	1.9, 0.7, 0.6	[2]
Zn_3Al-LDH	100	---	180 μmol	1.7 mmol H_2	500W Xe arc	200-1100	305-313	CO, CH_3OH	0.62, 0.039	[3]
ZnCuAl-LDH	100	---	180 μmol	1.7 mmol H_2	500W Xe arc	200-1100	305-313	CO, CH_3OH	0.37, 0.13	[3]
ZnGa-LDH	100	---	180 μmol	1.7 mmol H_2	500W Xe arc	200-1100	305-313	CO, CH_3OH	0.08, 0.051	[3]
ZnCuCa-LDH	100	---	180 μmol	1.7 mmol H_2	500W Xe arc	200-1100	305-313	CO, CH_3OH	0.079, 0.17	[3]
ZnCr-LDH	50	Pt,Pd,Au		water vapour	200 W Hg-Xe	240-400	RT	CO	7.6, 4.7, 3.4	[4]
C_3N_4/MgAl-LDH	200	Pd	200 torr	water solution	500 W Hg-Xe	---	RT	CO, CH_4	0.2, 0.77	[5]
TiO_2	150	Pd	suturated	1.5 mL H_2O	500 W Hg-Xe	>310	RT	CO	0.35	[6]
Cu_2O/TiO_2 nanosheets	20	---	40 mL	6 μL H_2O	300 W Xe	---	RT	CH_4	2.78	[7]
PbS/TiO_2	---	Cu	---	Saturated gas	300 W Xe	250-1800	RT	CO, CH_4	0.82, 0.58	[8]
β-Ga_2O_3	100	---	150 μmol	50 μmol H_2	200 W Hg-Xe	---	---	CO	0.76	[9]
$NaNbO_3$	100	Pt	80 Kpa	3 mL H_2O	300 W Xe	>300	---	CH_4	4.9	[10]
Zn_2GeO_4 Nanoribbons	100	Pt,RuO_2	230 mL	1 mL H_2O	300W Xe arc	---	---	CH_4	6.5	[11]
$ZnGa_2O_4/Zn_2GeO_4$	100	---	230 mL	0.4 mL H_2O	300W Xe arc	>200	---	CH_4	2.3	[12]
MgAl-LDO/TiO_2 cuboids	100	---	---	water	100W Hg	365	323	CO	1.5	[13]
$CaLa_4Ti_4O_{15}$	300	---	15 mL/min	360 mL H_2O	400W Hg	200-700	RT	CO	0.23	[14]
$CaLa_4Ti_4O_{15}$	300	Ag	15 mL/min	360 mL H_2O	400W Hg	200-700	RT	CO	0.07	[14]
$BaLa_4Ti_4O_{15}$	300	NiO	15 mL/min	360 mL H_2O	400W Hg	200-700	RT	CO	7.6	[14]
$BaLa_4Ti_4O_{15}$	300	Cu	15 mL/min	360 mL H_2O	400W Hg	200-700	RT	CO	2	[14]
$SrLa_4Ti_4O_{15}$	300	---	15 mL/min	360 mL H_2O	400W Hg	200-700	RT	CO	0.2	[14]
BiOCl	100	---	400 ppm	100 mL H_2O	500 W Xe	200-1000	RT	CO	1.1	[15]
ZnAl-LDH nanosheets	100	---	100 mL	0.4 mL H_2O	300W Xe arc	200-2500	RT	CO	7.6	[1]
HNb_3O_8	100	---	159 mL	Water vapor	350 W Xe	200-2500	318	CH_4	3.58	[16]
KNb_3O_8	100	---	159 mL	Water vapor	350 W Xe	200-2500	318	CH_4	1.71	[16]
P25/CoAl-LDH	50	---	1 bar	5 mL H_2O	300W Xe	200-1200	RT	CO	2.21	[17]
CoAl-LDH/ P25	50	---	1 bar	5 mL H_2O	300W Xe	200-1200	RT	CO	4.57	[18]
CoAl-LDH nanosheets	**30**	**---**	**400 ppm (0.25 mL)**	**0.5 mL H_2O**	**500 W Xe**	200-1000	---	**CH_4**	**4.3**	**This work**

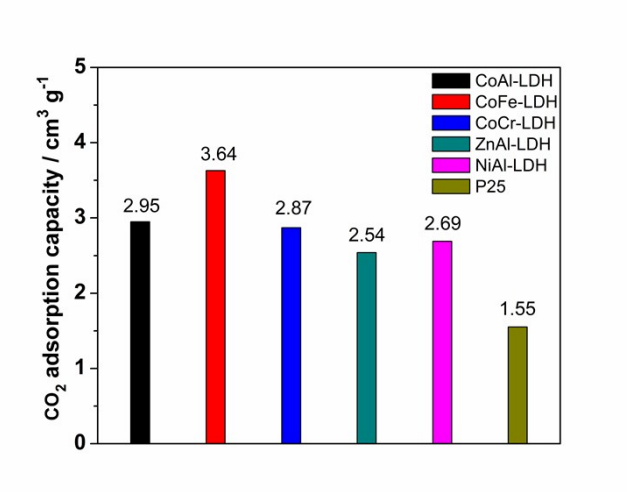

Figure S7. CO_2 adsorption capacities of several kinds of LDH and P25.

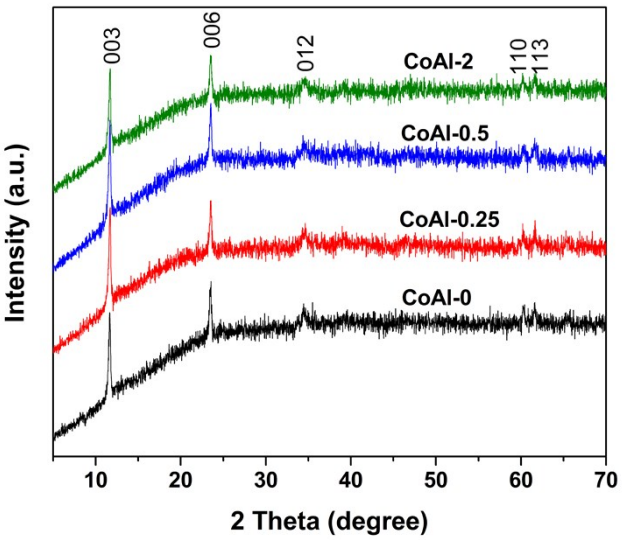

Figure S8. XRD patterns of CoAl-n (n=0, 0.25, 0.5, 2).

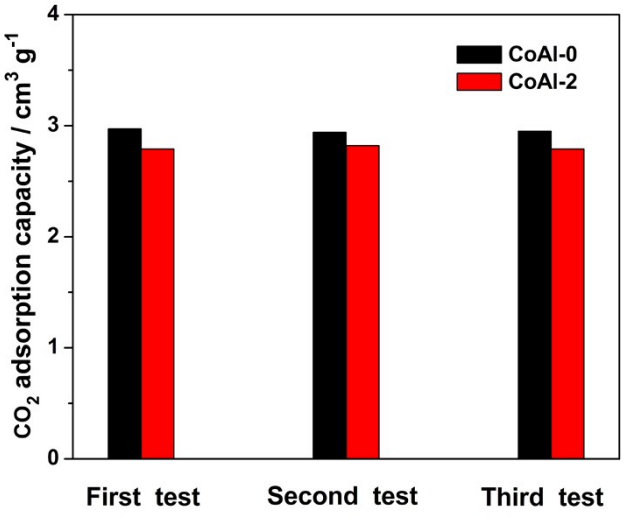

Figure S9. CO_2 adsorption capacities of CoAl-n (n=0, 2).

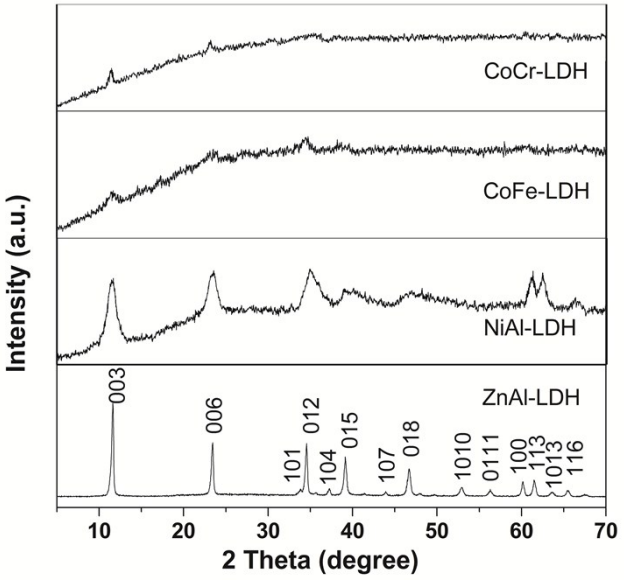

Figure S10. XRD patterns of ZnAl-LDH, NiAl-LDH, CoFe-LDH and CoCr-LDH.

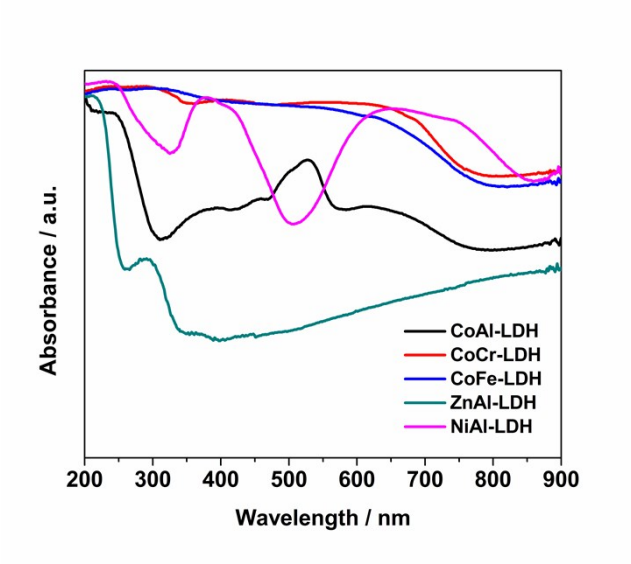

Figure S11. UV-visible absorption spectra of CoAl-LDH, ZnAl-LDH, NiAl-LDH, CoFe-LDH and CoCr-LDH.

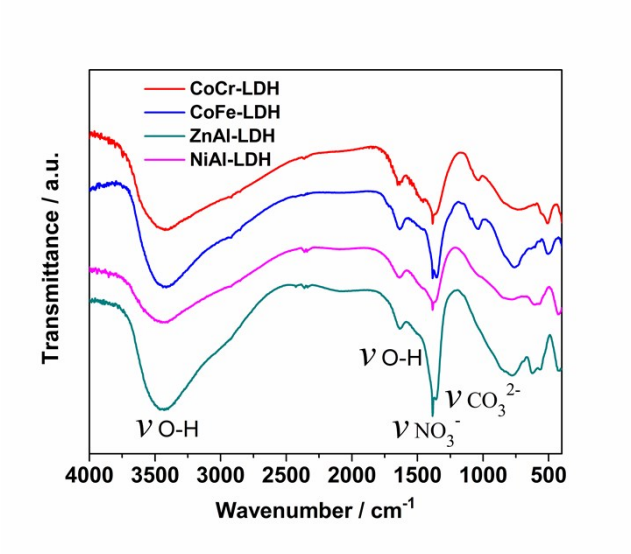

Figure S12. FT-IR spectra of ZnAl-LDH, NiAl-LDH, CoFe-LDH and CoCr-LDH.

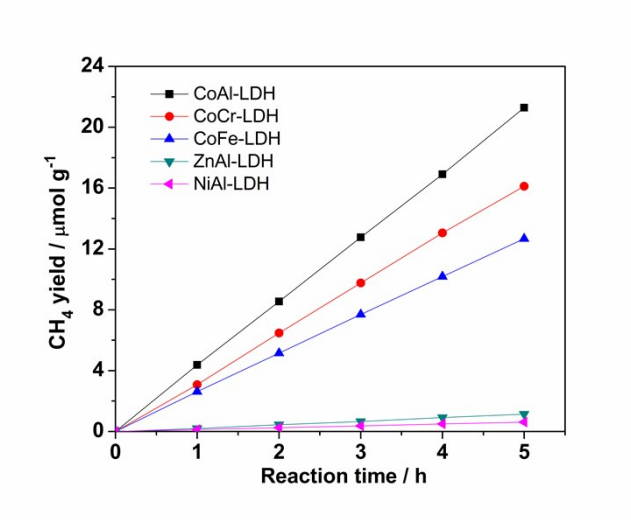

Figure S13. Time courses of CH_4 evolution for several kinds of LDH in the photocatalytic conversion of CO_2 with water.

References

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