Metal-Organic Frameworks: Preparations and Applications of Highly Efficient Heterogeneous Photocatalysis

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Table S1. Photocatalytic hydrogen production

No.	**Photocatalysts; MOFs as precursors**	**Light source**	**Reactant medium (sacrificial agent / concentration)**	**H_2 evolution/ $\mu mol \cdot g_{cat}^{-1} \cdot h^{-1}$**	**Ref. (Year)**
1	UiO-66	200 W Xe-doped Hg lamp	water/methanol 3:1	248	[1] (2010)
2	UiO-66(NH_2)			372	
3	$Cd_{0.2}Zn_{0.8}S$	300W Xe lamp with a UV cut-off filter (λ>420 nm)	0.1 M Na_2S and 0.1 M Na_2SO_3	2804.2	[2] (2017)
4	$Cd_{0.2}Zn_{0.8}S$@ 10wt% UiO-66(NH_2)			4591.6	
5	$Cd_{0.2}Zn_{0.8}S$@ 20wt% UiO-66(NH_2)			5846.5	
6	$Cd_{0.2}Zn_{0.8}S$@ 30wt% UiO-66(NH_2)			5235.9	
7	$Cd_{0.2}Zn_{0.8}S$@ 40wt% UiO-66(NH_2)			4922.7	
8	UiO-66(NH_2)			0	
9	MOF2 ($Zn_{0.986(12)}$TCPP-$[AlOH]_2$)	Visible light	EDTA/Pt	100	[3] (2012)
10	MOF1 (Al-PMOF, H_2TCPP$[AlOH]_2$(DMF_3-$(H_2O)_2$)			200	
11	Pt/Ti-MOF(NH_2)	500W Xe lamp with a UV cut-off filter (λ>420 nm)	0.01 M TEOA	366.7	[4] (2012)
12	MOF-253-Pt in CH_3CN/H_2O (v/v=1:1)	300W Xe lamp with a UV cut-off	15% TEOA (pH= 8.5) in 100 mL	~100 $\mu mol \cdot h^{-1}$ /0.53 mM based on Pt	[5] (2013)

13	MOF-253-Pt in H_2O	filter (λ>420 nm)		~50 μmol·h^{-1} /0.53 mM based on Pt	
14	Pt(bpydc)Cl_2 in CH_3CN/H_2O			~31.7 μmol·h^{-1} /0.53 mM based on Pt	
15	MOF-253 in CH_3CN/H_2O			~0 μmol·h^{-1} /1 equivalent MOF-253-Pt	
16	10 ppm-RhB/UiO-66(Zr)	300W Xe-doped Hg lamp with a UV cut-off filter (λ>420 nm)	10 vol% TEOA (pH = 7)	2.7	[6] 2014
17	100 ppm-RhB/UiO-66(Zr)			~6.0	
18	UiO-66(Zr) + 100 ppm-RhB in solution			33.9	
19	Pt@UiO-66(Zr) + 100 ppm-RhB in solution			101.4	
20	washed 100 ppm-RhB/Pt@UiO-66(Zr)			116.0	
21	100 ppm-RhB/Pt@UiO-66(Zr)			~1.3	
22	10 ppm-RhB/Pt@UiO-66(Zr)			5.6	
23	Pt@UiO-66(Zr)			3.9	
24	1.0wt%MoS_2/50wt%UiO-66/CdS	300W Xe lamp with a UV cut-off filter (λ>420 nm)	10 vol% lactic acid	25770	[7] (2015)
25	1.5wt%MoS_2/50wt%UiO-66/CdS			32500	
26	EY@UiO-66(NH_2)	300W Xe lamp with a UV cut-off	10 vol% TEOA (pH = 7)	11.9	[8] (2017)
27	EY@UiO-66(NH_2)/GO			22.0	
28	EY/MoS_2 QDs			418.0	

29	EY/MoS_2 QDs/GO	filter (λ>420 nm)		701.0	
30	EY/MoS_2 QDs@UiO-66(NH_2)			834.4	
31	EY/MoS_2 QDs@UiO-66(NH_2)/GO			2070.7	
32			10 vol% TEOA (pH = 5)	336.3	
33			10 vol% TEOA (pH = 6)	845.3	
34			10 vol% TEOA (pH = 8)	1448.7	
35			10 vol% TEOA (pH = 9)	1177.7	
36	$ZnIn_2S_4$	300W Xe lamp with a UV cut-off filter (λ>420 nm)	0.25 M Na_2SO_3 + 0.35 M Na_2S	339.1	[9] (2018)
37	$ZnIn_2S_4$@ 20 wt%MIL-125(Ti)(NH_2)			1069.9	
38	$ZnIn_2S_4$@ 30 wt%MIL-125(Ti)(NH_2)			1705.6	
39	$ZnIn_2S_4$@ 40 wt%MIL-125(Ti)(NH_2)			2204.2	
40	$ZnIn_2S_4$@ 50 wt%MIL-125(Ti)(NH_2)			1125.6	
41	MIL-125(Ti)(NH_2)			0	
42	Fe_2O_3@TiO_2; MIL-101	450W Xe lamp with a UV cut-off filter (λ>420 nm)	water/TEA (v/v=20/1)	1250.0	[10] (2012)
43	ZnO	300W Xe lamp	10 vol% methonal	220	[11] (2017)
44	Co_3O_4			190	

45	Zn_3P_2			730	
46	CoP			1320	
47	$ZnO-Co_3O_4$; ZnCo-ZIF			4450	
48	$Pt-ZnO-Co_3O_4$; ZnCo-ZIF			7800	
49	Pt-ZnS-CoS; ZnCo-ZIF			8210	
50	$Pt-Zn_3P_2-CoP$; ZnCo-ZIF			9150	
51	$Zr-MOF-bpy-PtCl_2$	500-W Xe lamp with a UV cut-off filter (λ>420 nm)	0.01 M TEOA	92.2	[12] (2016)
52	$UiO-66(NH_2)/NiO$	300 W Xe lamp ($\lambda \geq 420$ nm).	3 mL/L TEOA	2561.32	[13] (2018)
53	$[Cu(HDSPTP)_2(H_2O)_3]\cdot 6H_2O$	300 W Xe lamp ($\lambda \geq 420$ nm).	10 vol % TEOA	5.77	[14] (2018)
54	$[Cu(DSPTP)(H_2O)_2]\cdot H_2O$			6.99	
55	$Ni-Zn_xCd_{1-x}$-[Cd(bdc)(DMF)]	300 W Xe lamp ($\lambda \geq 420$ nm).	Na_2S/ Na_2SO_3 = 35.0 mmol/ 25.0 mmol	1678	[15] (2018)
56	CdS/UiO-66	300 W Xe lamp ($\lambda \geq 420$ nm).	4 mL CH_3CN + 0.3 mL DI-water + 1mL lactic acid	1725	[16] (2018)
57	$ZrT-1-NH_2$ ZrT-1; Zr-MOPs	300 W Xe lamp ($\lambda \geq 420$ nm).	5 mL CH_3CN + 15 mL DI-water	510.42	[17] (2018)

58	Cu/Zn-MOF	300 W Xe lamp (λ ≥ 420 nm).	Na_2S (0.35 M) and Na_2SO_3 (0.25 M)	310.43	[18] (2019)
59	Pt/Cu-MOFs (2D-SACs)	300 W Xe lamp (λ ≥ 420 nm).	0.1 M ascorbic acid	11320	[19] (2019)
60	Pt-RuO_x-MIL-125(Ti)(NH_2)	300 W Xe lamp (λ ≥ 420 nm).	13 mL Milli-Q water + 5 mL CH_3OH	218	[20] (2019)
61	Pt-UiO-66	300 W Xe lamp (λ ≥ 420 nm).	0.1 M L-ascorbic acid (pH= 4.0).	92	[21] (2015)

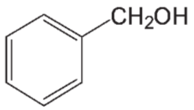
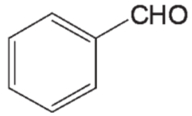
Table S2. photocatalytic CO_2 reduction

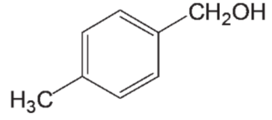
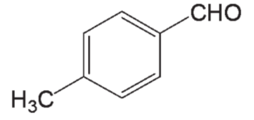
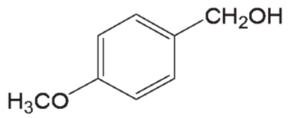
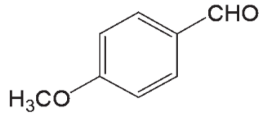
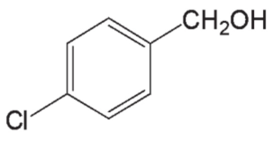
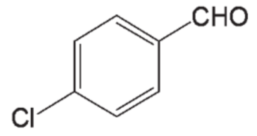
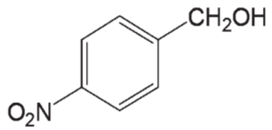
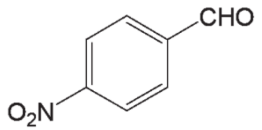
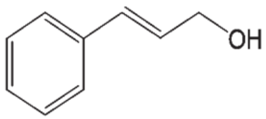
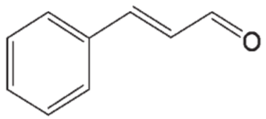
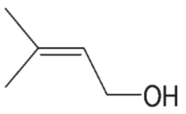
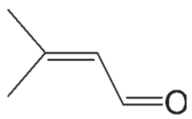
No	Photocatalysts; (MOFs as precursors)	Light source	Main products	Reaction rate/ $\mu mol \cdot g_{cat}^{-1} \cdot h^{-1}$	Ref. (Year)
1	$Cd_{0.2}Zn_{0.8}S$	300W Xe lamp with a UV cut-off filter (λ>420 nm)	CH_3OH	2.0	[2] (2017)
2	$Cd_{0.2}Zn_{0.8}S$@ 10wt% UiO-66(NH_2)			4.1	
3	$Cd_{0.2}Zn_{0.8}S$@ 20wt% UiO-66(NH_2)			6.8	
4	$Cd_{0.2}Zn_{0.8}S$@ 30wt% UiO-66(NH_2)			5.9	
5	$Cd_{0.2}Zn_{0.8}S$@ 40wt% UiO-66(NH_2)			5.3	
6	UiO-66(NH_2)			0	
7	mixed UiO-66(Zr)(NH_2)	Xe lamp with a filter (420-800 nm)	$HCOO^-$	41.4	[22] (2013)
8	UiO-66(Zr)(NH_2)			26.4	
9	UiO-66(Zr)			0	
10	MIL-125(Ti)(NH_2)			16.3	
11	PCN-222	Xe lamp with a filter (420-800 nm)	$HCOO^-$	~60	[23] (2015)
12	g-C_3N_4/ZIF-8	3W LED (365 nm)	CH_3OH	0.75	[24] (2017)
13	Re-MOF-NH_2; (UiO-67)	300W Xe lamp with a filter (400-700 nm)	CO	0.9	[25] (2017)

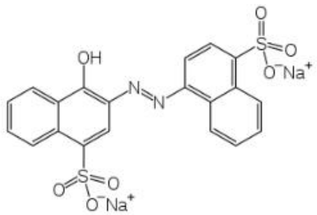
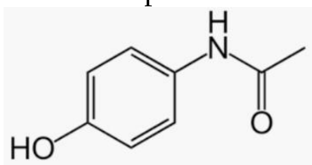
14	CdS/UiO-bpy/Co	300W Xe lamp with a filter ($\lambda \geq$ 420 nm)	CO	235	[26] (2018)
15	$Cd_{0.2}Zn_{0.8}S$@UiO-66-NH_2	300W Xe lamp with a filter ($\lambda \geq$ 420 nm)	CH_3OH	6.8	[2] (2016)
16	$CsPbBr_3$ QDs/UiO-66-NH_2	300W Xe lamp with a filter ($\lambda \geq$ 420 nm)	CO	8.21	[27] (2019)
17	Re-UiO-67	300W Xe lamp with a filter ($\lambda \geq$ 420 nm)	CO	5.7	[28] (2018)
18	ZnO/NiO; (MOF-derived ZnO/NiO-H_2BDC)	300W Xe lamp with a filter ($\lambda \geq$ 420 nm)	CH_3OH	1.57	[29] (2018)
19	$(Co/Ru)_{2.4}$-UiO-67(bpydc)	100 mW/cm^2 LED (450 nm)	CO	282.5	[30] (2019)
20	ZMO-450; ($ZnMn_2$-ptcda MOF)	500W Xe lamp with a filter ($\lambda \geq$ 420 nm)	CO	2.40	[31] (2019)
21	UiO-67-Re-30%	300W Xe lamp with a filter ($\lambda \geq$ 420 nm)	CO	0.5	[32] (2019)
22	In_2S_3-$CulnS_2$-15; (MIL-68)	300W Xe lamp with a filter ($\lambda \geq$ 420 nm)	CO	19	[33] (2018)

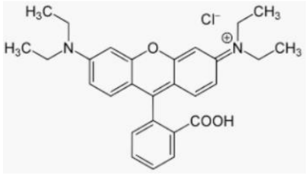
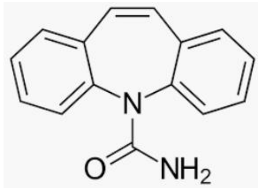
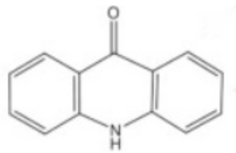
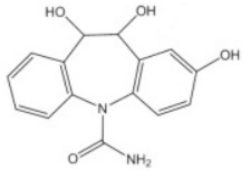
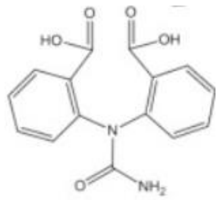
23	Zr-SDCA-NH_2; Zr-MOFs	300W Xe lamp with a filter (420-800 nm)	$HCOO^{-}$	1.57	[34] (2018)
24	NH_2-rGO(5 wt%)/Al-PMOF	300W Xe lamp with a filter ($\lambda \geq$ 420 nm)	$HCOO^{-}$	685.6	[35] (2018)
25	C-$Cu_{2-x}S$@g-C_3N_4-2; HKUST-1	300W Xe lamp with a filter ($\lambda \geq$ 420 nm)	CO	88.55	[36] (2019)
26	Ag@ Co-ZIF-9 (5.36 wt%)	200W Xe lamp with a filter ($\lambda \geq$ 420 nm)	CO	56,800	[37] (2018)
27	Physical mixed of Ag NPs and Co-ZIF-9			16,000	

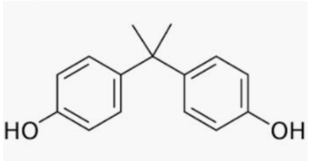
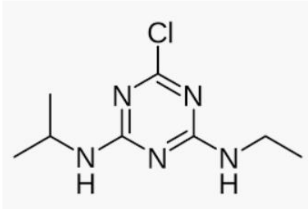
Table S3. Photocatalytic oxidative degradation

No.	**Photocatalysts; (MOFs as precursors)**	**Light source**	**Medium**	**Reactant**	**Product**	**Y:Yield; C:Conversion / Time**	**Ref. (Year)**
1	UiO-66(NH_2)	300W Xe lamp with a UV cut-off	BTF + 0.1 MPa pure O_2			Y= 21.0% /4 h	[38] (2013)

2		filter (λ>420 nm)				Y= 11.3% /4 h	
3						Y= 8.8% /4 h	
4						Y= 1.7% /4 h	
5						Y= 6.6% /4 h	
6						Y= 8.1% /4 h	
7						Y= 22.8% /4 h	
8	Fe(III)-aminogel with Fe_3-μ_3-oxo	Visible light (monochromatic light at	100 μM rhodamine 6G aqueous solution	Rhodamine 6G	N. D.	C= 25.9% / 1h	[39] (2013)

		550 nm) 1 ~7 mW					
9	NTU-9	300W Xe lamp with a UV cut-off filter (λ>420 nm)	100 µM rhodamine B aqueous solution + five drops 30% H_2O_2	Rhodamine B (RB)	N. D.	C= ~100% / 80 min	[40] (2014)
10			100 µM methylene blue aqueous solution + five drops 30% H_2O_2	Methylene blue (MB)	N. D.	C= ~100% / 20 min	
11	MIL-101	150W visible light	200mg/L Oxone	AMR 	N. D.	C= ~ 100% / 30 min	[41] (2019)
12	NH_2-MIL-125(Ti)	Solar light	5 mg/L ACE (pH=6.9)	Acetaminophen 	N. D.	C= ~ 99%/2 h	[42] (2019)
13	BiOBr (bismuth oxyhalides)	300 W Xe with a 420 nm	10 mg/L RhB		N. D.	C= ~ 67%/ 72 min	[43] (2019)

14	MIL-53(Fe)	cutoff filter (λ>420 nm)		Rhodamine B (RhB) 	N. D.	C= ~ 72%/ 72 min	
15	BiOBr / MIL-53(Fe) 20 wt%				N. D.	C= >90% / 72 min	
16	BiOBr		10 mg/L CBZ	Carbamazepine (CBZ) 		C= ~ 12%/ 100 min	
17	MIL-53(Fe)					C= ~ 10%/ 100 min	
18	BiOBr / MIL-53(Fe) 20 wt%					C= ~ 85%/ 100 min	
19	α-Fe_2O_3/ MIL-101(Cr)	300 W Xe with a 420 nm cutoff filter (λ>420 nm)	30 mg/L CBZ	Carbamazepine (CBZ)	N. D.	C= ~ 100%/ 3 h	[44] (2019)
20				Phenol	N. D.	C= ~ 95%/2 h	

21	M.MIL-100(Fe) @ZnO nanosphere	LSH-500W Xe arc lamp (λ≥420 nm)	5 mg/L (pH=2) + H_2O_2 10 mM	Biphenol A 	N. D.	C= > 90%/2 h	[45] (2019)
				Atrazine 	N. D.	C= > 80%/2hr	
22	$BiVO_4$/MIL-125(Ti)	A 500 W Xenon lamp with a 420 nm cut-off filter	10 mg/L Rodamin B	Rhodamine B	N. D.	C= ~ 92%/3hr	[46] (2018)
23	MOF-derived In_2S_3–8h nanorods; (MIL-68 (In))	Visible light	N. D.	Methyl orange	N. D.	C= ~ 97% / 2 h	[47] (2018)
			50 mg/L	Tetracycline hydrochloride (TC)	N. D.	C= ~ 66% / 2 h	
24	ACMA-1 nanocomposites (Ag/AgCl@MIL-88A(Fe); Fe:Ag=5:1)	500 W Xe lamp with a 420 nm cutoff filter	10 mg/L	Ibuprofen (IBP)	N. D.	C= ~ 100% /3.5 h	[48] (2018)
25	ACMA-2 nanocomposites (Fe:Ag=2:1)					C= ~ 97% /3.5 h	

26	ACMA-3 nanocomposites (Fe:Ag=1:1)					C= ~ 93% /3.5 h	
27	Ag_3VO_4/Cu-MOF / rGO	Visible light	10 mg/L	Acid Blue 92 (AB92)	N. D.	C= ~80% / 2 h	[49] (2019)
28	CdS / gC_3N_4/ MOF	300 W Xe lamp with a 420 nm cutoff filter	N. D.	RhB	N. D.	C= ~95% / 1 h	[50] (2019)
29	MOF-199 ($Cu_3(BTC)_2$)	9 W UV lamp	15 mg/L	Basic Blue 41 (BB41)	N. D.	C= ~99% / 3h	[51] (2019)
30	MOF / $CuWO_4$ (MOF: [CoNi(μ_3-tp)$_2$ (μ_2-pyz)$_2$])	5 W LED visible light	10 mg/L	Methylene blue (MB)	N. D.	C = 98% / 135 min	[52] (2018)
				4-nitrophenol (4- NP)	N. D.	C = 81% / 105 min	
31	Al-doped ZnO; (MIL-53(Al)-ZnO-400)	100 W Hg arc lamp	25 mg/L	Methyl orange (MO)	N. D.	C = ~98.15% / 1h	[53] (2019)
32	1 wt%CQDs /NH_2-MIL-125	300 W Xenon lamp with a cutoff filter (λ>420 nm)	10 mg/L	RhB	N. D.	C = ~100% / 2 h	[54] (2019)
33		300 W Xenon lamp with a cutoff filter (λ>700 nm)			N. D.	C = ~40% / 2 h	

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