Are Sacrificial Agents a Sustainable Practice in Scalable Photocatalytic Hydrogen Production from Water?

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Table S1. Selected photocatalysts that worked for hydrogen evolution, water oxidation, and overall water-splitting.

Photocatalyst	Cocatalyst	Application	Ref.
g-C_3N_4/$Cd_{0.9}Zn_{0.1}S$/Ni_2P	Ni_2P	H_2 production	1
Pt/CdS/RuDCT	Pt	Water splitting	2
Pt/CdSe/PdS	Pt	H_2 production	3
MoS_2/CdS/RuO_2	MoS_2	Water splitting	4
NiCoPi/CdS/NiCoP	NiCoPi	H_2 production	5
Pt/Ta_3N_5/IrO_2	Pt	Water splitting	6
Pt/TiO_2/CoO_x	Pt	H_2 production	7
Pt/TiO_2/RuO_2	Pt	H_2 production	8
Pt/TiO_2/In_2O_3/MnO_x	Pt	H_2 production	9
CuPt/TiO_2/MnO_x	CuPt	H_2 production	10
Pt/TiO_2/RuO_2	Pt	H_2 production	11
Au/$BiVO_4$/MnO_x	Au	Water oxidation	12
Pt/$BiVO_4$/MnO_x	Pt	Water oxidation	12
Ag/$BiVO_4$/MnO_x	Ag	Water oxidation	12
Ag/$BiVO_4$/PbO_x	Ag	Water oxidation	12
Au/$BiVO_4$/PbO_x	Au	Water oxidation	12
Pt/$BiVO_4$/PbO_x	Pt	Water oxidation	12
Pt/$SrTiO_3$/CoO_x	Pt	Water splitting	13
Pt/$BiVO_4$/Co_3O_4	Pt	Water oxidation	14
Pt/TiO_2/Co_3O_4	Pt	H_2 production	15
RhO_x/$SrTiO_3$/CoOOH	RhO_x	Water oxidation	16
Ir/$BiVO_4$/$FeCoO_x$	Ir	Water oxidation	17
Ir/$BiVO_4$/IrO_2	Ir	Water oxidation	18

Table S2. Performance comparison of representative SA assisted H_2 production and OWS.

H_2 production pathway	Photocatalyst	Cocatalyst	Reactant solution	AQE (%)	STH (%)	Ref.
OWS	$SrTiO_3$:Al	Rh/Cr_2O_3, CoOOH	H_2O	96	0.65	22
	C_3N_4	carbon dots	H_2O	16	2	23
	Ta_3N_5/$KTaO_3$	Ru/Cr_2O_3	H_2O	0.024	0.014	24
	$Y_2Ti_2O_5S_2$	Ru/Cr_2O_3, IrO_2	H_2O	0.05	0.007	25
	$SrTiO_3$:La,Rh/C/$BiVO_4$:Mo	Ru/Cr_2O_3	H_2O	26	1.2	26
	aza-CMP/C_2N	Pt, $Co(OH)_2$	H_2O	4.3	0.73	27
	B-doped, N-deficient C_3N_4	Pt, $Co(OH)_2$	H_2O	11.76	1.16	28
SA	$ZnIn_2S$/ α-MnO_2	-	H_2O + TEOA	78	-	29
	g-C_3N_4-Lik	Pt	H_2O + TEOA	57	-	30
	g-C_3N_4-Nak	Pt	H_2O + TEOA	60	-	31
	g-C_3N_4	Pt	H_2O + TEOA	50.7	-	32
	P3HT/g-C_3N_4	Pt	H_2O + ascorbic acid	77.4	-	33

Table S2. Representative quantitative benchmarks for photocatalytic overall water splitting (OWS) using solid mediator Z-scheme and HER/OER coupled systems.

Photocatalyst system	**Architecture / key feature**	**STH efficiency (%)**	**Stability / test conditions**	**Ref.**
Oxysulfide Z-scheme photocatalyst sheet	Particulate Z-scheme sheet	0.40–0.67	Stable OWS under reduced pressure (4 kPa), 301 K	19
Carbon-mediated oxysulfide Z-scheme sheet	Solid electron mediator, sheet reactor	~0.22	Continuous operation >1,000 h (reported)	19
ZnCdS with dual HER/OER cocatalysts	Matched cocatalyst design	~1.57	Stoichiometric H_2/O_2 evolution under visible light	20
Halide perovskite-WO_3 system with redox shuttle	Mediated OWS architecture	~2.07	Stoichiometric gas evolution under simulated sunlight	21

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