

Electronic Supporting Information

Ion Exchange Synthesis of All Tungsten Based Z-Scheme Photocatalytic System with Highly Enhanced Photocatalytic Activity

Yi Zheng, Gang Chen,* Yaoguang Yu, Jingxue Sun, Yansong Zhou, and Fang He

Table S1 The short name of synthesized samples with different synthesis condition.

sample	condition	label
1	0.5 g Na ₂ WO ₄ , 0.5021 g Pb(NO ₃) ₂	PW
2	0.5 g Na ₂ WO ₄ , 0.0863 g Pb(NO ₃) ₂ , 2.6 mL dilute nitric acid solution	PWH-1
3	0.5 g Na ₂ WO ₄ , 0.1726 g Pb(NO ₃) ₂ , 2.6 mL dilute nitric acid solution	PWH-2
4	0.5 g Na ₂ WO ₄ , 0.3452 g Pb(NO ₃) ₂ , 2.6 mL dilute nitric acid solution	PWH-3
5	0.5 g Na ₂ WO ₄ , 0.6907 g Pb(NO ₃) ₂ , 2.6 mL dilute nitric acid solution	PWH-4
6	0.5 g Na ₂ WO ₄ , 1.3808 g Pb(NO ₃) ₂ , 2.6 mL dilute nitric acid solution	PWH-5
7	0.5 g Na ₂ WO ₄ , 2.6 mL dilute nitric acid solution	W

The mass percentage of PW and W in PWH samples is calculated based on the

formula: $W_w = \frac{I_w}{I_w + \frac{I_{PW}}{K_w^{PW}}}$, where W_w is the mass percentage of W in PWH samples, I_w is the

main W reflection of (220) crystal face, I_{PW} is the main PW reflection of (112) crystal face,

$K_w^{PW} = \frac{K_{Al_2O_3}^{PW}}{K_{Al_2O_3}^W} = \frac{20.38}{6.39} = 3.189$, $W_{PW} = 1 - W_w$. The results are listed in Table S2.

Table S2 The mass percentage of PW and W in PWH samples

sample	W m%	PW m%
PWH-1	69.63	30.37
PWH-2	51.79	48.21
PWH-3	40.25	59.75
PWH-4	37.61	62.39
PWH-5	30.88	69.12

Table S3 XPS data of PW, PWH-5, and W.

	O 1s (eV)	W 4f (eV)	Pb 4f (eV)	VB (eV)	O at %	W at %	Pb at %
PW	530.18	34.98 37.08	138.38 143.28	1.77	42.01	11.24	13.53
PWH-5	530.38	35.68 37.78	138.78 143.68	-	52.92	15.59	4.67
W	530.48	35.78 37.88	-	2.95	53.4	17.02	0

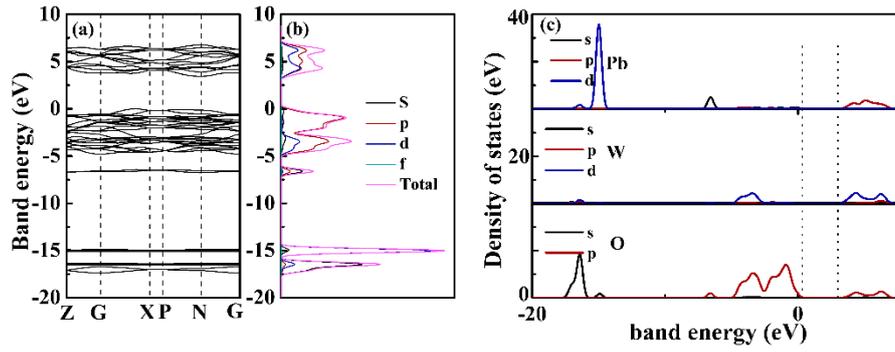


Figure S1 Band dispersion and density of states (DOS) for PbWO₄ (a), partial DOS for Pb atom, W atom, and O atom of PbWO₄ (b).

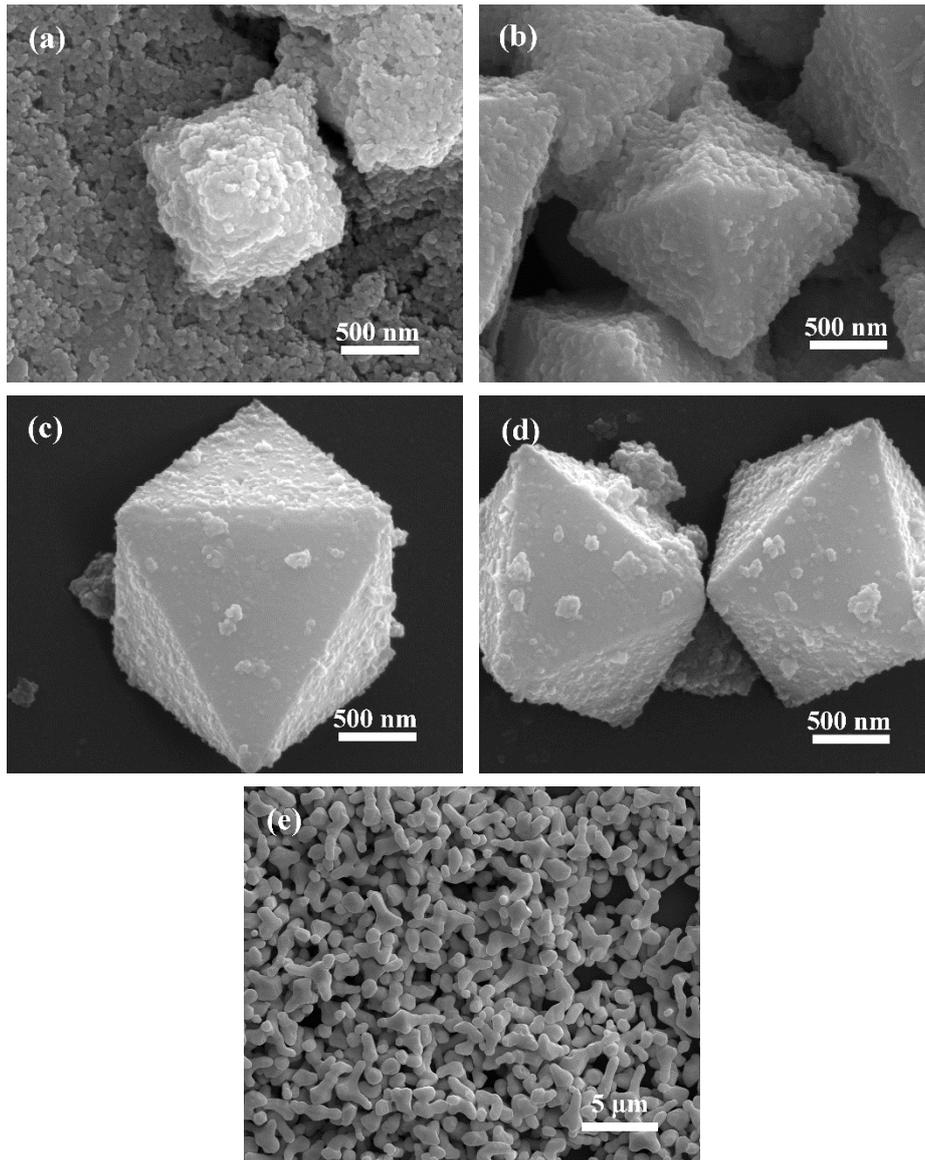


Figure S2 SEM images of PWH-1 sample (a), PWH-2 sample (b), PWH-3 sample (c), PWH-4 sample (d), and PW sample (e).

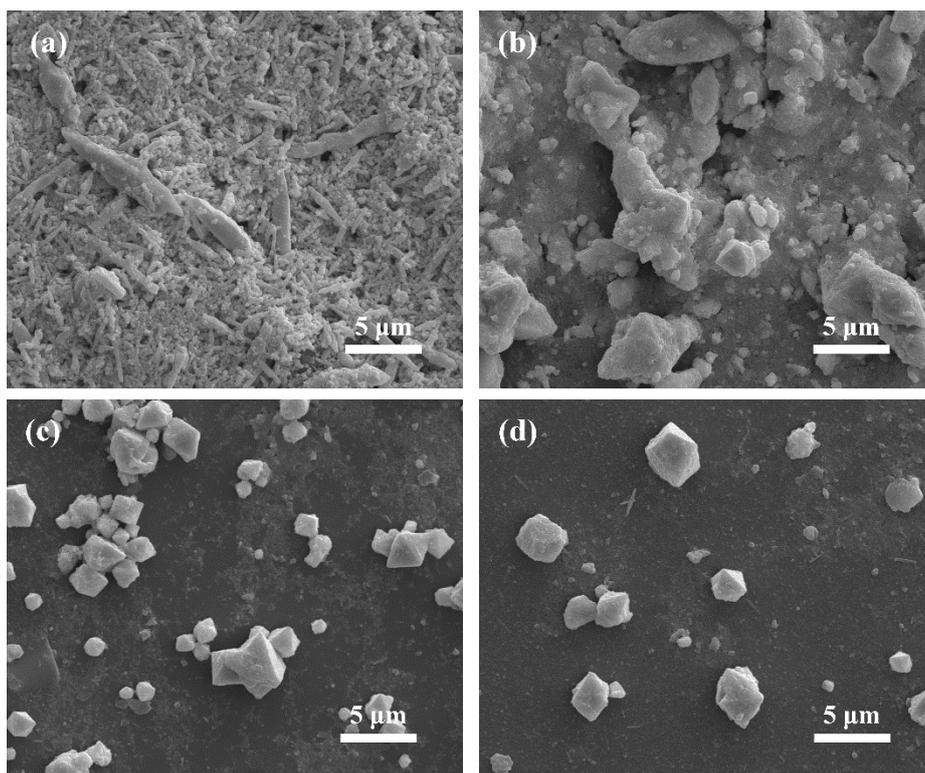


Figure S3 SEM images of PWH samples with different amount of dilute nitric acid ($V_{\text{HNO}_3} : V_{\text{H}_2\text{O}}$ is 1 to 5), (a) 0.3 mL, (b) 0.65 mL, (c) 1.3 mL, (d) 3.9 mL.

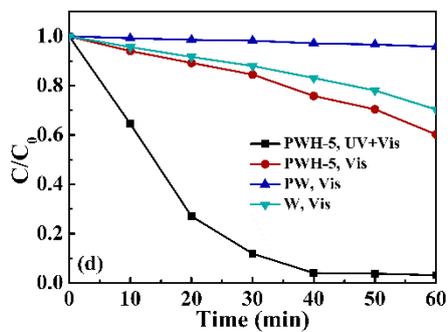


Figure. S4 Photodegradation of RhB over composite and monomer under visible light.

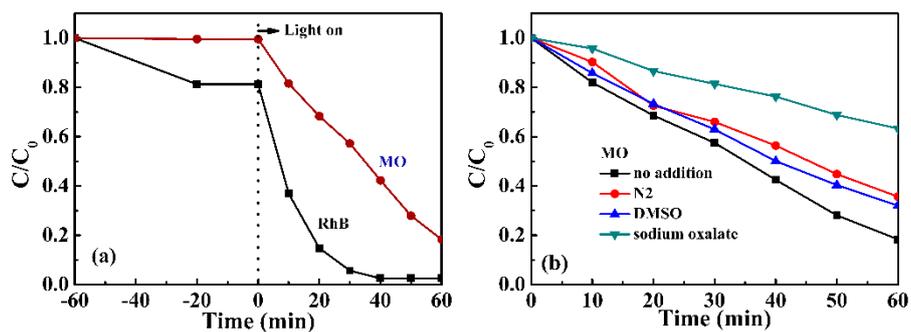


Figure S5 Photodegradation curves of different dye solution using PWH-5 sample under irradiation with 300W Xe lamp (a), photodegradation curves of MO solution using different quenchers over the PWH-5 sample under 300W Xe lamp illumination (b).