

Bi₂WO₆/Ag₂S/ZnS Z-scheme heterojunction photocatalyst with enhanced visible-light photoactivity towards multiple dye pollutants degradation

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Table S1. Experimental factors and levels in the central composite design.

Factor	Name	Units	Minimum	Maximum	Coded	Values	Mean		
A	pH	-	3.00	9.00	4.50	7.50	6.06		
B	Photocatalyst dosage	g/L	0.008	0.016	0.010	0.014	0.012		
C	Irradiation Time	min	60.00	120.00	75.00	105.00	90.58		
D	Concentration of MG	mg/L	4.00	12.00	6.00	10.00	8.080		
E	Concentration of AO	mg/L	2.00	6.00	3.00	5.00	4.04		
Run	A	B	C	D	E	Actual R% MG	Predicted R% MG	R% AO	Predicted R% AO
1	6.0	0.008	90	8	4	61.10	60.86	49.21	48.94
2	6.0	0.016	90	8	4	86.79	86.55	80.94	80.67
3	6.0	0.012	90	12	4	51.17	50.93	50.73	50.46
4	4.5	0.014	105	6	5	79.31	79.47	76.62	76.80
5	7.5	0.014	105	6	3	66.90	67.06	99.55	99.73
6	9.0	0.012	90	8	4	83.18	82.94	73.42	73.15
7	4.5	0.010	105	10	5	32.62	32.78	46.41	46.59
8	6.0	0.012	90	8	2	86.98	86.74	74.43	74.16
9	6.0	0.012	90	8	4	74.24	73.70	65.57	65.66
10	4.5	0.014	75	10	5	82.83	82.99	51.69	51.87
11	6.0	0.012	60	8	4	66.01	65.77	54.49	54.22
12	3.0	0.012	90	8	4	73.71	73.47	65.73	65.46
13	6.0	0.012	90	8	4	73.44	73.70	65.07	65.66
14	6.0	0.012	90	8	4	73.44	73.70	65.79	65.66
15	4.5	0.014	105	10	3	96.08	96.24	71.63	71.81
16	6.0	0.012	90	4	4	95.71	95.47	79.41	79.14
17	6.0	0.012	90	8	4	73.44	73.70	66.07	65.66
18	4.5	0.010	75	6	3	81.10	81.42	59.52	59.88
19	6.0	0.012	90	8	6	59.91	59.67	55.72	55.45
20	7.5	0.010	75	10	5	72.68	72.84	44.17	44.35
21	6.0	0.012	120	8	4	80.87	80.63	75.66	75.39
22	7.5	0.014	75	10	3	54.11	54.27	69.4	69.58
23	7.5	0.014	75	6	5	97.51	97.67	74.38	74.56
24	6.0	0.012	90	8	4	73.44	73.70	65.27	65.66
25	7.5	0.010	105	10	3	71.62	71.78	64.12	64.30
26	7.5	0.010	105	6	5	75.41	75.57	69.1	69.28

Table S2. Sequential Model Sum of Squares for MG degradation.

R% MG						
Sequential Model Sum of Squares						
Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Mean vs Total	1.423E+005	1	1.423E+005			
Linear vs Mean	2110.11	5	422.02	2.69	0.0515	
2FI vs Linear	3098.73	10	309.87	73.90	< 0.0001	
Quadratic vs 2FI	40.46	5	8.09	27.42	0.0012	Suggested
Cubic vs Quadratic	0.96	1	0.96	7.53	0.0517	Aliased
Residual	0.51	4	0.13			
Total	1.476E+005	26	5675.68			
Lack of Fit Tests						
Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Linear	3140.15	16	196.26	1533.28	< 0.0001	
2FI	41.42	6	6.90	53.93	0.0009	
Quadratic	0.96	1	0.96	7.53	0.0517	Suggested
Cubic	0.000	0				Aliased
Pure Error	0.51	4	0.13			
Model Summary Statistics						
Source	Std. Dev.	R-Squared	Adjusted R-Squared	Predicted R-Squared	PRESS	
Linear	12.53	0.4019	0.2523	-0.1621	6101.94	
2FI	2.05	0.9920	0.9800	0.9636	191.13	
Quadratic	0.54	0.9997	0.9986	0.8966	543.16	Suggested
Cubic	0.36	0.9999	0.9994		+	Aliased

Table S3. Sequential Model Sum of Squares for AO degradation.

R% AO						
Sequential Model Sum of Squares						
Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Mean vs Total	1.130E+005	1	1.130E+005			
Linear vs Mean	3765.24	5	753.05	179.04	< 0.0001	
2FI vs Linear	49.84	10	4.98	1.45	0.2826	
Quadratic vs 2FI	32.43	5	6.49	17.45	0.0035	Suggested
Cubic vs Quadratic	1.22	1	1.22	7.66	0.0504	Aliased
Residual	0.64	4	0.16			
Total	1.169E+005	26	4494.41			
Lack of Fit Tests						
Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Linear	83.49	16	5.22	32.76	0.0020	
2FI	33.65	6	5.61	35.21	0.0020	
Quadratic	1.22	1	1.22	7.66	0.0504	Suggested
Cubic	0.000	0				Aliased
Pure Error	0.64	4	0.16			
Model Summary Statistics						
Source	Std. Dev.	R-Squared	Adjusted R-Squared	Predicted R-Squared	PRESS	
Linear	2.05	0.9781	0.9727	0.9583	160.40	
2FI	1.85	0.9911	0.9777	0.9187	312.95	
Quadratic	0.61	0.9995	0.9976	0.8212	688.15	Suggested
Cubic	0.40	0.9998	0.9990		+	Aliased

Table S4. Analysis of variance (ANOVA) results for quadratic model of degradation process.

Source	df	R% of MG					R% of	
		Sum of Squares	Mean Square	F Value	p-value Prob > F		Sum of Squares	Mean Square
Model	20	5249.30	262.47	889.35	< 0.0001	3847.51	192.38	
<i>A</i>	1	44.84	44.84	151.94	< 0.0001	29.57	29.57	
<i>B</i>	1	329.99	329.99	1118.15	< 0.0001	503.40	503.40	
<i>C</i>	1	110.41	110.41	374.12	< 0.0001	224.08	224.08	
<i>D</i>	1	991.91	991.91	3361.04	< 0.0001	411.27	411.27	
<i>E</i>	1	366.39	366.39	1241.51	< 0.0001	175.03	175.03	
<i>AB</i>	1	398.60	398.60	1350.66	< 0.0001	13.74	13.74	
<i>AC</i>	1	292.16	292.16	989.97	< 0.0001	13.74	13.74	
<i>AD</i>	1	9.65	9.65	32.69	0.0023	1.69	1.69	
<i>AE</i>	1	281.80	281.80	954.87	< 0.0001	1.68	1.68	
<i>BC</i>	1	132.35	132.35	448.47	< 0.0001	0.19	0.19	
<i>BD</i>	1	133.90	133.90	453.71	< 0.0001	8.11	8.11	
<i>BE</i>	1	249.26	249.26	844.61	< 0.0001	8.11	8.11	
<i>CD</i>	1	2.26	2.26	7.67	0.0394	8.11	8.11	
<i>CE</i>	1	156.56	156.56	530.51	< 0.0001	8.11	8.11	
<i>DE</i>	1	230.86	230.86	782.27	< 0.0001	8.14	8.14	
<i>A</i> ²	1	34.81	34.81	117.94	0.0001	22.73	22.73	
<i>B</i> ²	1	2.424E-004	2.424E-004	8.213E-004	0.9782	1.25	1.25	
<i>C</i> ²	1	0.42	0.42	1.41	0.2886	1.25	1.25	
<i>D</i> ²	1	0.42	0.42	1.41	0.2886	1.26	1.26	
<i>E</i> ²	1	0.41	0.41	1.38	0.2930	1.25	1.25	
Residual	5	1.48	0.30			1.86	0.37	
<i>Lack of Fit</i>	1	0.96	0.96	7.53	0.0517	1.22	1.22	
<i>Pure Error</i>	4	0.51	0.13			0.64	0.16	
Cor Total	25	5249.30	262.47	889.35	< 0.0001	3849.37		

Table S5. Statistical supplementary results of quadratic model.

	R% AO		R% MG
Std. Dev.	0.54		0.61
Mean	73.98		65.93
C.V. %	0.73		0.92
PRESS	543.16		688.15
-2 Log Likelihood	-0.81		5.18
R-Squared	0.9997		0.9995
Adj R-Squared	0.9986		0.9976
Pred R-Squared	0.8966		0.8212
Adeq Precision	132.910		101.087
BIC	67.61		73.60
AICc	272.19		278.18