Electronic Supplementary Material (ESI) for New Journal of Chemistry.

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3 D Hierarchical heterostructures of $Bi_2W_{1-X}Mo_XO_6$ with enhanced oxygen evolution reaction from water under natural sunlight

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Figure S1

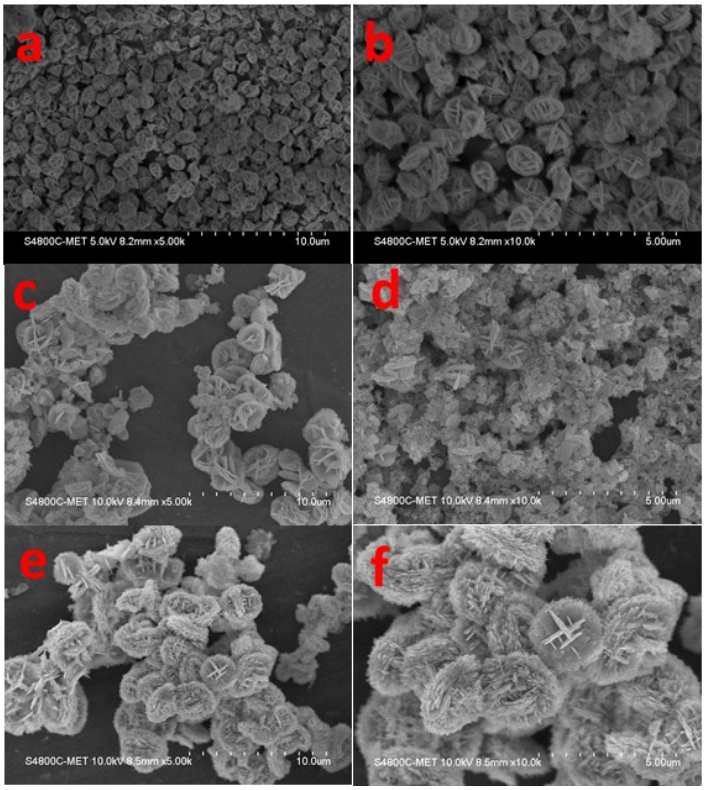
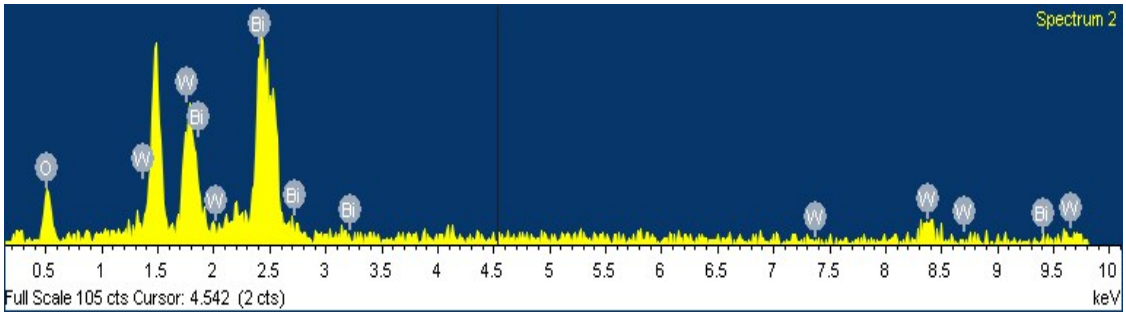


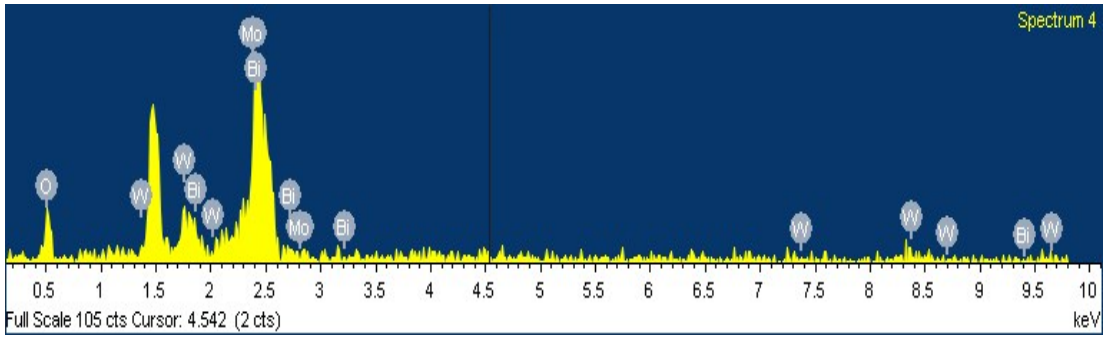
Figure S1: FE-SEM images (a, b) $Bi_2W_{0.8}Mo_{0.2}O_6$ (c, d) $Bi_2W_{0.4}Mo_{0.6}O_6$ and (e, f) $Bi_2W_{0.2}Mo_{0.8}O_6$

EDAX SPECTRA

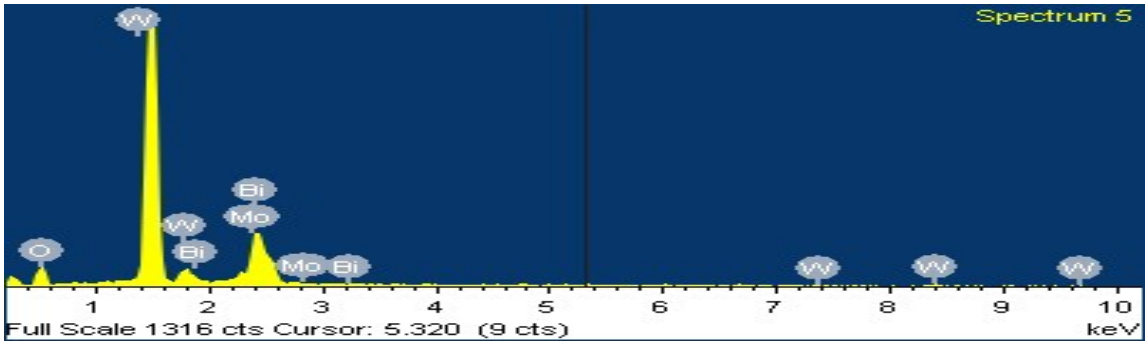
a) S1



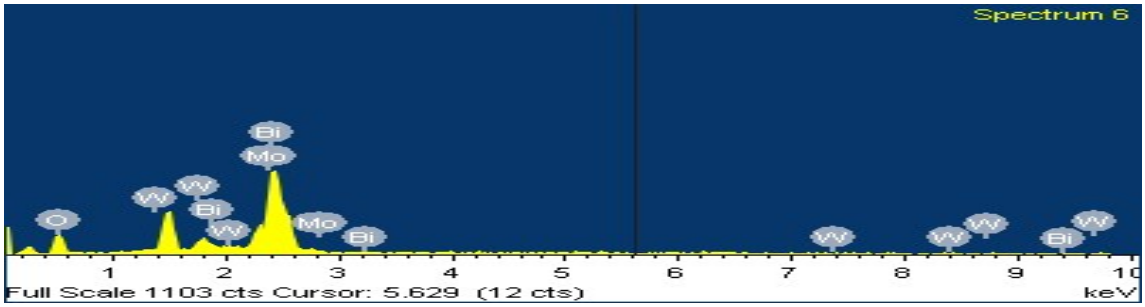
b) S3



c) **S4**


Spectrum 5
O
W
Bi
Mo
1 2 3 4 5 6 7 8 9 10
Full Scale 1316 cts Cursor: 5.320 (9 cts)
keV

d) **S5**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W
Bi
Mo
1 2 3 4 5 6 7 8 9
Full Scale 1103 cts Cursor: 5.629 (12 cts)
keV

e) **S6**

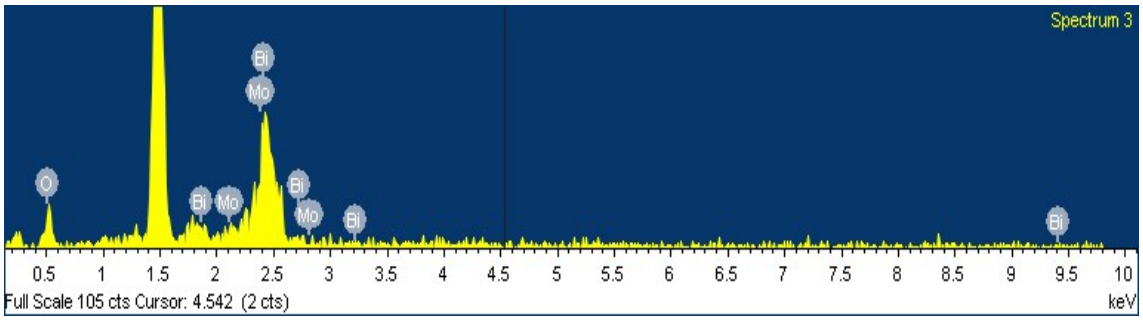
Spectrum 3
O
Bi
Mo
0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8 8.5 9 9.5 10
Full Scale 105 cts Cursor: 4.542 (2 cts)
keV

Table 1 Elemental Composition from EDAX

S1

Element	Weight %	Atomic %
O K	19.91	75.78
W L	22.29	7.38
Bi M	57.80	16.84

S3

Element	Weight %	Atomic %
O K	23.83	78.04
W L	8.72	4.76
Mo L	8.15	2.32
Bi M	59.30	14.87

S4

Element	Weight %	Atomic %
O K	29.75	83.20
W L	5.40	2.52
Mo L	13.37	3.25
Bi M	51.47	11.02

S5

Element	Weight %	Atomic %
O K	25.96	79.46
W L	7.10	1.89
Mo L	10.75	5.49
Bi M	56.19	13.48

S6

Element	Weight %	Atomic %
O K	27.91	81.41
Mo L	9.48	4.61
Bi M	62.61	13.98

Figure S2

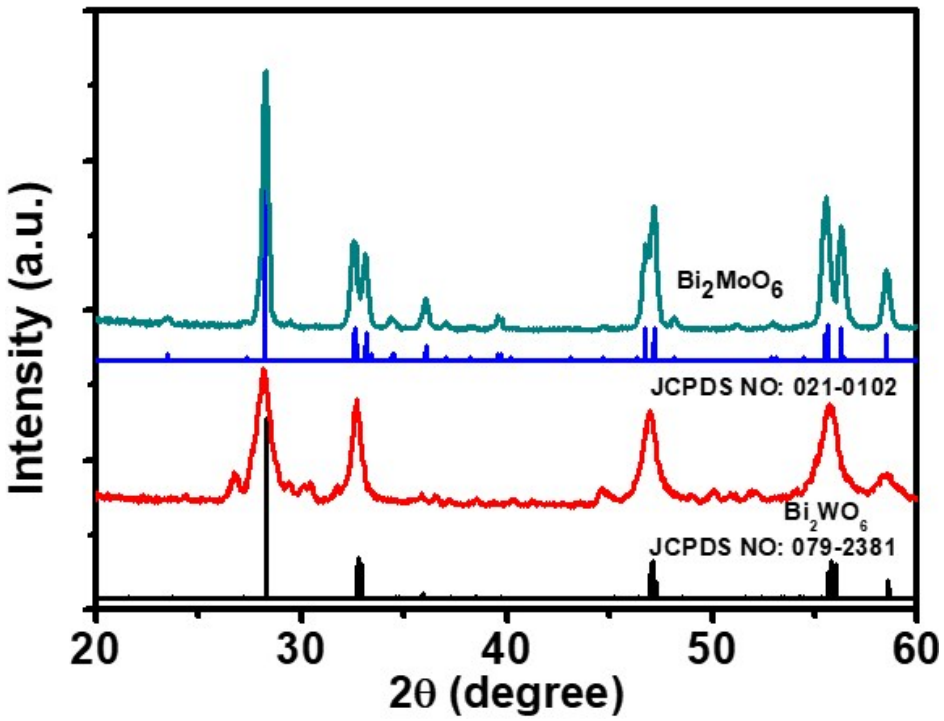

Figure S2: Comparative XRD patterns of Bi_2WO_6 and Bi_2MoO_6 with standard XRD pattern

Figure S3

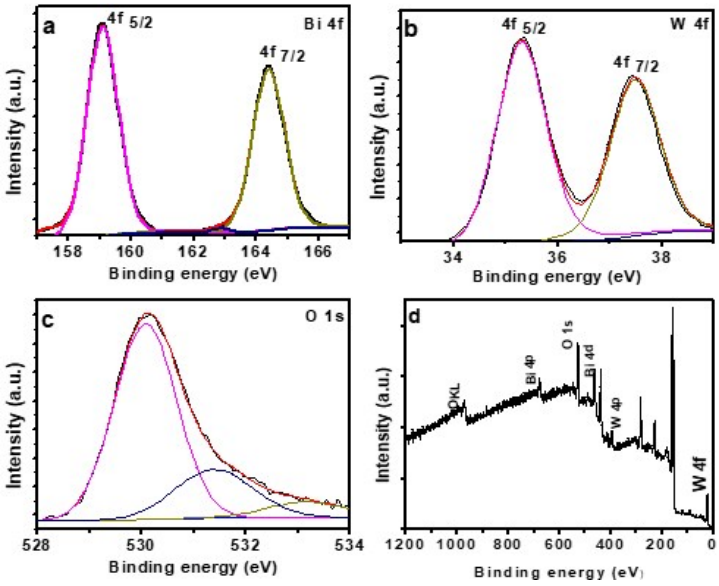

Figure S3: XPS spectra of Bi_2WO_6 (S1) a) Bi 4f b) W 4f c) O 1s d) survey spectrum

Figure S4

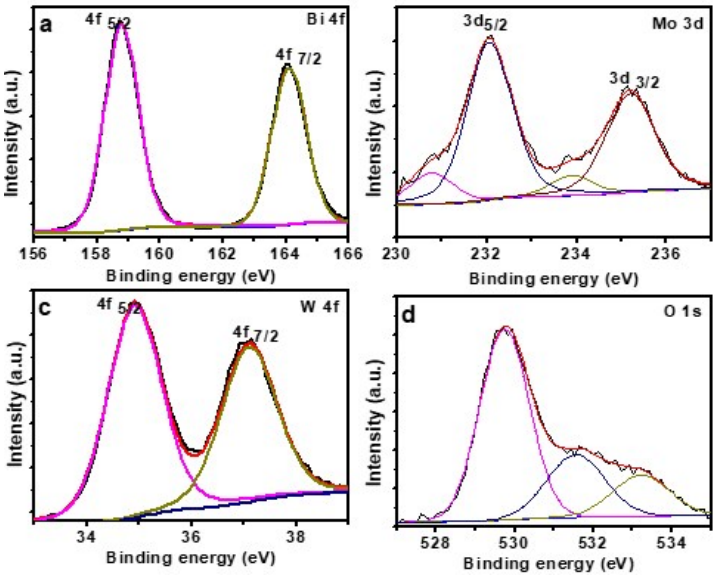

Figure S4: XPS spectra of $Bi_2W_{0.6}Mo_{0.4}O_6$ (S3) a) Bi 4f b) Mo 3d c) W 4f d) O 1s

Figure S5

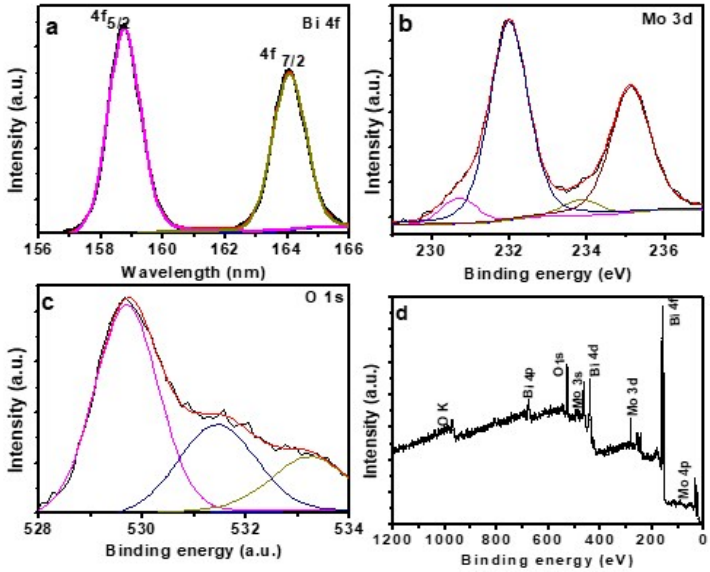

Figure S5: XPS spectra of Bi_2MoO_6 (S6) a) Bi 4f b) Mo 3d C) O 1s d) Survey spectrum

Table 2 Sample composition of of Bi, Mo, W and O from $Bi_2W_{1-X}Mo_XO_6$ from XPS

Compound	Bi	W	Mo	O
S1	22.18	10.30	-	67.51
S3	20.80	5.07	3.30	70.82
S6	19.58	-	7.72	72.70

Table 3 Composition of each precursor for synthesis of $Bi_2W_{1-x}Mo_xO_6$

Sample code	$Bi(NO_3)_3$ in (mm)	Na_2WO_4 in (mm)	Na_2MoO_4 in (mm)	% of Bi:W:Mo (from ICP-AES)
S1	0.96	0.29	-	Bi 62.22%, W 23.41%
S2	0.96	0.23	0.048	
S3	0.96	0.17	0.096	Bi 63.15%, W 12.1 %, Mo 8.48%
S4	0.96	0.11	0.144	
S5	0.96	0.05	0.19	

S6	0.96	0.25	-	Bi 63.06%, Mo 17.11%

Figure S6

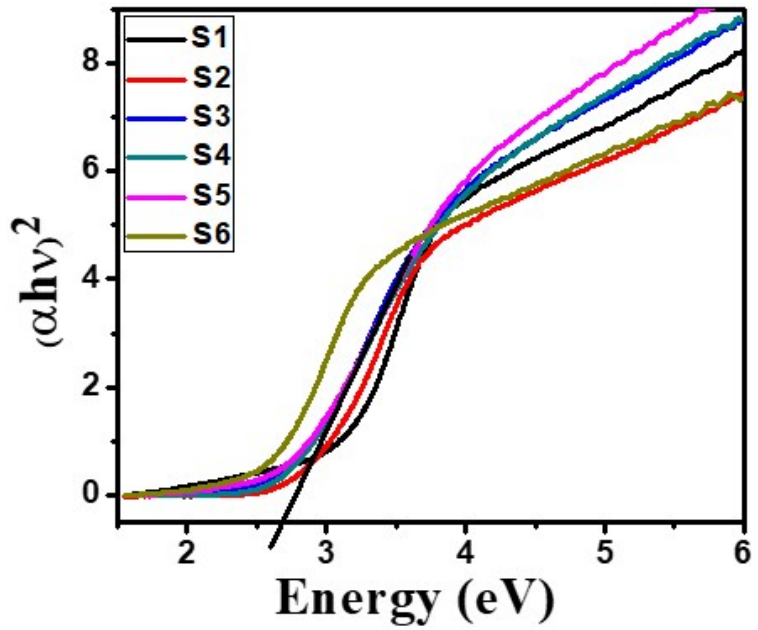

Figure S6: Tauc plot of samples S1) (Bi_2WO_6), S2) ($Bi_2W_{0.8}Mo_{0.2}O_6$), S3) ($Bi_2W_{0.6}Mo_{0.4}O_6$), S4) ($Bi_2W_{0.4}Mo_{0.6}O_6$), S5) ($Bi_2W_{0.2}Mo_{0.8}O_6$) and S6) (Bi_2MoO_6)

Figure S7

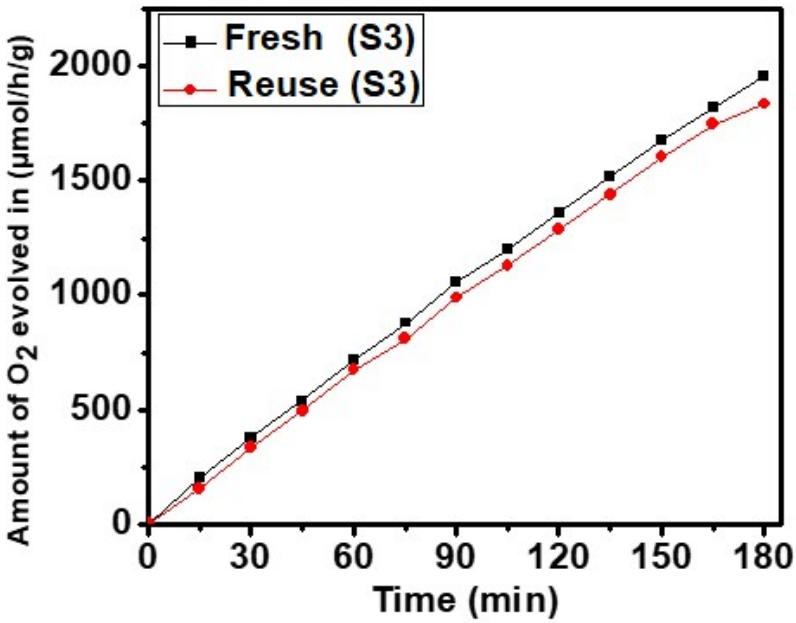

Figure S7: Recycle study of $Bi_2W_{0.6}Mo_{0.4}O_6$ (S3) for photocatalytic oxygen evolution reaction

Figure 8

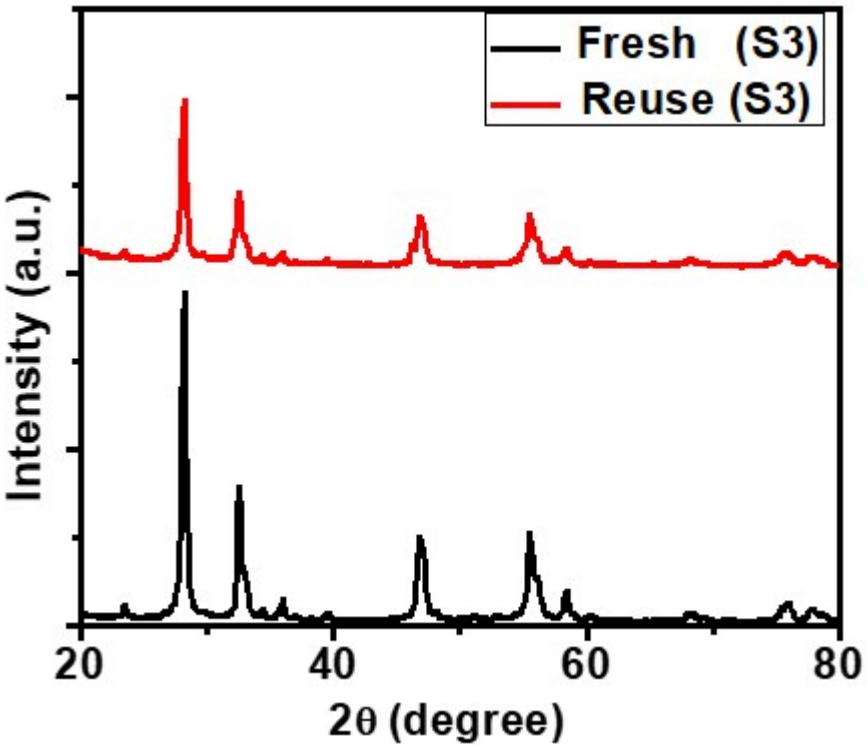

Figure 8: XRD pattern of sample (S3)**:** after photocatalytic oxygen evolution reaction

Figure 9

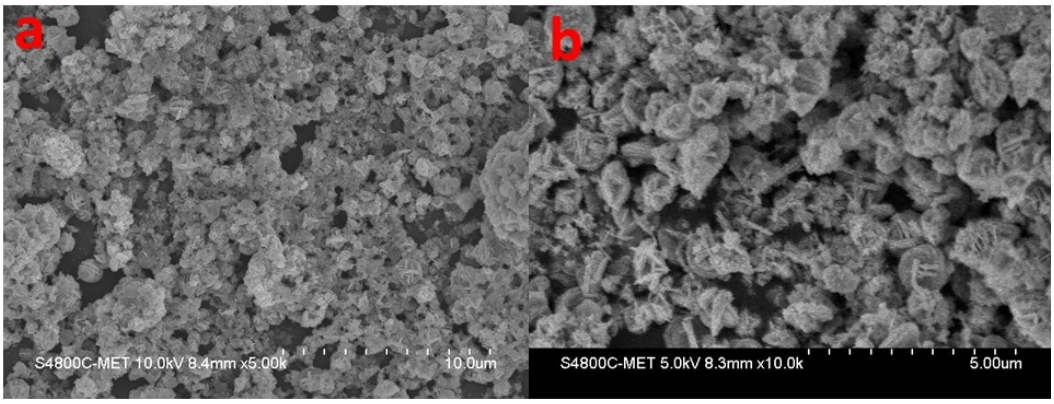

Figure 9: FESEM images of sample (S3) after photocatalytic reaction

Table 4 A comparison study of the photocatalysts in this work and previous reported $BiVO_4$ based photocatalysts for water oxidation reaction.

Photocatalyst	Light source	Wavelength(nm)	Sacrificial agent	Oxygen evolution rate (μmol/h/g)	References
Bi_2MoO_6	300 W Xe	>300	$Ag(NO)_3$	127	1
Bi_2WO_6	450 W Xe	>420	$Ag(NO)_3$	34	2
Mo-$BiVO_4$	300 W Xe	> 420	$Ag(NO)_3$	500	3
$BiVO_4$	300 W Xe	>300	$Ag(NO)_3$	82.8	4
Fe-$BiVO_4$	300 W Xe	>300	$Ag(NO)_3$	50	4
Fe/Mo $BiVO_4$	300 W Xe	>300	$NaOH/Na_2S_2O_8$	191.5	5
Bi_2WO_6	Sunlight	>300	$Ag(NO)_3$	116.5	Present work
Bi_2MoO_6	Sunlight	>300	$Ag(NO)_3$	81.2	Present work
MO-Bi_2WO_6	Sunlight	>300	$Ag(NO)_3$	652	Present work

References

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2) A. Kudo, S. Hijii, Chem. Lett. 1999, **10**, 1103–1104.

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5) R. Liu, J. Ren, D. Zhao, J. Ning, Z. Zhang, Y. Wang, Y. Zhong, C. Zheng, and Y. Hua, Inorg. Chem Front.**,** 2017, **4**, 2045-2054.