Supporting Information for

Bi-metal-organic frameworks type II heterostructure for enhanced photocatalytic styrene oxidation

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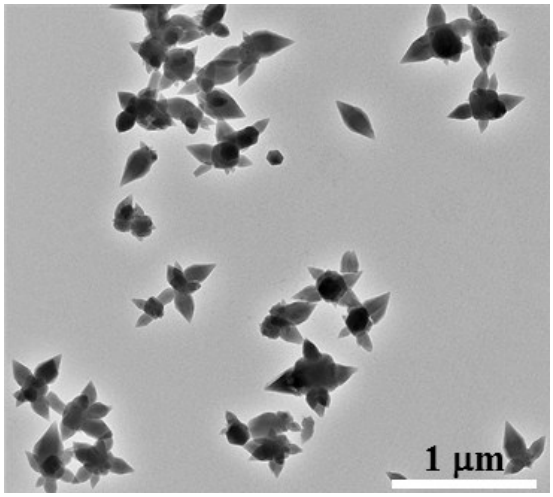

Fig.S1 TEM image of UOML-7 heterostructure.

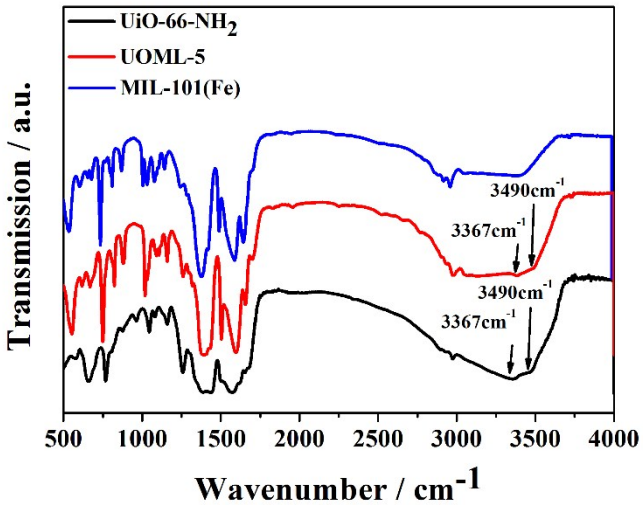

Fig.S2 FTIR spectra of pristine UiO-66-NH_2, MIL-101(Fe) and UOML-5 heterostructure.

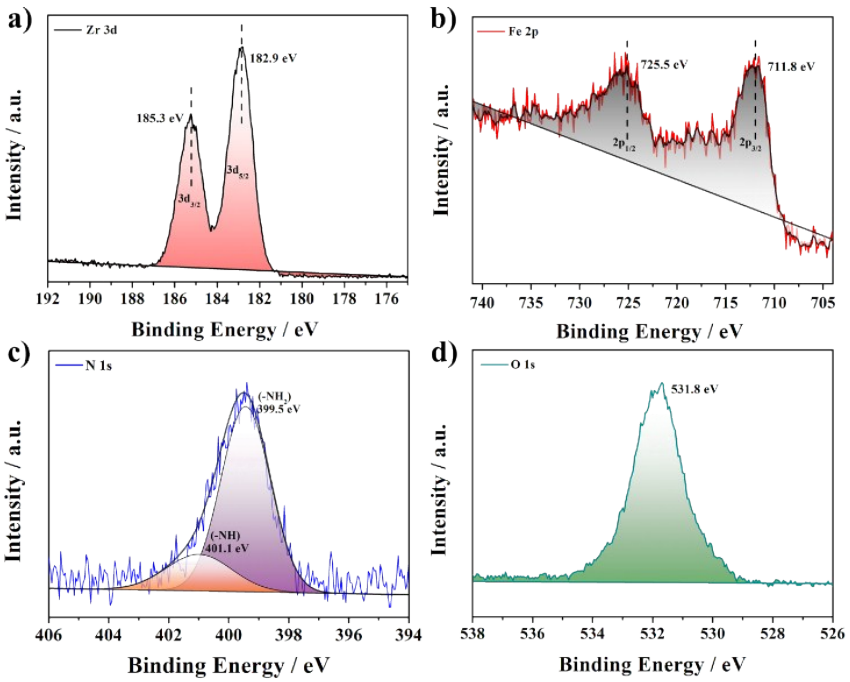

Fig.S3 XPS spectra of UOML-5: a) Zr 3d, (b) Fe 2p, (c) N 1s, and (d) O 1s.

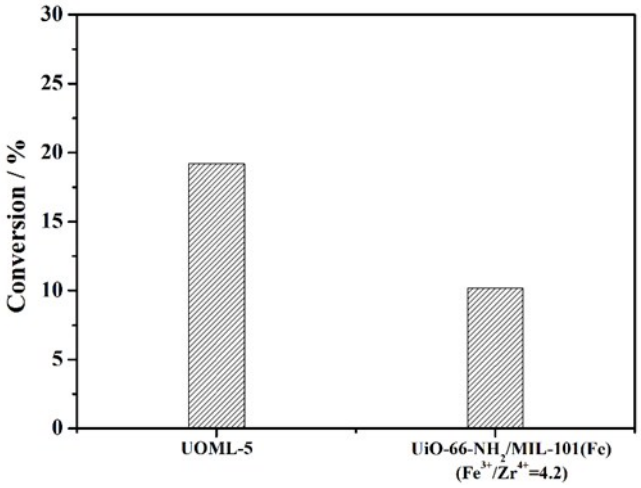

Fig.S4 Styrene conversion over UOML-5 heterostructure and physical mixing UiO-66-NH_2/MIL-101(Fe) composite (Fe^{3+}/Zr^{4+}=4.2).

Table S1. The atomic percentage of Fe and Zr determined using ICP-MS.

Material	Fe, at%	Zr, at%	Experimental Fe^{3+}/Zr^{4+}
UOML-3	71.4	28.6	2.5
UOML-5	80.8	19.2	4.2
UOML-7	85.9	14.1	6.1
UOML-9	88.1	11.9	7.4

Table S2. The photocatalytic activity of UOML-5 heterostructure in different organic solvents after 12 h.

Reagent	Solvent	Conversion	Selectivity	
			Benzaldehyde	Others
Styrene	CH_3CN	19.2%	91.7%	8.3%
	Acetone	15.6%	93.4%	6.6%
	Toluene	12.8%	90.2%	9.8%

Table S3. Summary of photocatalytic oxidation of styrene based on various photocatalysts reported in references and obtained in the present work.

Photocatalyst	**Reaction Conditions**	**Conversion %**	**Selectiviy (Benzaldehyde) %**	**Ref.**
UOML-5 heterostructure	O_2, visible-light	19.2	91.7	This work
UiO-66-NH_2	O_2, visible-light	7.7	83.4	[1]
TiO_2	Acid, H_2O_2, UV	12	90	[2]
V(0.5)/SBA-15	H_2O_2, UV	28.2	29.4	[3]
Cr-SiO_2	O_2, visible-light	2.4	80	[4]

Table S4. Photocatalytic oxidation of toluene over UOML-5 heterostructure.

Reagent	Conversion	Selectivity	
		Benzaldehyde	Others
Toluene	3.8%	89.3%	10.7%

Reaction conditions: photocatalyst (100 mg), toluene (0.5 mmol), benzene (10 ml), room temperature, O_2, visible-light irradiation (λ>420nm, 8h).

Table S5. Structural parameters obtained from N_2 adsorption isotherms analysis.

Sample	S_{BET} ($m^2\ g^{-1}$)	Pore volume ($cm^3\ g^{-1}$)	Average Pore Size (nm)
UiO-66-NH_2	770.1	0.4516	1.52
UOML-5	916.2	0.6223	1.77

References

1. J. Long, S. Wang, Z. Ding, S. Wang, Y. Zhou, L. Huang and X. Wang, *Chem. Commun.*, 2012, **48**, 11656-11658.
2. H. Lachheb, C. Guillard, H. Lassoued, M. Haddaji, M. Rajah and A. Houas, *J. Photochem. Photobiol., A*, 2017, **346**, 462-469.
3. G. Wang, S. Zhang, Y. Huang, F. Kang, Z. Yang and Y. Guo, *Appl. Catal., A*, 2012, **413-414**, 52-61.
4. Y. Shiraishi, Y. Teshima and T. Hirai, *J. Phys. Chem. B*, 2006, **110**, 6257-6263.