

Three CoS/CoO microspheres and its mixed matrix membrane for the highly efficient photocatalytic degradation of methyl blue

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Supporting Information (SI)

XRD patterns of **3-MMM** before and after recycling (Fig. S1); XPS spectra of **3-MMM**. (a) The survey spectra of **3-MMM**; (b) Co 2p XPS spectra; (c) O 1s XPS spectra; (d) S 2p XPS spectra (Fig. S2); SEM and EDS mappings of **3-MMM** (Fig. S3); Particle size analysis of **1-3** (Fig. S4); N₂ adsorption-desorption isotherm diagram of **1**, **2** and **3** at 77 K (Fig. S5); UV-vis spectra at different times for MB in the presence of **1**, **2**, **3**, and **3-MMM**, respectively (Fig. S6); UV-vis spectra for MB in the presence of **1**, **2**, **3**, and **3-MMM** under metal halide lamp irradiation (Fig. S7); Adsorption and photocatalytic degradation of methyl blue solution by no catalyst, **PVDF-M**, **3-MMM** and **3**, respectively (Fig. S8); Total decontamination efficiency of methyl blue contrast. (a) no catalyst; (b) **PVDF-M**; (c) **3-MMM**; (d) **3** (Fig. S9); Comparison of the photocatalytic degradation behavior of MB by **3**, **3-MMM** and some reported photocatalysts (Table S1).

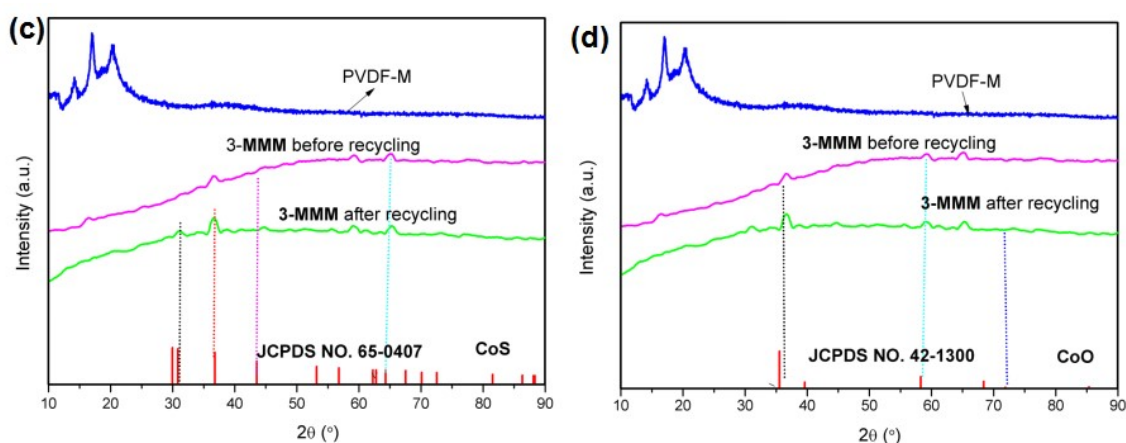


Fig. S1 XRD patterns of **3-MMM** before and after recycling.

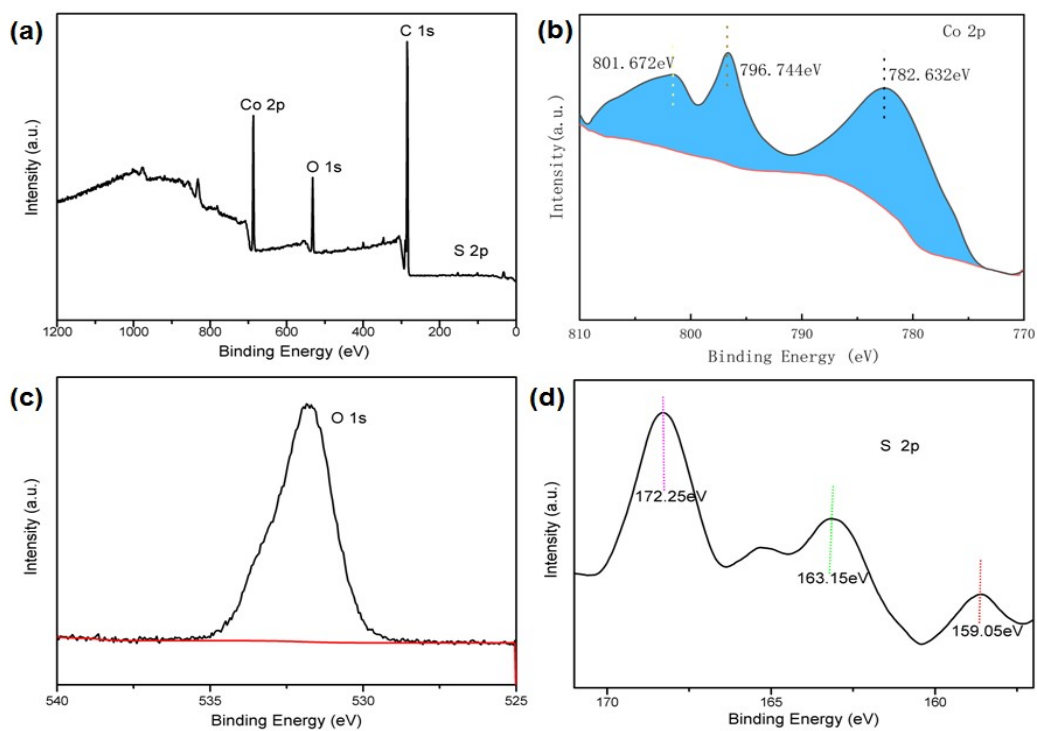


Fig. S2 XPS spectra of 3-MMM. (a) The survey spectra of 3-MMM; (b) Co 2p XPS spectra; (c) O 1s XPS spectra; (d) S 2p XPS spectra.

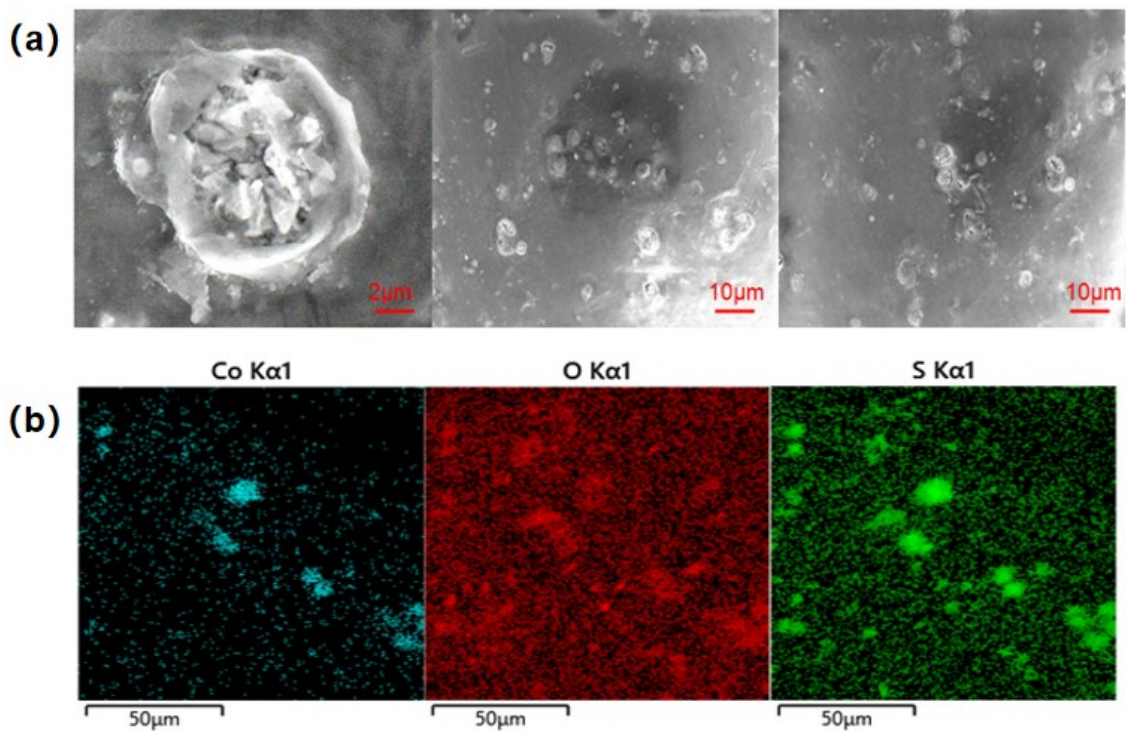


Fig. S3 (a) and (b) are SEM and EDS mappings of 3-MMM respectively.

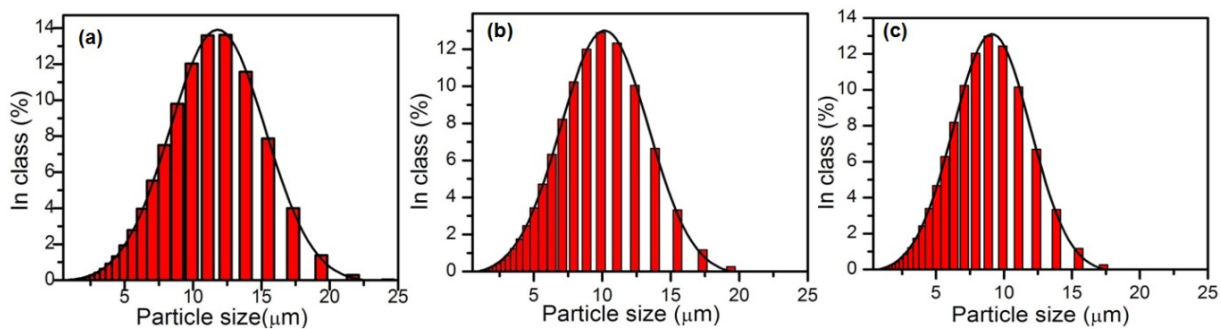


Fig. S4 Particle size analysis of **1** (a), **2** (b) and **3**(c), respectively.

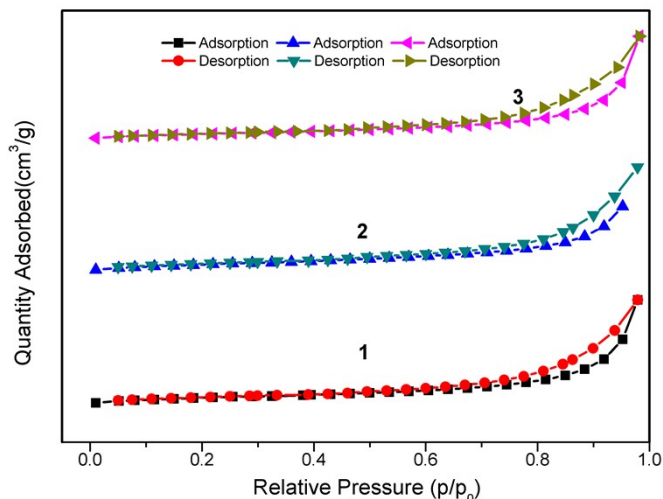


Fig. S5 N₂ adsorption-desorption isotherm diagram of **1**, **2** and **3** at 77 K

Fig. S6 UV-vis spectra at different times for MB in the presence of **1**, **2**, **3**, and **3-MMM**, respectively.

Fig. S7 UV-vis spectra for MB in the presence of **1**, **2**, **3**, and **3-MMM** under metal halide lamp irradiation.

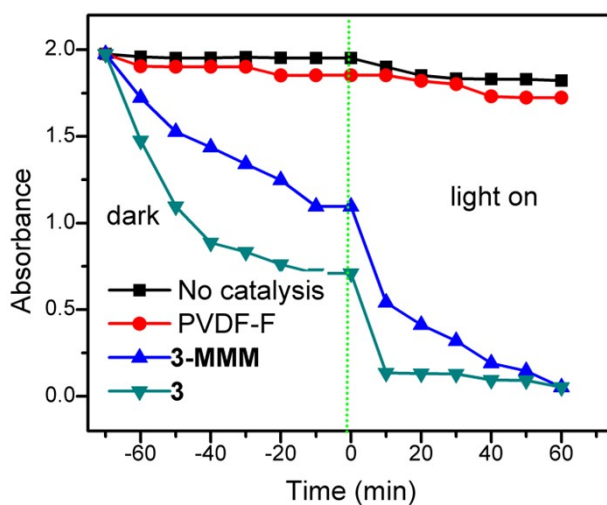


Fig. S8 Adsorption and photocatalytic degradation of methyl blue solution by no catalyst, PVDF-Membrane (PVDF-M), 3-MMM and 3, respectively.

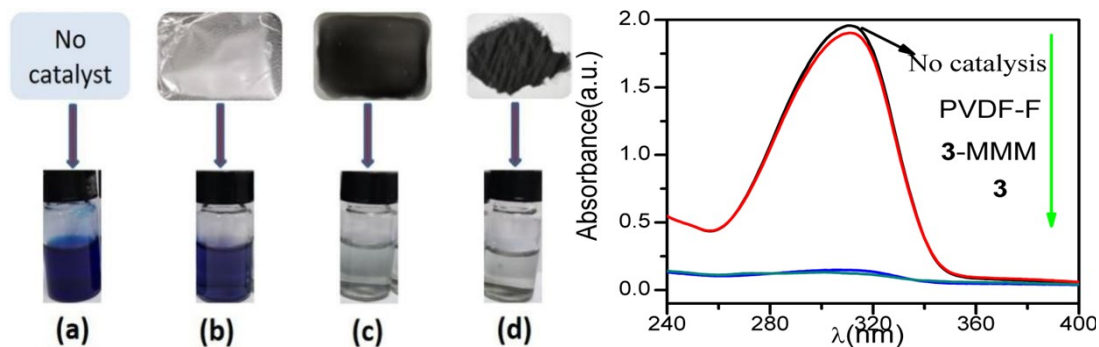


Fig. S9 Total decontamination efficiency of methyl blue contrast. (a) no catalyst; (b) PVDF-Membrane (PVDF-M); (c) 3-MMM; (d) 3.

Table S1. Comparison of the photocatalytic degradation behavior of MB by 3, 3-MMM and some reported photocatalysts

Type of photocatalyst	Photocatalyst dosage (mg)	MB concentration (mg/L)	Solution Volume (mL)	Irradiation time (min)	Photocatalytic Degradation rate(%)	Cycle number (time)	Literature sources
3	20	80	20	60	97.3%	12	This work
3-MMM	20	80	20	60	97.34%	12	This work
2% C/TiO_2	100	20	100	129	—	—	(Alkorbi et al., 2022)
ZnO nanorods/C-dots	—	80	20	70	74.98%	—	(Roza et al., 2020)
Co_3O_4 nanoparticle	5	50	20	180	91.7%	—	(Dhiman et al., 2022)
Cu_2O -Based Photocatalysis	60	50	100	120	79%	—	(Zhou et al., 2022)
Al-doped ZnO thin films	—	80	10	45	79.9%	—	(Roza et al., 2020)

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