Electronic Supporting Information

Rational synthesis of isomorphic rare earth metal-organic framework materials for simultaneous adsorption and photocatalytic degradation of organic dyes in water

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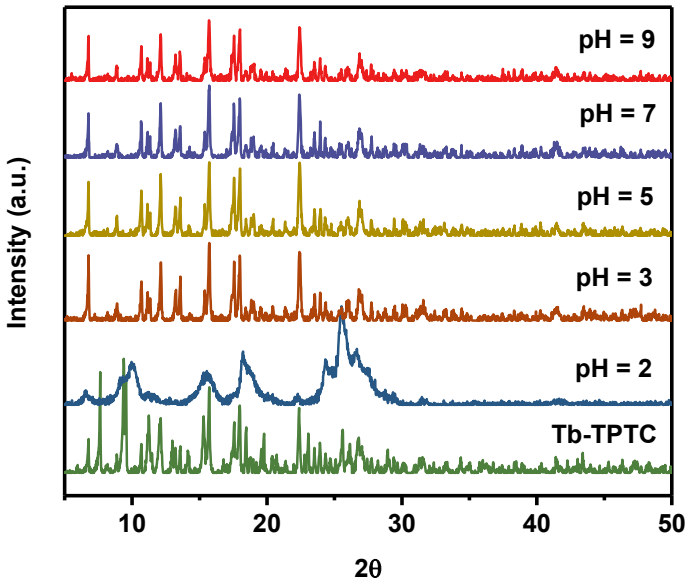
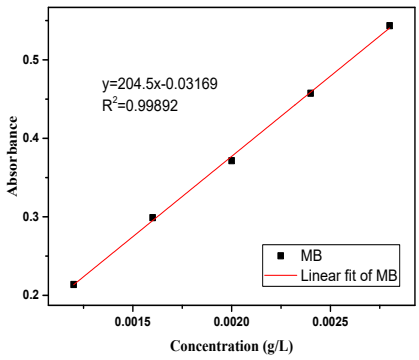
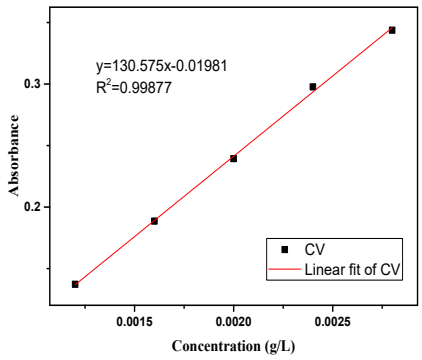


Fig. S1. XRD spectra of Tb-TPTC at different pH values.



(a)



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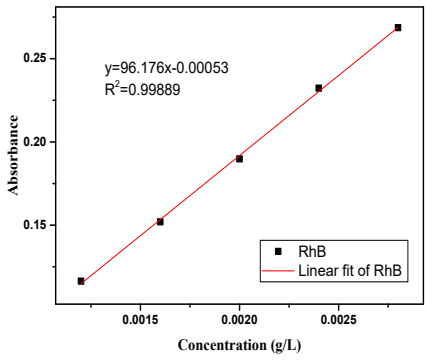
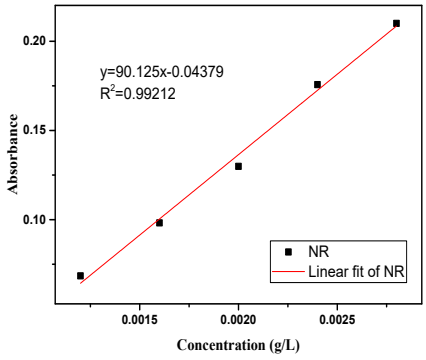
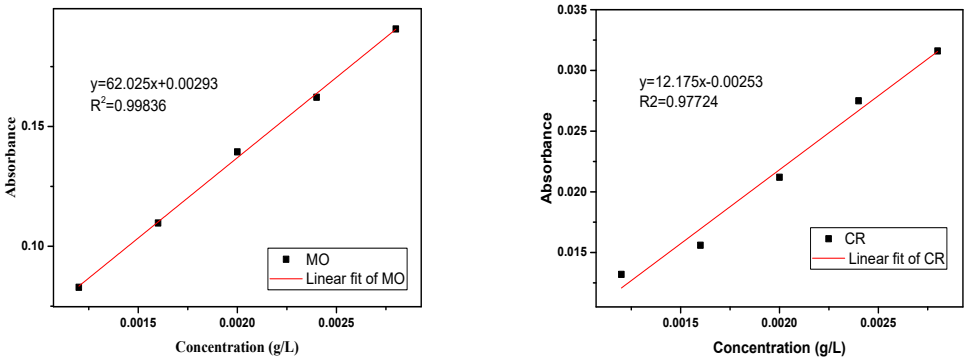


(c)



(d)



(e) (f)

Fig. S2 Standard curve diagram of different dyes.

Photoluminescent Properties

Fig. S3 showed the emission spectra of Eu^{3+} / Tb^{3+} in different ratios. The Eu-TPTC and Tb-TPTC exhibited series of sharp bands corresponding to the characteristic transitions of $^5D_0 \rightarrow {}^7F_J$ (J = 0–4) and $^5D_4 \rightarrow {}^7F_J$ (J = 6–3). Eu-TPTC was red, and Tb-TPTC was green. As the Eu^{3+} concentration increased, the emission color of the compound also changed from green to orange to red. It was worth noting that the Eu^{3+} emission was dominant when the Eu^{3+} ratio increased to Eu : Tb = 4:1 and the Tb^{3+} emission was dominant when the Tb^{3+} ratio increased to Eu : Tb = 1:9.

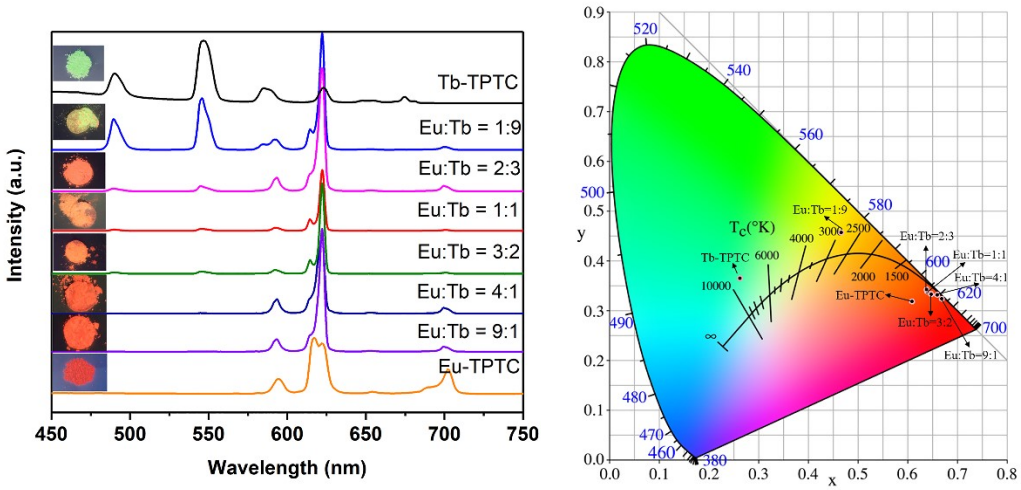


Fig. S3 Emission spectra of Eu^{3+}/Tb^{3+} with different molar ratios and the corresponding CIE chromaticity.

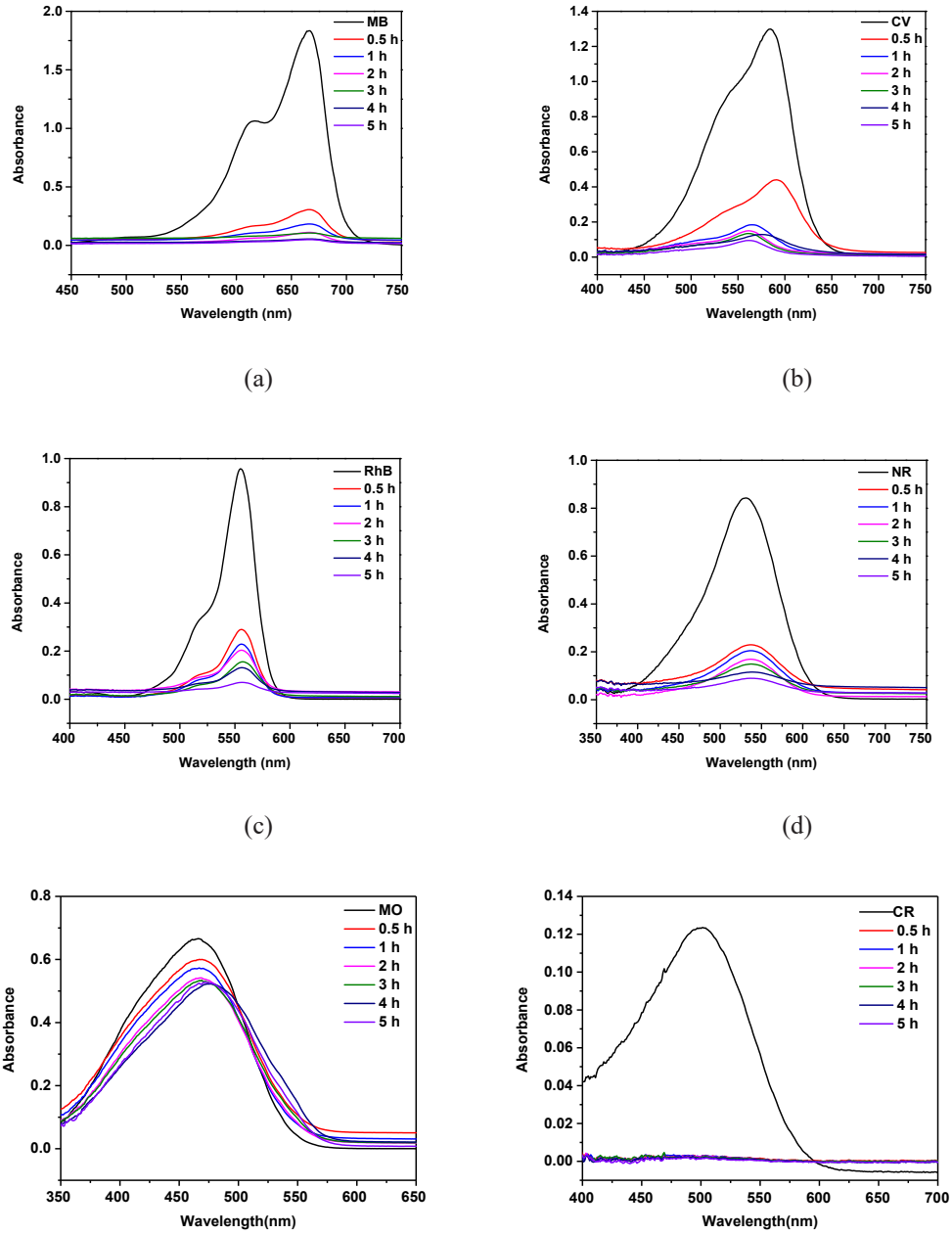


Fig. S4 UV-vis absorption spectra of different dyes adsorption over Eu-TPTC.

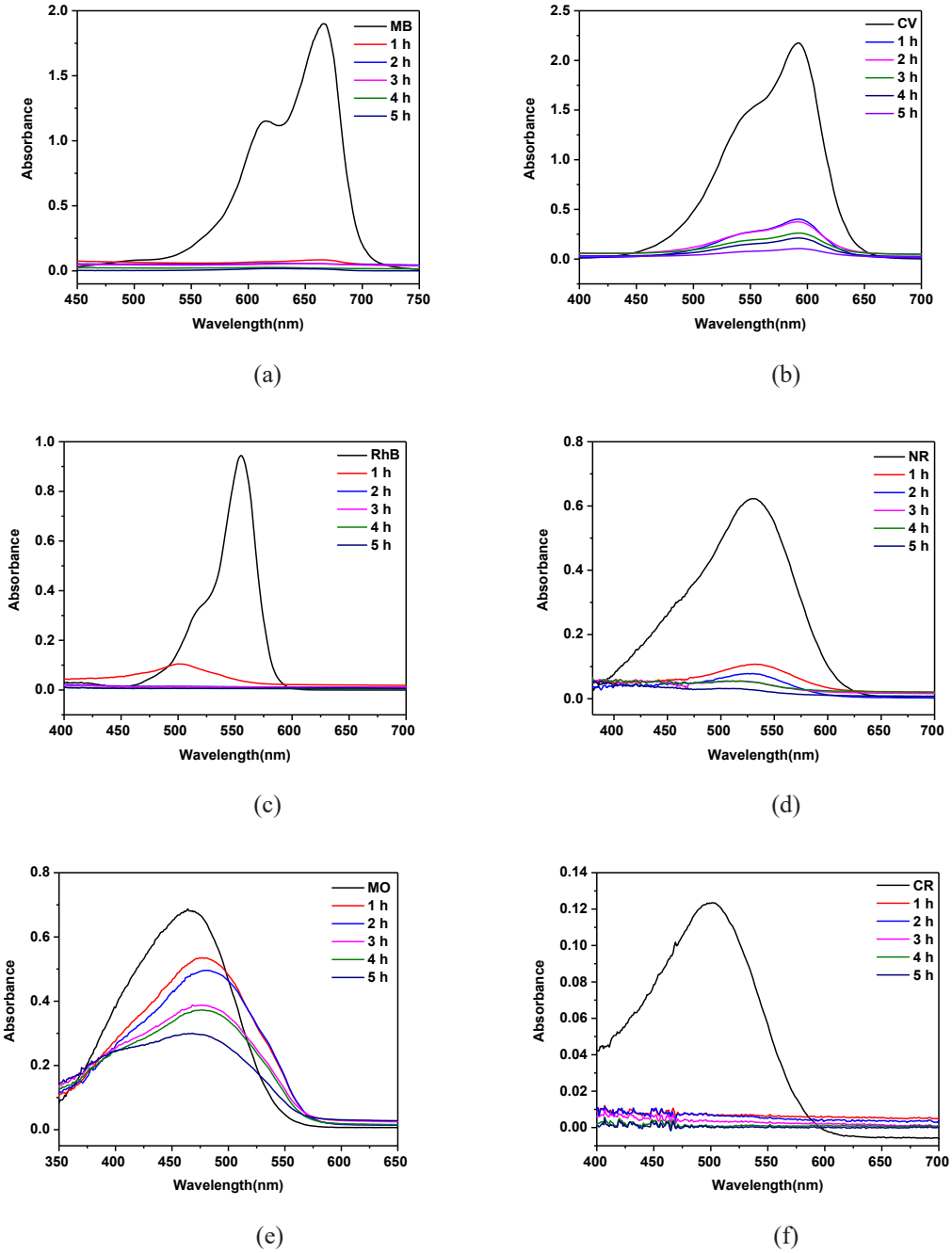


Fig. S5 UV-vis absorption spectra of different dyes degradation over Eu-TPTC.

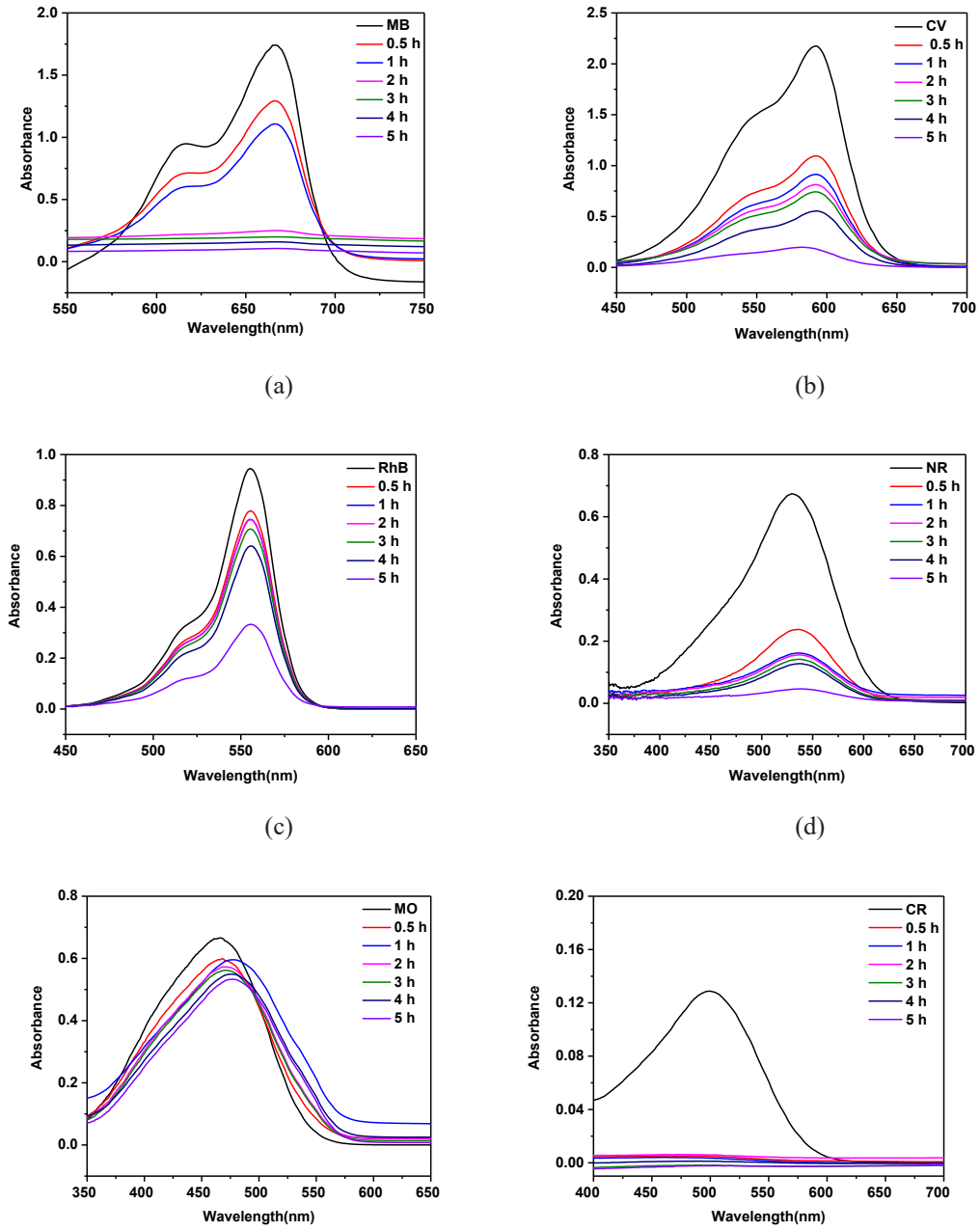


Fig. S6 UV-vis absorption spectra of different dyes adsorption over Tb-TPTC.

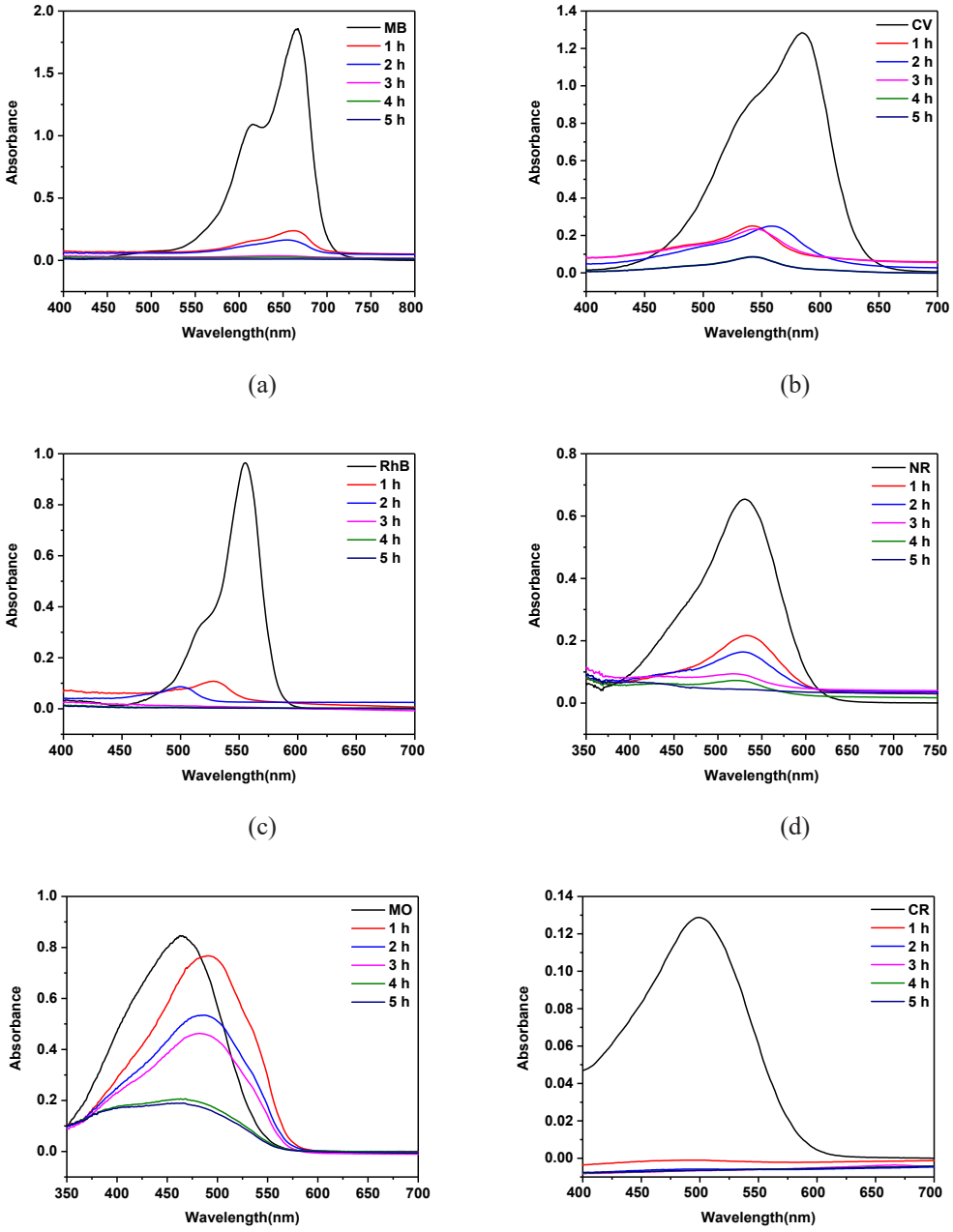


Fig. S7 UV-vis absorption spectra of different dyes degradation over Tb-TPTC

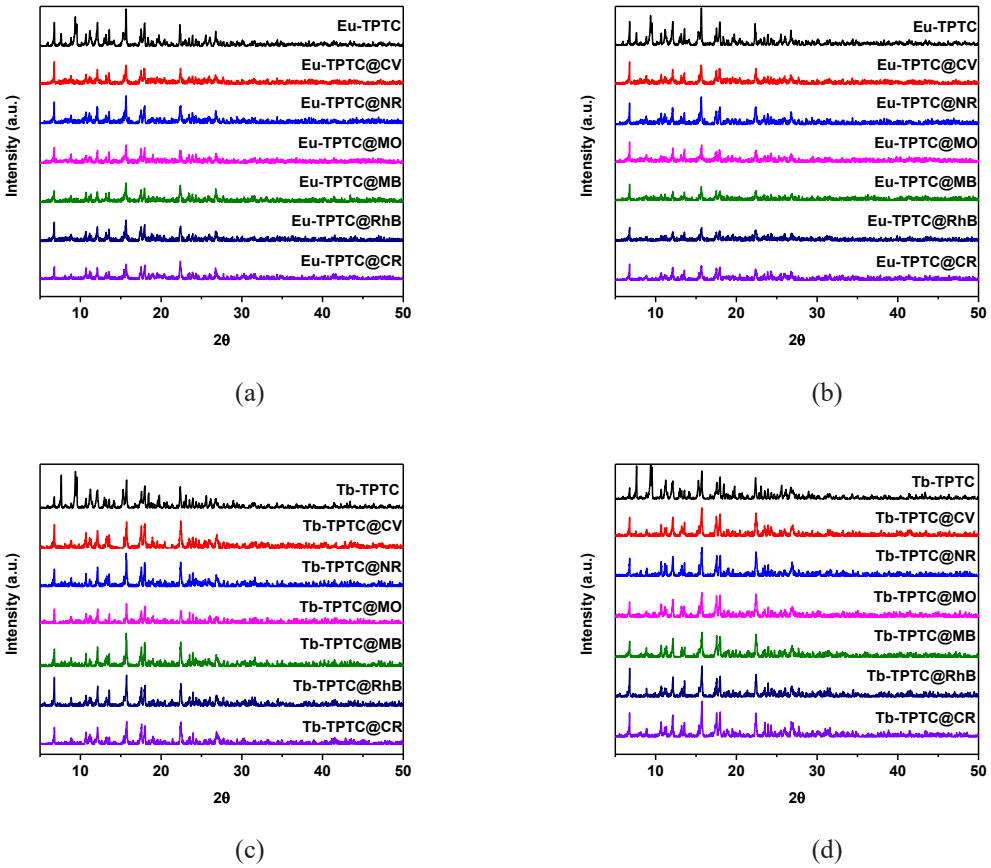


Fig. S8 (a) XRD patterns of Eu-TPTC before and after adsorption of different dyes; (b) XRD patterns of Eu-TPTC before and after degradation of different dyes; (c) XRD patterns of Tb-TPTC before and after adsorption of different dyes; (d) XRD patterns of Tb-TPTC before and after degradation of different dyes.

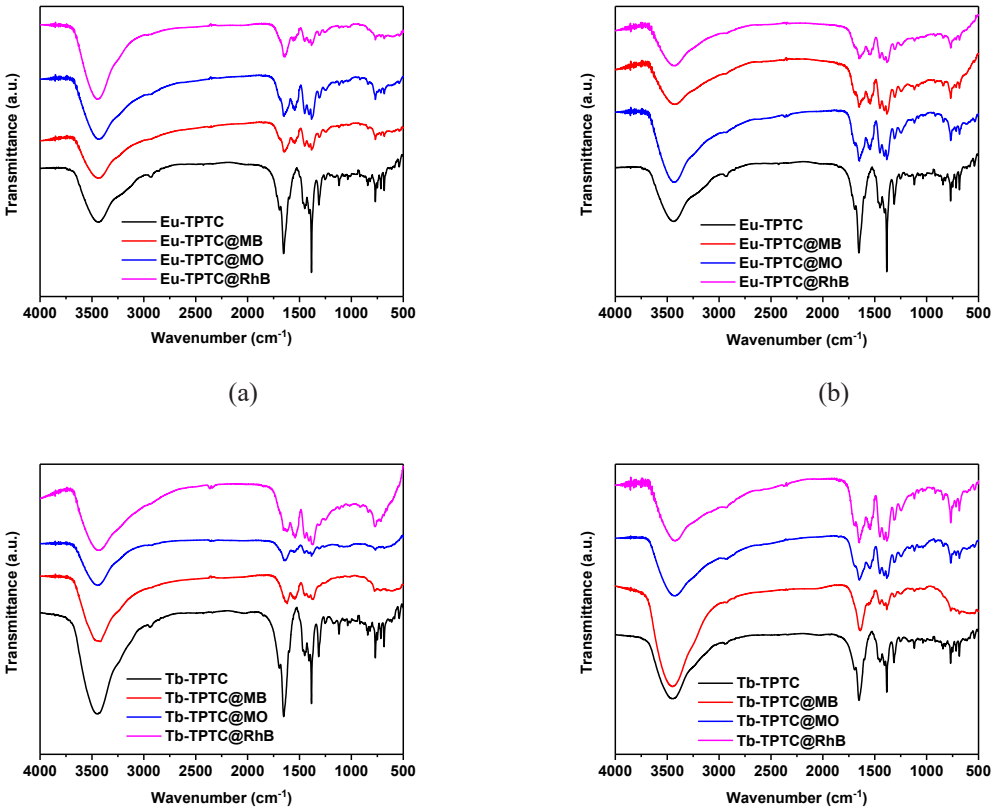


Fig. S9 (a) FTIR spectra of Eu-TPTC before and after adsorption of different dyes; (b) FTIR spectra of Eu-TPTC before and after degradation of different dyes; (c) FTIR spectra of Tb-TPTC before and after adsorption of different dyes; (d) FTIR spectra of Tb-TPTC before and after degradation of different dyes.

Table S1 Selected bond lengths and angles for Eu-TPTC.

Eu-TPTC			
Bond	Length/Å	Bond	Length/Å
Eu1–O1	2.362(4)	Eu1–O2#2	2.357(4)
Eu1–O5#1	2.355(4)	Eu1–O5#3	2.690(5)
Eu1–O6#3	2.423(5)	Eu1–O7	2.537(5)
Eu1-O8	2.496(5)	Eu1-O10	2.435(5)
Eu1-O11	2.402(5)		
Bond	Angles/°	Bond	Angles/°
O1-Eu1-O5#3	70.05(15)	O1-Eu1-O6#3	77.52(16)
O1-Eu1-O7	70.11(17)	O1-Eu1-O8	73.92(18)
O1-Eu1-O10	139.84(17)	O1-Eu1-O11	133.35(17)
O2#2-Eu1-O1	134.08(16)	O2#2-Eu1-O5#3	68.30(15)
O2#2-Eu1-O6#3	90.51(17)	O2#2-Eu1-O7	144.66(17)
O2#2-Eu1-O8	146.23(18)	O2#2-Eu1-O10	74.02(18)
O2#2-Eu1-O11	75.68(17)	O5#1-Eu1-O1	73.07(16)
O5#1-Eu1-O2#2	77.48(16)	O5#1-Eu1-O5#3	73.69(16)
O5#1-Eu1-O6#3	123.14(15)	O5#1-Eu1-O7	90.26(18)
O5#1-Eu1-O8	135.63(17)	O5#1-Eu1-O8	135.63(17)
O5#1-Eu1-O11	83.82(18)	O6#3-Eu1-O5#3	50.66(14)
O6#3-Eu1-O7	123.25(17)	O6#3-Eu1-O8	76.49(19)
O6#3-Eu1-O10	73.84(18)	O7-Eu1-O5#3	139.86(16)
O8-Eu1-O5#3	120.44(19)	O8-Eu1-O7	50.65(19)
O10-Eu1-O5#3	109.94(17)	O10-Eu1-O7	103.5(2)
O10-Eu1-O8	72.45(19)	O11-Eu1-O5#3	140.69(16)
O11-Eu1-O6#3	146.69(18)	O11-Eu1-O7	70.07(17)
O11-Eu1-O8	98.2(2)	O11-Eu1-O10	73.3(2)

Symmetry transformations used to generate equivalent atoms: For Eu-TPTC, #1:x, $-y + 2$, $z + 1/2$; #2:$-x + 1/2$, $-y + 3/2$, $-z$; #3:$-x + 1/2$, $y - 1/2$,$-z - 1/2$.

Table S2 Standard curve of the maximum absorption wavelength of different types of dyes.

Dyes	λ_{max} (nm)	Standard curve	R^2
MB	665	y = 204.554x-0.03169	0.9989
CV	592	y= 130.575x-0.01981	0.9988
RhB	555	y = 96.176x-0.00053	0.9989
NR	553	y = 90.125x-0.04397	0.9921
MO	466	y = 62.025x+0.00293	0.9984
CR	497	y = 12.175x-0.00253	0.9772

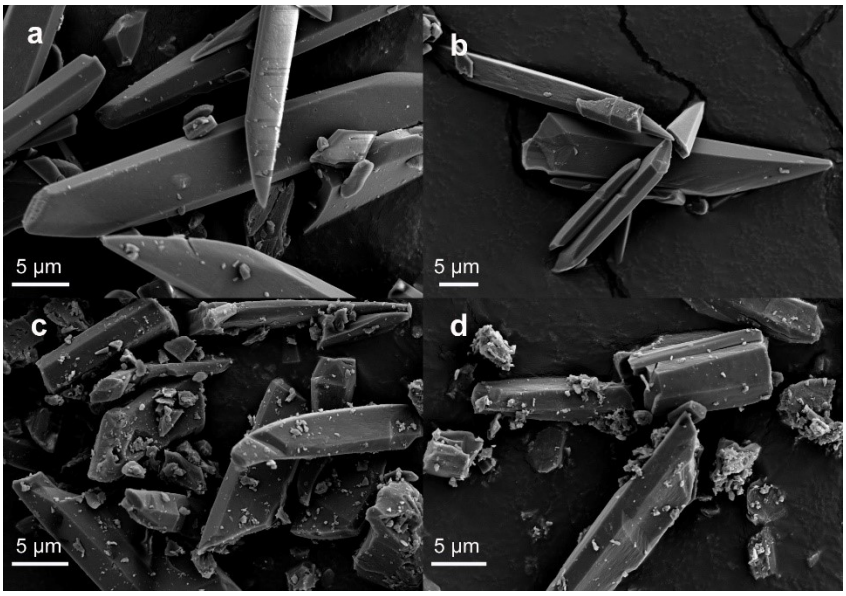


Fig. S10. SEM images of Eu-TPTC and Tb-TPTC before and after RhB degradation (a) Eu-TPTC; (b) Tb-TPTC; (c) Eu-TPTC after RhB degradation; (d) Tb-TPTC after RhB degradation.

Adsorption kinetics

The following equation described the pseudo-second-order kinetics model.

$$kt = \frac{1}{C} - \frac{1}{C_0} \quad (1)$$

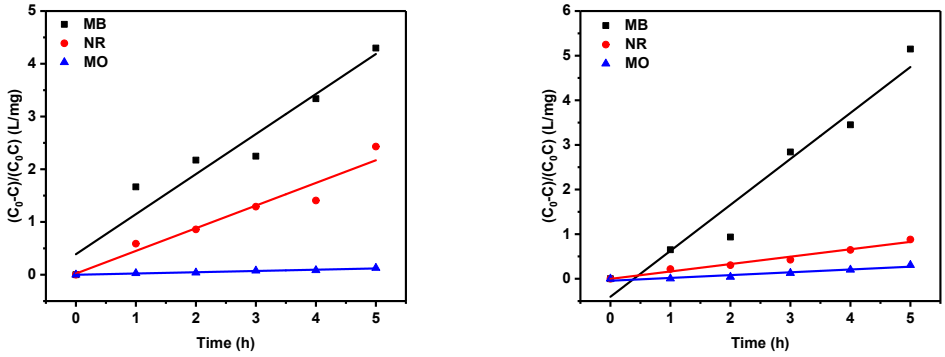
where C and C_0 referred to the adsorption capacity at equilibrium and time t (h), respectively, k was the rate constant of second-order adsorption ($L \cdot mg^{-1} \cdot h^{-1}$). From the plot of $(C_0\text{-}C)/C_0C$ versus t, as shown in Fig. S11, a linear graph could be fitted, from which values of C and k could be determined from the slope and the intercept, respectively.

Table S3 Pseudo-second-order kinetics parameters for three different types of dyes adsorbed over Eu-TPTC

Dyes	C_0 (mg L^{-1})	C (mg L^{-1})	k (L mg^{-1} h^{-1})	R^2
MB	9.024	0.290	0.759	0.921
NR	8.387	0.392	0.430	0.928
MO	10.210	4.440	0.024	0.959

Table S4 Pseudo-second-order kinetics parameters for three different types of dyes adsorbed over Tb-TPTC

Dyes	C_0 (mg L^{-1})	C (mg L^{-1})	k (L mg^{-1} h^{-1})	R^2
MB	9.249	0.281	1.030	0.940
NR	7.745	0.991	0.166	0.971
MO	9.921	2.300	0.063	0.909



(a) (b)

Fig. S11. Pseudo-second-order kinetic models for three different types of dyes (a) Eu-TPTC; (b) Tb-TPTC.