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Supplementary Information

Efficient adsorption of methyl orange and methyl blue dyes by a novel triptycene-based hyper-crosslinked porous polymer

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Experimental part

All reagents used are commercially available and the purity of reagents is AR and were used without further purification.

Synthesis of triptycene porous polymer (TPP)

As shown in Fig. S1, place the monomer triptycene (4mmol, 1.0088g) in a round bottom flask, and then add 1,2-dichloroethane (20mL) to dissolve the monomers. Formaldehyde dimethyl acetal (FDA, 16 mmol) and anhydrous $FeCl_3$ (16 mmol) were added sequentially to an experimental round bottom flask under nitrogen atmosphere. And after thorough mixing the mixture was heated to 80 °C in an oil bath and then the reaction was continued with magnetic stirring for 24 hours. After the reaction is over, cool to room temperature, collect the crude product by filtration, and wash with methanol for several times until the filtrate is almost colorless. Then, the filtered crude product was purified by Soxhlet extraction with methanol for 24 hours, and it was vacuum dried at 80 °C for 6 hours to obtain powder TPP (yield:71.69%).

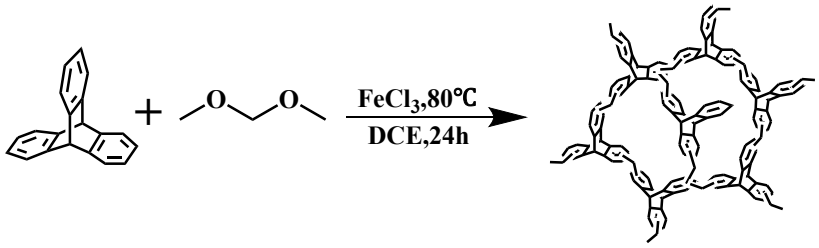


Fig. S1 The schematic representation of synthesis route of triptycene porous polymer TPP

Synthesis of the pyrrole porous polymer (PP)

As shown in Fig. S2, the monomer pyrrole (4mmol, 0.2775mL) in a round bottom flask, and then add 1,2-dichloroethane (20mL) to dissolve the monomers. Formaldehyde dimethyl acetal (FDA, 16 mmol) and anhydrous $FeCl_3$ (16 mmol) were added sequentially to an experimental round bottom flask under nitrogen atmosphere. And after thorough mixing the mixture was heated to 80 °C in an oil bath and then the reaction was continued with magnetic stirring for 24 hours. After the reaction is over, cool to room temperature, collect the crude product by filtration, and wash with methanol for several times until the filtrate is almost colorless. Then, the filtered crude product was purified by Soxhlet extraction with methanol for 24 hours, and it was vacuum dried at 80 °C for 6 hours to obtain powder PP (yield:84.6%).

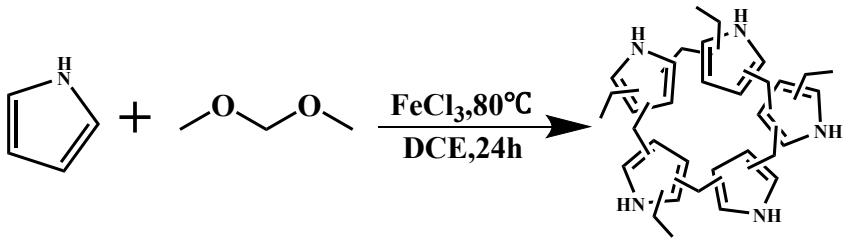


Fig. S2 The schematic representation of synthesis route of pyrrole porous polymer PP

Synthesis of TPP-PP in different proportions

This experiment discusses the adsorption performance of synthetic materials in different ratios. The molar ratio of monomer triptycene and pyrrole is adjusted to 1:1; 1:2; 2:1; 3:2.

Place the monomer triptycene (4mmol, 1.0088g) and pyrrole (4mmol, 0.2775mL) in a round bottom flask, and then add 1,2-dichloroethane (20mL) to dissolve the monomers. Formaldehyde dimethyl acetal (FDA, 16 mmol) and anhydrous $FeCl_3$ (16 mmol) were added sequentially to an experimental round bottom flask under nitrogen atmosphere. And after thorough mixing the mixture was heated to 80 °C in an oil bath and then the reaction was continued with magnetic stirring for 24 hours. After the reaction is over, cool to room temperature, collect the crude product by filtration, and wash with methanol for several times until the filtrate is almost colorless. Then, the filtered crude product was purified by Soxhlet extraction with methanol for 24 hours, and after Soxhlet extraction, it was vacuum dried at 80° C for 6 hours to obtain powder TPP-PP (1:1).

Place the monomer triptycene (4mmol, 1.0088g) and pyrrole (8mmol, 0.555mL) in a round bottom flask, and then add 1,2-dichloroethane (20mL) to dissolve the monomers. Formaldehyde dimethyl acetal (FDA, 16 mmol) and anhydrous $FeCl_3$ (16 mmol) were added sequentially to an experimental round bottom flask under nitrogen atmosphere. And after thorough mixing the mixture was heated to 80 °C in an oil bath and then the reaction was continued with magnetic stirring for 24 hours. After the

reaction is over, cool to room temperature, collect the crude product by filtration, and wash with methanol for several times until the filtrate is almost colorless. Then, the filtered crude product was purified by Soxhlet extraction with methanol for 24 hours, and after Soxhlet extraction, it was vacuum dried at 80 °C for 6 hours to obtain powder TPP-PP (1:2).

Place the monomer triptycene (2mmol, 0.5044g) and pyrrole (4mmol, 0.2775mL) in a round bottom flask, and then add 1,2-dichloroethane (20mL) to dissolve the monomers. Formaldehyde dimethyl acetal (FDA, 16 mmol) and anhydrous FeCl3 (16 mmol) were added sequentially to an experimental round bottom flask under nitrogen atmosphere. And after thorough mixing the mixture was heated to 80 °C in an oil bath and then the reaction was continued with magnetic stirring for 24 hours. After the reaction is over, cool to room temperature, collect the crude product by filtration, and wash with methanol for several times until the filtrate is almost colorless. Then, the filtered crude product was purified by Soxhlet extraction with methanol for 24 hours, and after Soxhlet extraction, it was vacuum dried at 80 °C for 6 hours to obtain powder TPP-PP(2:1).

Place the monomer triptycene (3mmol, 0.7566g) and pyrrole (2mmol, 0.1388mL) in a round bottom flask, and then add 1,2-dichloroethane (20mL) to dissolve the monomers. Formaldehyde dimethyl acetal (FDA, 16 mmol) and anhydrous FeCl3 (16 mmol) were added sequentially to an experimental round bottom flask under nitrogen atmosphere. And after thorough mixing the mixture was heated to 80°C in an oil bath and then the reaction was continued with magnetic stirring for 24 hours. After the reaction is over, cool to room temperature, collect the crude product by filtration, and wash with methanol for several times until the filtrate is almost colorless. Then, the filtered crude product was purified by Soxhlet extraction with methanol for 24 hours, and after Soxhlet extraction, it was vacuum dried at 80 °C for 6 hours to obtain powder TPP-PP(3:2).

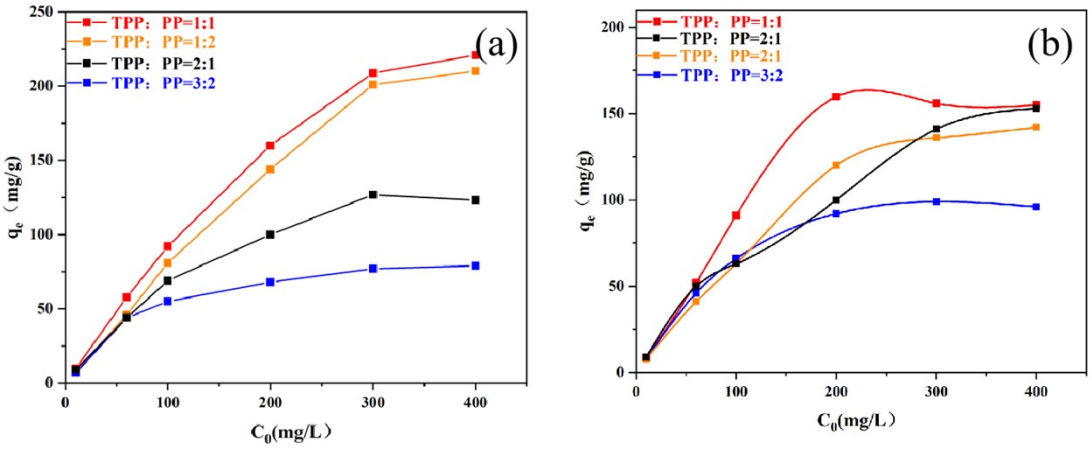


Fig. S3 adsorption capacity of different proportions of TPP-PP to (a) MO and (b)MB

BET

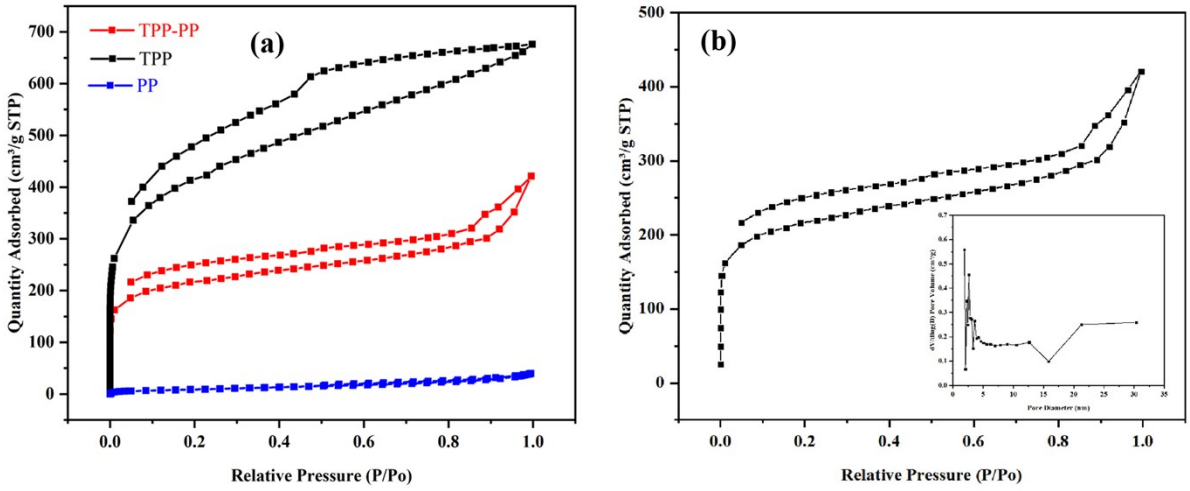


Fig. S4 (a) N_2 adsorption-desorption isotherms of TPP-PP TPP, PP at 77K; (b) N_2 adsorption-desorption isotherms and pore size distributions (in the inset of (d)) of TPP-PP

SEM and TEM

The following figure shows the SEM and TEM plot of the TPP and PP.

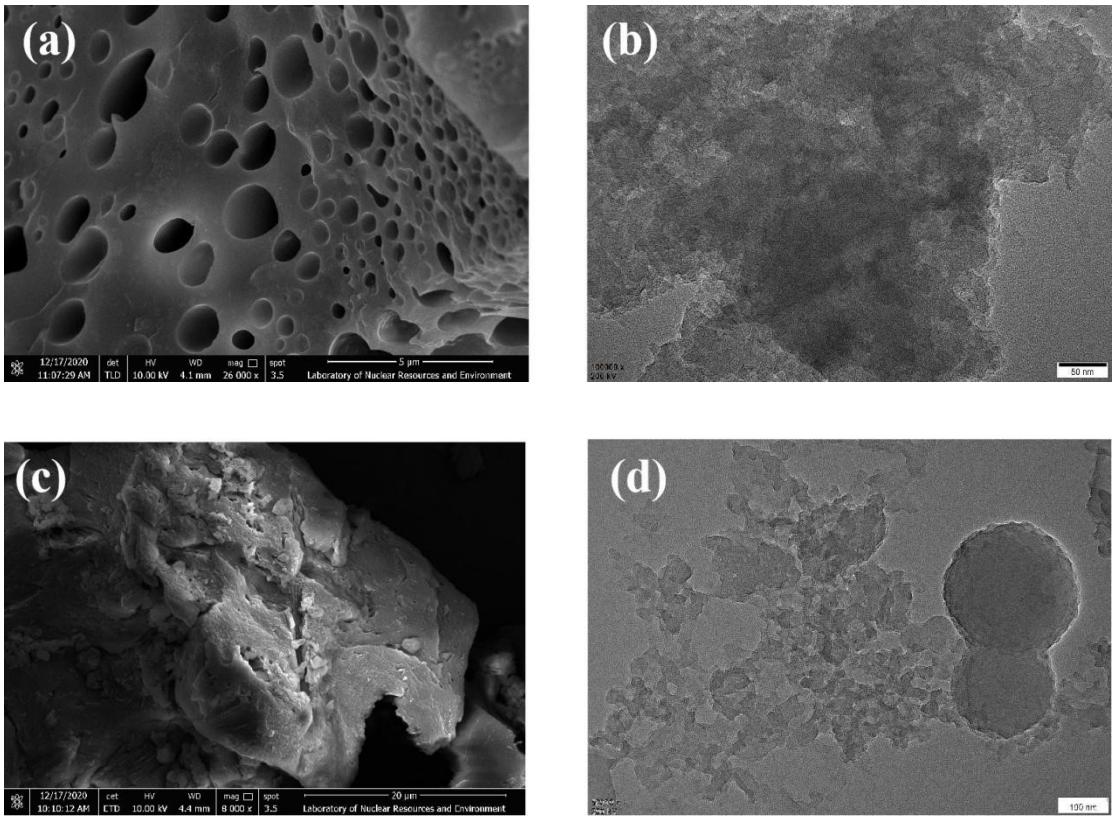


Fig. S5 (a)(b)SEM and TEM images of TPP; (c)(d)SEM and TEM images of PP

NMR analysis of TPP-PP

The NMR analysis of polymer TPP-PP is shown in Fig. S3. The peak at 54 ppm is two bridging carbon atoms a in triptycene; the absorption peak at 104 ppm corresponds to two carbon atoms b in pyrrole opposite to the amino group. It shows that pyrrole was successfully cross-linked on triptycene; the absorption peaks at 128.63 ppm and 144 ppm are aromatic carbon on triptycene; the absorption peak at 178ppm may be the resonance peak of c/d.

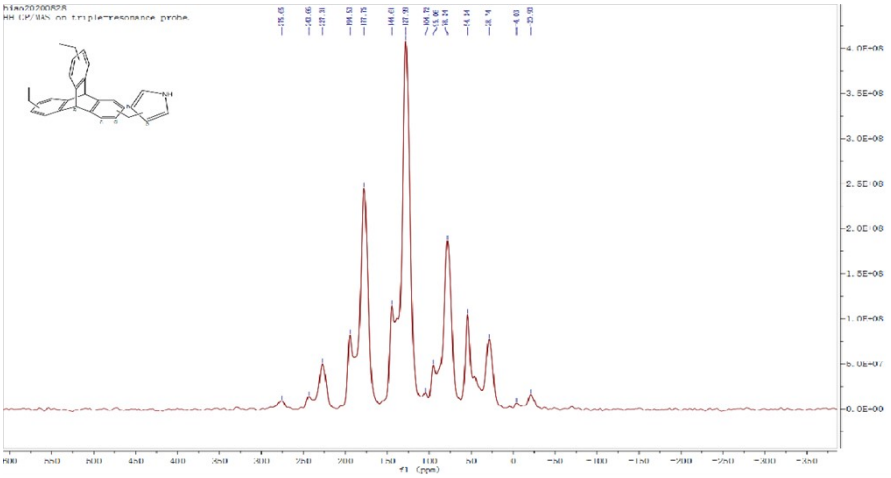
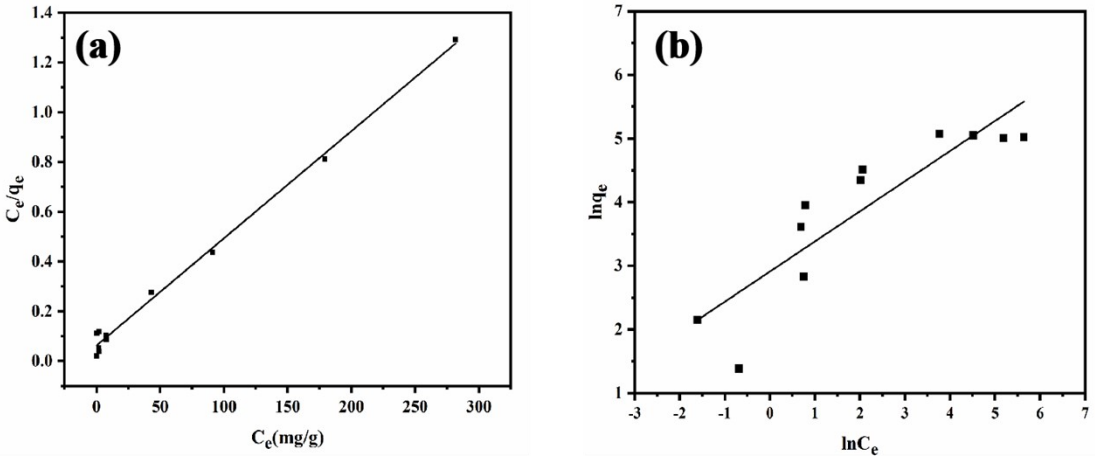
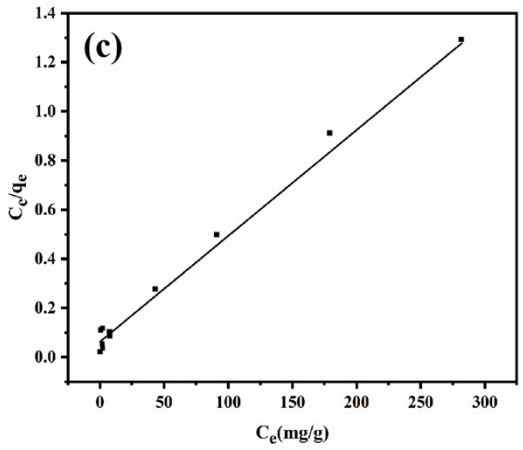
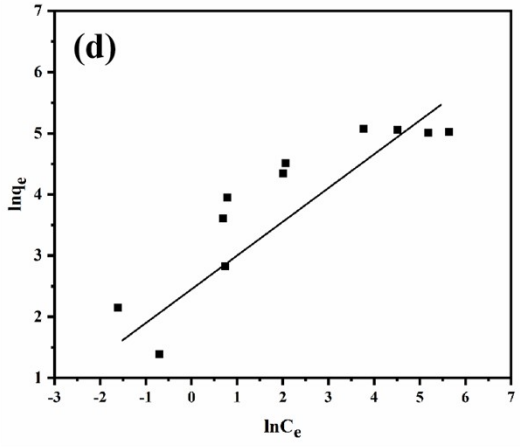


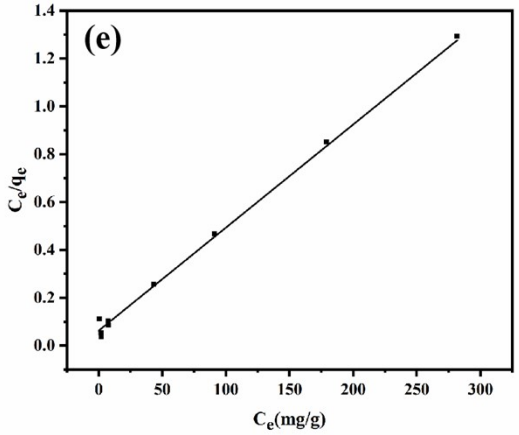
Fig. S6 NMR chart of TPP-PP

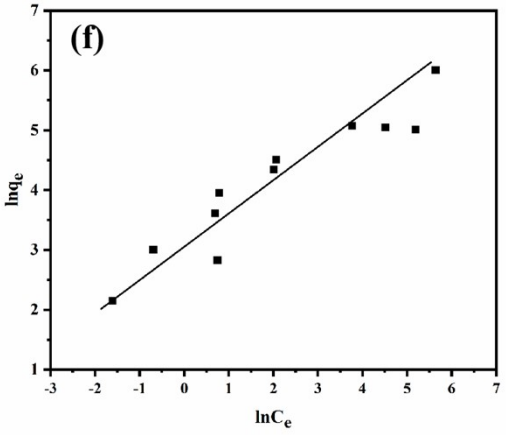
The isothermal adsorption model

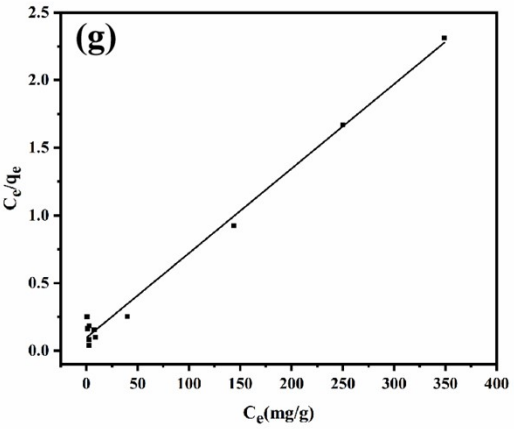


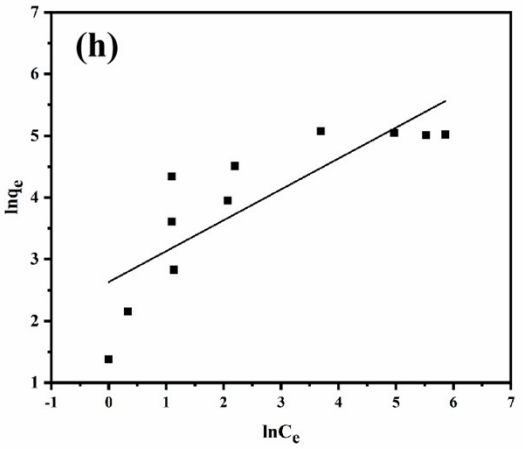

(c)
C_e/q_e
C_e(mg/g)

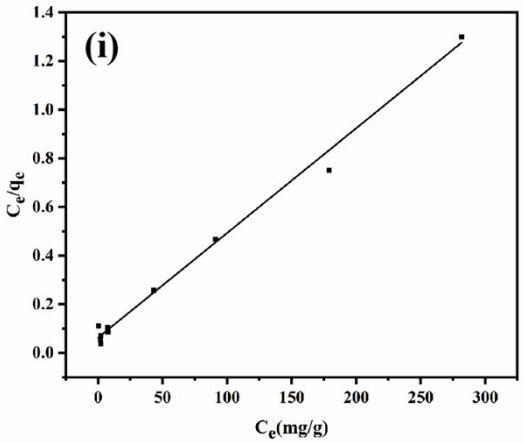

(d)
$\ln q_e$
$\ln C_e$

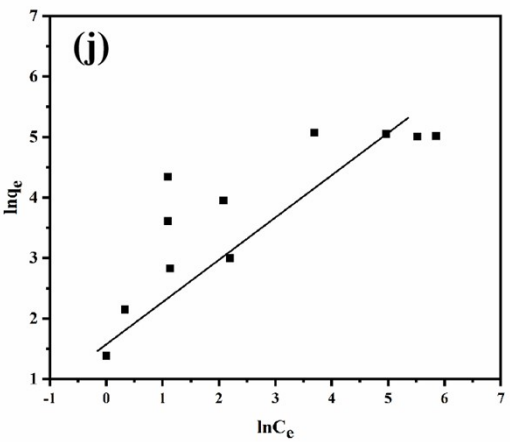

(e)
C_e/q_e
C_e(mg/g)


(f)
$\ln q_e$
$\ln C_e$


(g)
C_e/q_e
C_e(mg/g)


(h)
$\ln q_e$
$\ln C_e$


(i)
C_e/q_e
C_e(mg/g)


(j)
$\ln q_e$
$\ln C_e$

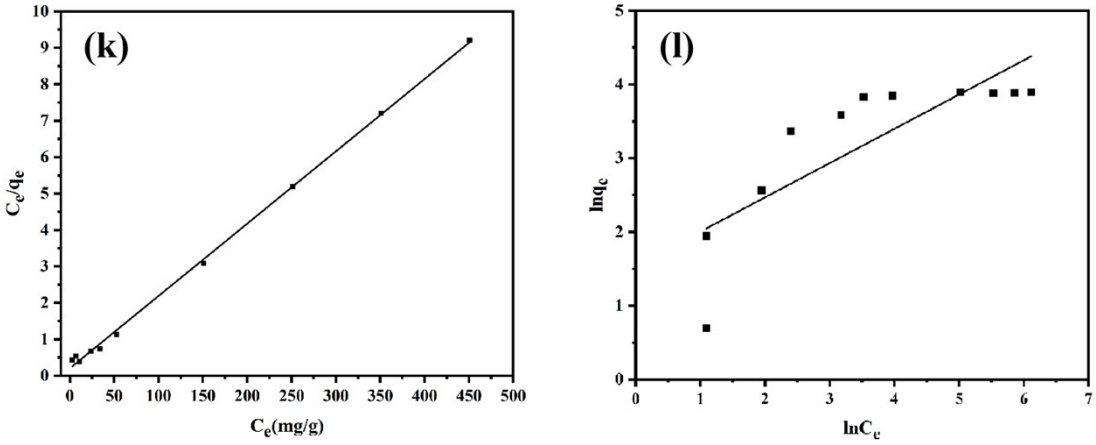


Fig. S7 (a)(b)(c)(d)(e)(f) are the Langmuir and Freundlich adsorption models of TPP-PP, TPP, and PP on MO respectively, (g)(h)(i)(j)(k)(l) are the Langmuir and Freundlich adsorption models of TPP-PP, TPP, and PP on MB respectively

Dynamics adsorption

In kinetic studies, fitting the kinetic data with the quasi-primary and quasi-secondary kinetic models yields the following data showing that the adsorption process of TPP-PP ， TPP and PP can be well described by the quasi-secondary kinetic model.

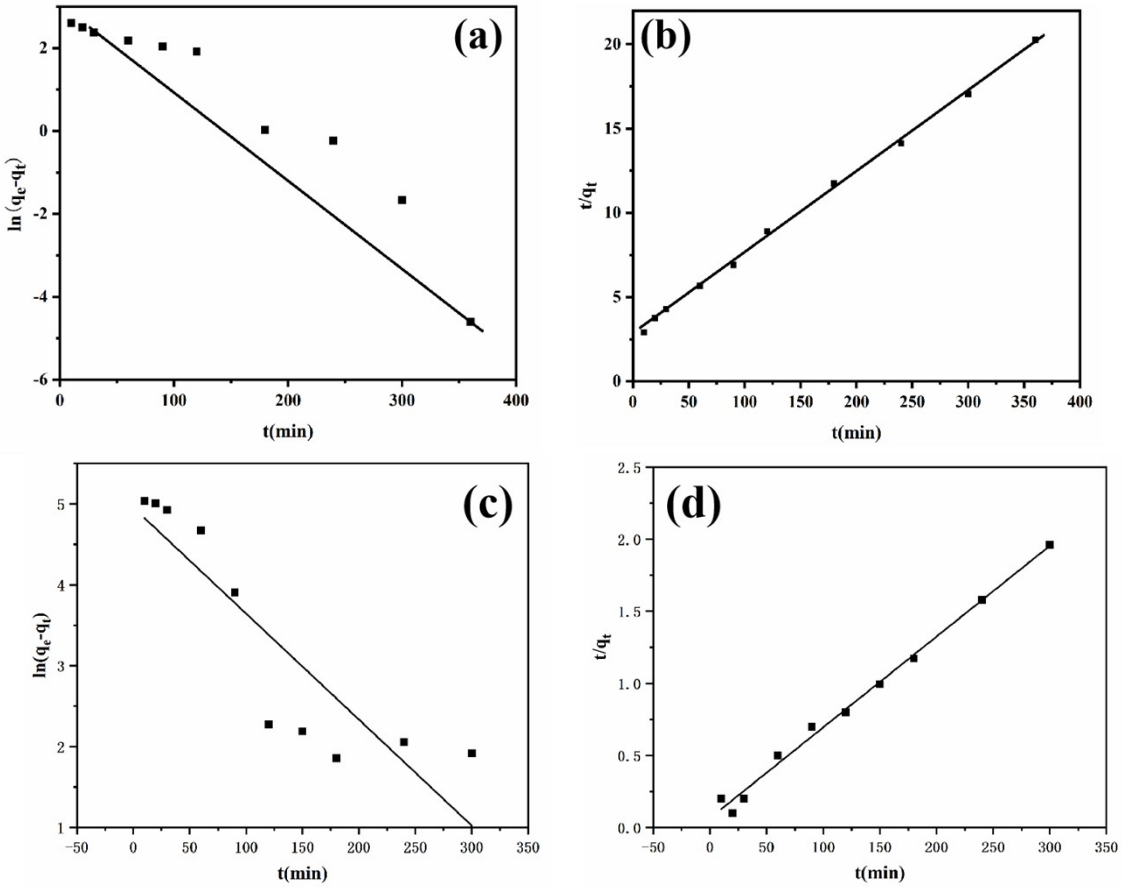


Fig.S8 (a)(b) is the quasi-first-order kinetic model and quasi-second-order kinetic model of TPP-PP for MO, (c)(d) is the quasi-first-order kinetic model and quasi-second-order kinetic model of TPP-PP for MB

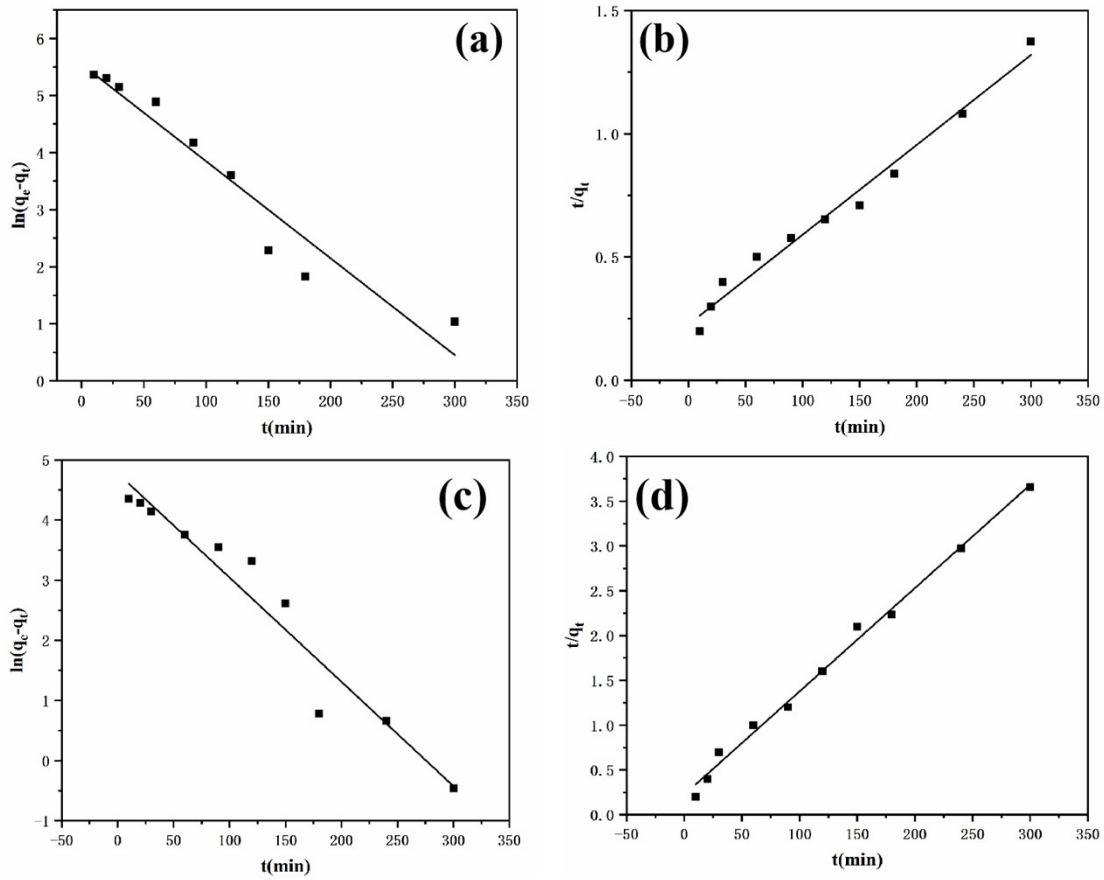
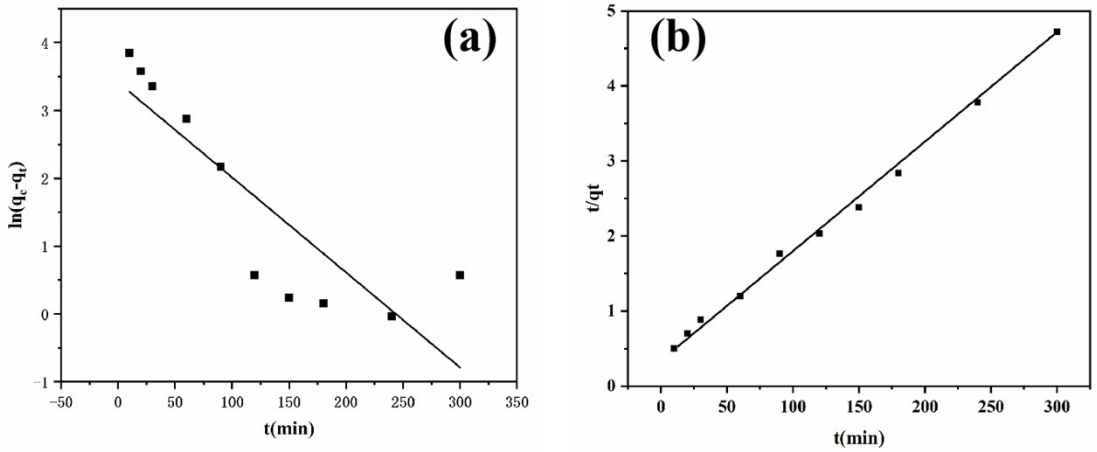


Fig.S9 (a)(b) is the quasi-first-order kinetic model and quasi-second-order kinetic model of TPP for MO, (c)(d) is the quasi-first-order kinetic model and quasi-second-order kinetic model of TPP for MB



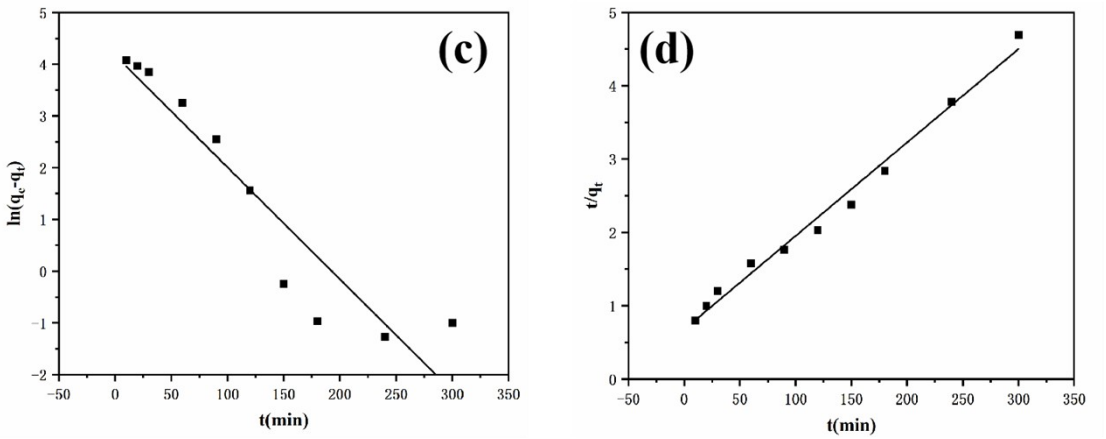


Fig.S10 (a)(b) is the quasi-first-order kinetic model and quasi-second-order kinetic model of PP for MO, (c)(d) is the quasi-first-order kinetic model and quasi-second-order kinetic model of PP for MB

Tables:

TableS1 Pseudo-second-order kinetic and pseudo -first-order kinetic parameters for the adsorption of MB and MO on TPP-PP,TPP and PP

	pseudo -first-order kinetic model of the MO			A pseudo-second kinetic model of the MO			pseudo -first-order kinetic model of the MB			pseudo-second kinetic model of the MB		
	q_e（mg/g）	K_1	R^2	K_2	q_e/(mg/g)	R^2	q_e（mg/g）	K_1	R^2	K_2	q_e/(mg/g)	R^2
TPP-PP	221.86	0.0158	0.9083	0.00086	20.6654	0.9985	150.89	0.0235	0.9271	0.00061	158.7301	0.9916
TPP	82.41	0.0184	0.9051	0.00006	273.9726	0.9796	105.78	0.0146	0.9021	0.00004	170.9402	0.9567
PP	49.75	0.01878	0.6044	0.00052	70.9220	0.9965	64.31	0.0198	0.9335	0.00024	78.4929	0.9861

TableS2 The Langmuir model and Freundlich model parameters for the adsorption of MB and MO on TPP-PP,TPP and PP

	The Langmuir model of the MO			The Freundlich model of the MO			The Langmuir model of the MB			The Freundlich model of the MB		
	q_m（mg/g）	K_L	R^2	K_F	1/n	R^2	q_m（mg/g）	K_L	R^2	K_F	1/n	R^2
TPP-PP	232.02	0.0692	0.9934	18.3210	0.4734	0.7683	160.01	0.0654	0.9894	9.7769	0.5401	0.7013
TPP	74.62	0.1225	0.9864	20.4875	0.2407	0.8606	101.03	0.0672	0.9911	6.3778	0.5257	0.709
PP	51.86	0.5021	0.9834	4.6568	0.4647	0.6243	50.35	0.0989	0.9986	7.4494	0.4079	0.5847