Supporting Information (SI)

Fast adsorption of methylene blue, basic fuchsin, and malachite green by a novel sulfonic-grafted triptycene-based porous organic polymer

Cheng Li, a Yan He,* a,b Li Zhou, a Ting Xu, a Jun Hu, a Changjun Peng,** Honglai Liu a

a: Key Laboratory for Advanced Materials and Department of Chemistry, East China University of Science and Technology, Shanghai, 200237, China
b: Jiangxi Province Key Laboratory of Polymer Micro/Nano Manufacturing and Devices, School of Chemistry, Biology and Materials Science, East China University of Technology, Nanchang 330013, People's Republic of China

Fig. S1 XRD of TPP-SO\textsubscript{3}H.

Fig. S2 TGA of TPP-SO\textsubscript{3}H.

Fig. S3 FT-IR for TPPs and TPP-SO\textsubscript{3}H.

Fig. S4 XPS survey spectra of TPP and TPP-SO\textsubscript{3}H.

Fig. S5 \textsuperscript{13}C CP/MAS NMR spectrum of TPPs and TPP-SO\textsubscript{3}H.

Fig. S6 The plots of the pseudo-first-order kinetics for the adsorption of MEB, BF, and MG.

Fig. S7 The ESP surfaces of TPP-SO\textsubscript{3}H and dyes MEB, BF, and MG.

Fig. S8 Optimized structures for the complexes.

Fig. S9 Adsorption isotherms of MEB, BF, and MG on TPP and TPP-SO\textsubscript{3}H based on Freundlich isotherm model.

Table S1 The porosity properties of TPP-SO\textsubscript{3}H and TPP.

Table S2 Comparison of MEB, BF and MG equilibrium rate constants among different adsorbents.

Table S3 Adsorption kinetic model parameters for MEB, BF, and MG.

Table S4 Parameters of Langmuir's equation and Freundlich model's equation base on TPP-SO\textsubscript{3}H.
Fig. S1 XRD of TPP-SO$_3$H
Fig. S2

Fig. S2 TGA of TPP-SO$_3$H
Fig. S3

Fig. S3 FT-IR spectra of TPP (Black), TPP-SO$_3$H (red)
Fig. S4 XPS survey spectra of (a) TPP and TPP-SO$_3$H; (b) S2p spectra of TPP-SO$_3$H
Fig. S5

Fig. S5 $^{13}$C CP/MAS NMR spectrum of TPP and TPP-SO$_3$H
Fig. S6

Fig. S6 The plots of the pseudo-first-order kinetics for the adsorption of MEB, BF and MG.
It is well-known that in the diagrams of ESP surfaces, red represents negative ESP which has an ability to absorb cations. On the contrary, blue means positive ESP to absorb anions.
Fig. S8 Optimized structures for the complexes (unit is Å)
Fig. S9 Adsorption isotherms of MEB, BF and MG on TPP and TPP-SO$_3$H based on Freundlich isotherm model
Table S1

Table S1 The porosity properties of TPP-SO$_3$H

| Polymer  | SA$_{BET}$(m$^2$.g$^{-1}$) | $V_b$(cm$^3$.g$^{-1}$) | $V_m$ (cm$^3$.g$^{-1}$) | $\% V_m/V_t$ |
|----------|-----------------------------|------------------------|-------------------------|---------------|
| TTP-SO$_3$H | 573.3 | 0.3084 | 0.2299 | 70.5 |
| TTP      | 1220.1 | 0.9633 | 0.1941 | 20.2 |

a: surface area calculated by the BET equation; b: pore volume at $p/p_0 = 0.99$; c: micropore volume obtained by t-plot.
| Adsorbents                  | equilibrium rate constants $K_2$ (g·mg$^{-1}$·min$^{-1}$) | Ref. |
|-----------------------------|------------------------------------------------------------|-----|
| MEB                         | MEB: $1 \times 10^{-3}$, BF: $4.6 \times 10^{-4}$, MG: $3.25 \times 10^{-4}$ | 1   |
| BF                          | BF: $4.11 \times 10^{-4}$, MG: $9.515 \times 10^{-5}$ | 2   |
| MG                          | MG: $7.5 \times 10^{-4}$, BF: $2 \times 10^{-3}$ | 3   |
| CMt porous carbon           | CMt: $1 \times 10^{-3}$, BF: $4.6 \times 10^{-4}$, MG: $3.25 \times 10^{-4}$ | 4   |
| MIL-100-SO$_2$H             | MIL-100-SO$_2$H: $4.11 \times 10^{-4}$, BF: $3.25 \times 10^{-4}$ | 5   |
| calcium alginate membrane   | calcium alginate membrane: $9.515 \times 10^{-5}$, BF: $1.4 \times 10^{-3}$ | 6   |
| Fe$_3$O$_4$@ AMCA-MIL-53(Al) | Fe$_3$O$_4$@ AMCA-MIL-53(Al): $7.5 \times 10^{-4}$, BF: $1.4 \times 10^{-3}$ | 7   |
| TSF-HMMS                    | TSF-HMMS: $2 \times 10^{-3}$, BF: $9.79 \times 10^{-4}$ | 8   |
| bottom ash                  | bottom ash: $9.79 \times 10^{-4}$, BF: $9.3 \times 10^{-3}$ | 9   |
| TPP-SO$_3$H                 | TPP-SO$_3$H: $2.6 \times 10^{-3}$, BF: $1.49 \times 10^{-2}$, MG: $9.3 \times 10^{-3}$ | This work |

**Table S2**

Comparison of MEB, BF and MG equilibrium rate constants among different adsorbents.
Table S3 Adsorption kinetic model parameters for MEB, BF, and MG

| Dyes  | $q_{eq}^{(exp)}$ (mg·g$^{-1}$) | Pseudo-first-order kinetic model | Pseudo-second-order kinetic model |
|-------|------------------------------|---------------------------------|----------------------------------|
|       | $q_{e}^{(cal)}$ (mg·g$^{-1}$) | $K_1$(min$^{-1}$) | $R^2$ | $q_{e}^{(cal)}$ (mg·g$^{-1}$) | $K_2$(g·mg$^{-1}$·min$^{-1}$) | $R^2$ |
| MEB   | 199.44 | 27.47 | 0.0158 | 0.907 | 199.60 | 0.0026 | 0.997 |
| BF    | 198.36 | 24.84 | 0.0173 | 0.698 | 198.02 | 0.0149 | 0.999 |
| MG    | 596.77 | 14.71 | 0.0135 | 0.628 | 591.72 | 0.0093 | 0.999 |
| Dyes     | $q_{eq}^{(exp)}$ (mg·g⁻¹) | $q_{eq}^{(cal)}$ (mg·g⁻¹) | $K_L$ (g·mg⁻¹) | $R^2$ | $1/n_F$ | $K_F$ (mg·g⁻¹) | $R^2$ |
|----------|---------------------------|---------------------------|-----------------|-------|---------|----------------|-------|
| TPP      |                           |                           |                 |       |         |                |       |
| MEB      | 177.99                    | 178.89                    | 0.079           | 0.998 | 0.485   | 20.994         | 0.946 |
| BF       | 197.01                    | 196.08                    | 0.103           | 0.997 | 0.070   | 81.280         | 0.861 |
| MG       | 1077.04                   | 1079.42                   | 0.515           | 0.999 | 0.250   | 302.348        | 0.887 |
| TPP-SO₃H |                           |                           |                 |       |         |                |       |
| MEB      | 981.81                    | 983.43                    | 0.308           | 0.999 | 0.070   | 626.714        | 0.840 |
| BF       | 586.16                    | 588.24                    | 0.224           | 0.999 | 0.113   | 265.316        | 0.937 |
| MG       | 1942.50                   | 1947.02                   | 0.162           | 0.999 | 0.101   | 1003.702       | 0.887 |

References:
1 D. S. Tong, C. W. Wu, M. O. Adebajo, J. C. Jin, W. H. Yu, S. F. Ji, C. H. Zhou, Applied Clay Science, 2018, 161, 256–264.
2 B. Chen, Z. Yang, G. Ma, D. Kong, W. Xiong, J. Wang, Y. Zhu, Y. Xia, Microporous Mesoporous Mater., 2018, 257, 1–8.
3 X. P. Luo, S. Y. Fu, Y. M. Du, J. Z. Guo, B. Li, Microporous Mesoporous Mater., 2017, 237, 268–274.
4 Q. Li, Y. Li, X. Ma, Q. Du, K. Sui, D. Wang, C. Wang, H. Li, Y Xia, Chem. Eng. J., 2017, 316, 623–630.
5 A. A. Alqadami, M. Naushad, Z. A. Aloothman, T. Ahamad, J. Environ. Manage., 2018, 223, 29–36.
6 H. Zhang, X. Li, G. He, J. Zhan, and D. Liu. Ind. Eng. Chem. Res., 2013, 52, 16902–16910.
7 V. K. Gupta, A. Mittal, V. Gajbe, J. Mittal, J. Colloid Interf. Sci., 2008, 319, 30–39.