Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

One-dimensional controllable crosslinked polymers grafted with N-methyl-D-glucamine for effective boron adsorption

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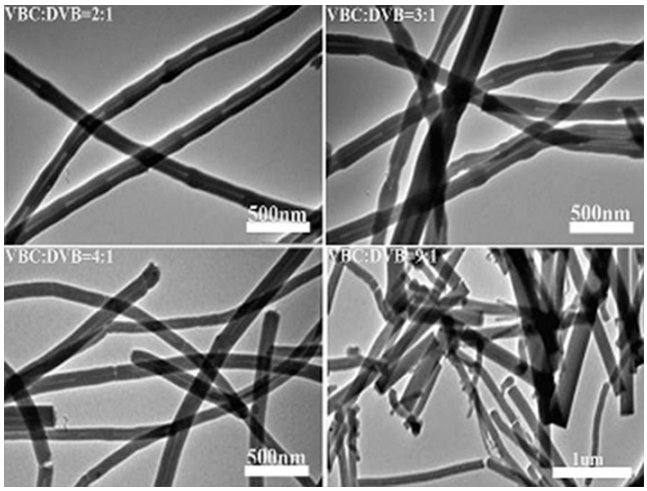


Fig. S1 TEM images of polymers with different mass ratios

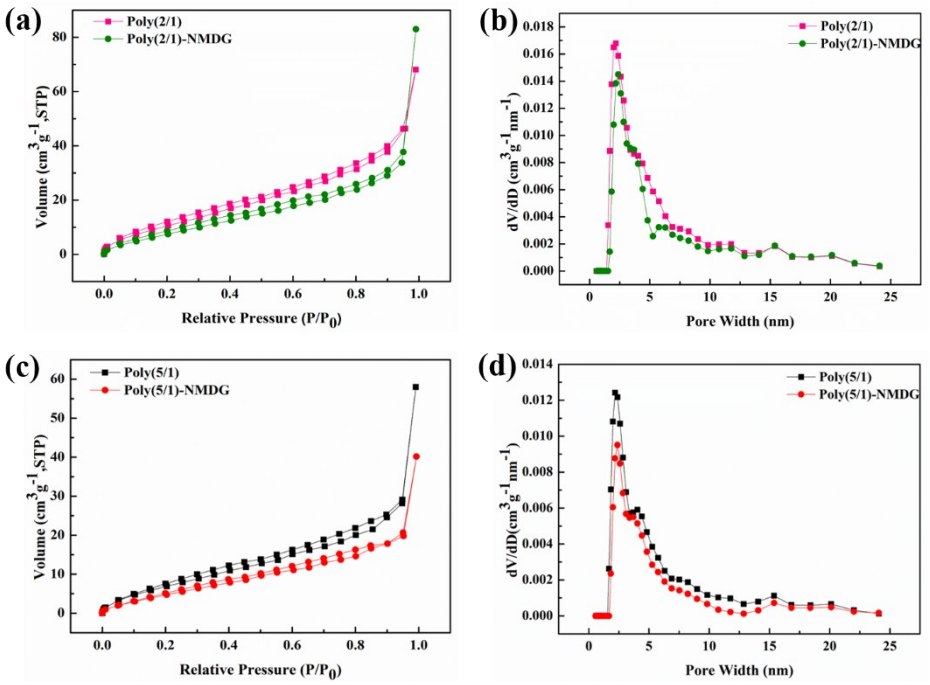


Fig. S2 N_2 adsorption/desorption isotherms and pore size distribution (a, b) Poly(2/1) and Poly(2/1)-NMDG, respectively; and (c, d) Poly(5/1) and Poly(5/1)-NMDG), respectively.

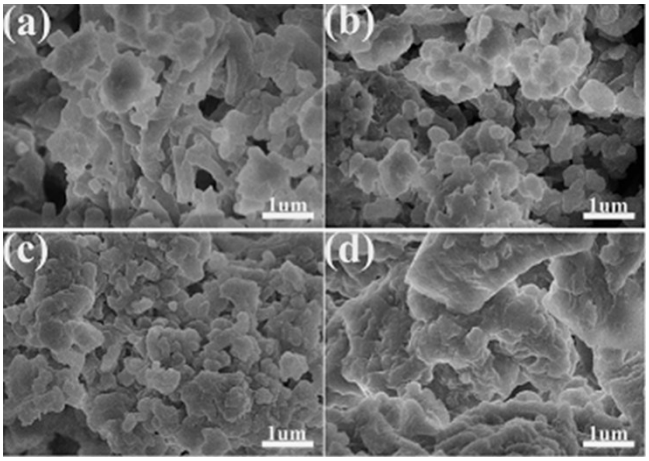


Fig. S3 SEM images of Poly(5/1)-NMDG before sorption (a) and after four cycles (b); Poly(6/1)-NMDG before sorption (c) and after four cycles (d)

Part. S1

During the regeneration of adsorbents, Poly(5/1)-NMDG (0.7 g) and Poly(6/1)-NMDG (0.7 g) were added into 70 mL of 500 mg L^{-1} H_3BO_3 solution at pH=8, this solution was oscillated (200 rpm) for 24 h at room temperature. After filtration, the solution and sorbents were collected, respectively. The loaded sorbents were eluted with 70 mL HCl (1 mol L^{-1}) and NaOH (1 mol L^{-1}) solution, respectively. After filtration, the adsorbents were washed to neutrality with water and alcohol, and dried in oven for 24 h. Then, the regenerated sorbents were reused in the next adsorption experiments.

To study the influence of pH on boron removal, 250 mg L^{-1} H_3BO_3 solutions with different pH values (4, 5, 6, 7, 8, 9, 10±0.05) were prepared. The Poly(5/1)-NMDG adsorbent (0.1 g) was added into the 10 mL H_3BO_3 solution with different pH values, respectively. The mixture was oscillated (200 rpm) for 24 h at room temperature.

For adsorption isotherm experiments, the sorbent (0.1 g) was added into 10 mL different concentration boric acid (5, 10, 20, 50, 100, 200, 250, 350, 500 mg L^{-1}) solutions at pH=9, room temperature. The mixture reacted for 24 h. The boron concentration of the filtrate was measured once the equilibrium reached.

The adsorption kinetic experiments were carried out by adding 0.1g sorbents into the 10 mL boric acid solution (350 mg L^{-1}) at pH=9. They were oscillated (200 rpm) for different time (10, 20, 30, 60, 120, 240, 480, 720 min) at room temperature. After the filtration, all the liquids were tested to obtain the boron concentration.

Part. S2

Langmuir eqn (2) and Freundlich eqn (3) are shown below:

$$\frac{C_e}{Q_e} = \frac{1}{Q_m} C_e + \frac{1}{K_L Q_m} \tag{2}$$

$$\lg Q_e = \frac{1}{n} \lg C_e + \lg K_F \tag{3}$$

Here, C_e is the equilibrium concentration, Q_e denotes the equilibrium adsorption capacity, Q_m is the maximum adsorption capacity, K_L represents the Langmuir isothermal constant, K_F and n are Freundlich constants related to adsorption capacity and adsorption rate.

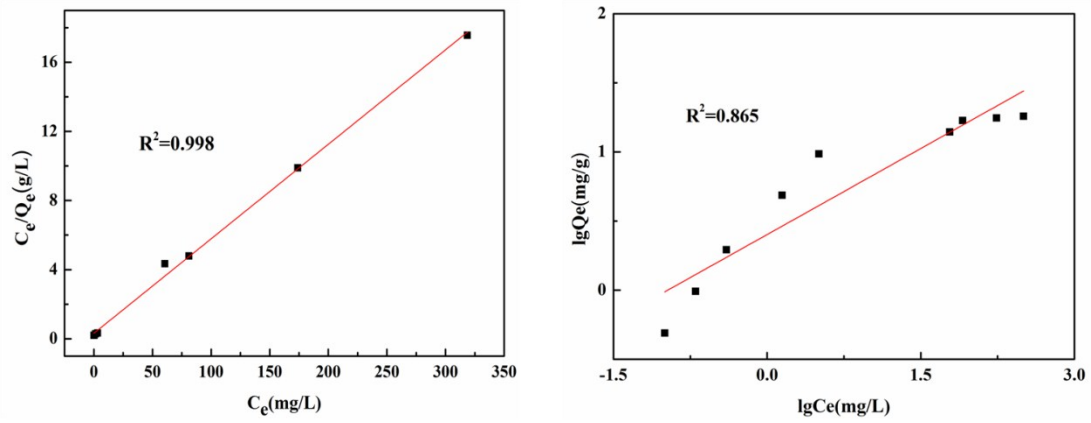


Fig. S4 Isotherm adsorption curves of the Langmuir (a) and Freundlich (b) models

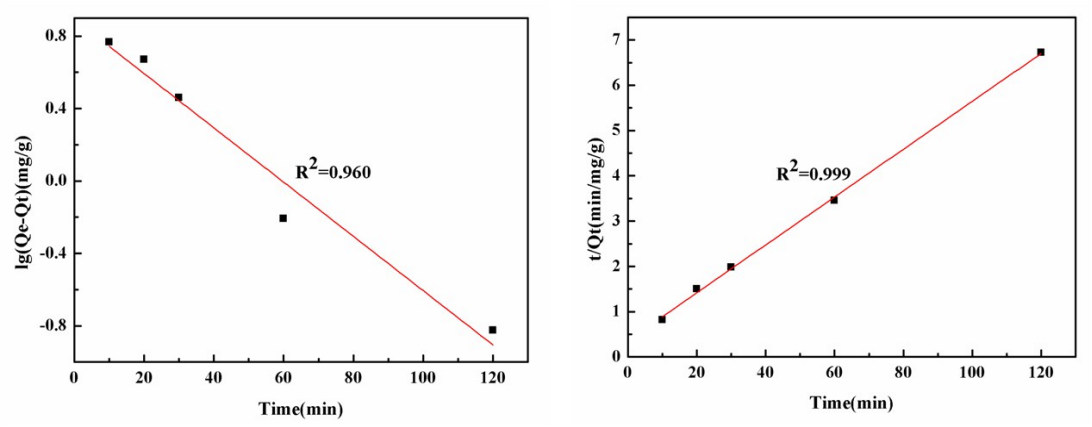
Part. S3

Pseudo-first-order kinetic eqn (4) and pseudo-second-order kinetic eqn (5):

$$\lg(Q_e - Q_t) = \lg Q_e - \frac{k_1}{2.303} t \quad (4)$$

$$\frac{t}{Q_t} = \frac{1}{k_2 Q_e^2} + \frac{1}{Q_e} t \quad (5)$$

Here, Q_e is equilibrium capacity, Q_t is boron adsorption at different time, k_1 and k_2 are pseudo-first-order kinetics and pseudo-second-order kinetics adsorption rate constant respectively.



(a) (b)

Fig. S5 Fitting curves of the pseudo-first-order (a) and pseudo-second-order (b) kinetics

Table S1. Adsorption conditions and adsorption capacity of magnetic boron adsorbents

Sample	*PH*	*C_0 (mg L^{-1})*	*t (min)*	*T (°C)*	*Adsorption (mg g^{-1})*
Poly(2/1)@Fe_3O_4-NMDG	8	350	120	20	5.4