Highly efficient and rapid Pb (II) removal from acidic wastewater using superhydrophilic polystyrene phosphate resin

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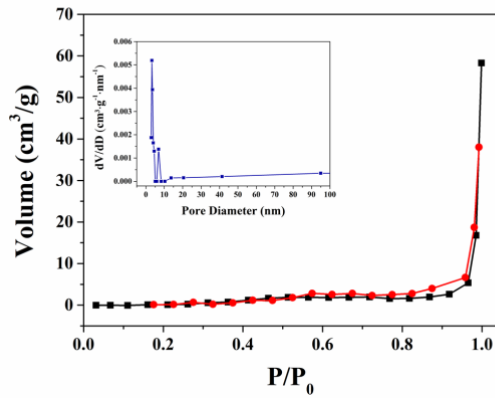* **Corresponding author:** E-mail: ism_jiangxc@ujn.edu.cn (X.C. Jiang), chm_cuiy@ujn.edu.cn (Y. Cui)

Fig. S1 N_2 adsorption–desorption isotherms of PSP (inset: the corresponding pore size distribution curves).
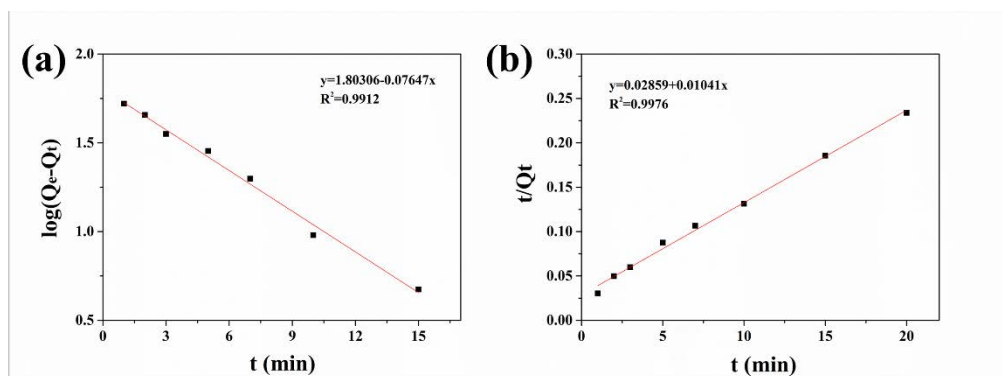

Fig. S2 Fitting kinetic curves of PSP for Pb(II) (a) pseudo-first-order model (b) pseudo-second-order model (Pb(II)=100 mg·L^{-1}, pH=4, 25 ^{o}C).
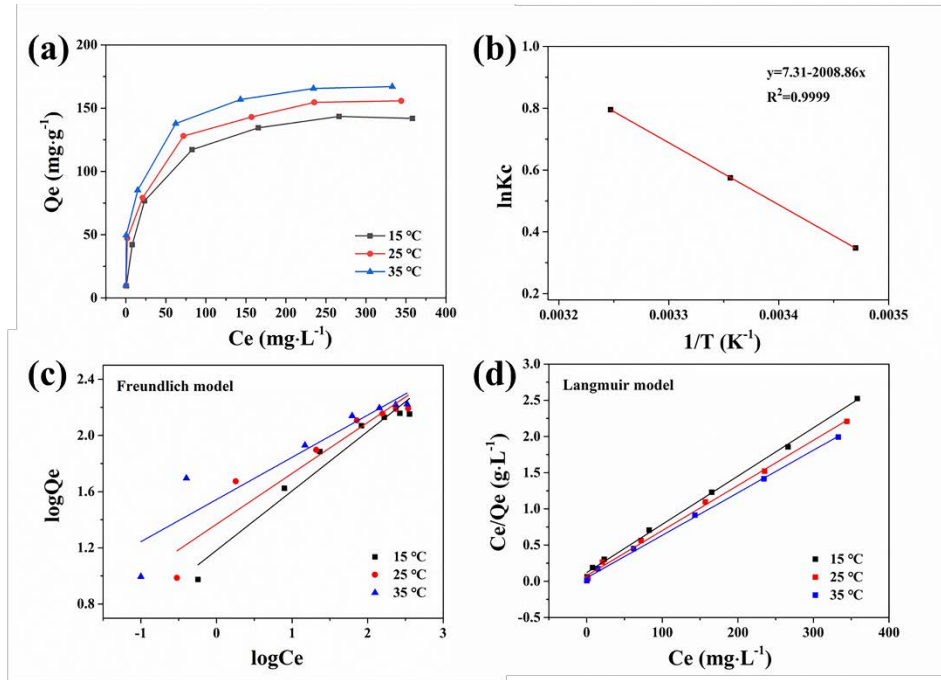
Fig. S3 (a) Adsorption isotherms of Pb(II) on PSP resin. (b) Fitting plot between 1/T and lnKc. The linear fitting plots of (c) Langmuir isotherm model (d) Freundlich isotherm model.
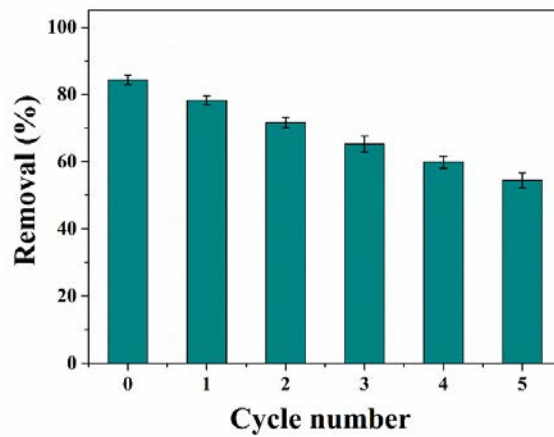

Fig. S4 Removal ratio of Pb(II) at different regeneration cycles (Pb(II)=100 mg·L^{-1}, pH=4, 25 $^{\circ}$C).

Table S1. The removal ratio and distribution coefficients of PSP for six metal ions.

Metal ion	Pb(II)	Cu(II)	Cd(II)	Zn(II)	Ni(II)	Co(II)
R (%)	76.5	42.9	51.6	31	16.1	9.3
K_d (mL·g^{-1})	3.2510	0.7526	1.0650	0.4499	0.1920	0.1032

Table S2. Parameters of linear pseudo-first-order model and pseudo-second-order model fitting.

Metal ion	C_0 (ppm)	Q_{exp} (mg·g^{-1})	Pseudo-first-order model			Pseudo-second-order model		
			K_1 (min^{-1})	Q_{cal} (mg·g^{-1})	R^2	K_2 (g·mg^{-1}·min^{-1})	Q_{cal} (mg·g^{-1})	R^2
Pb(II)	100	85.6	0.1761	63.54	0.9912	0.0038	96.06	0.9976

Table S3. Parameters of non-linear Langmuir and Freundlich isotherm models fitting for Pb(II) adsorption at 15 °C, 25 °C, 35 °C.

Isotherm model	Parameters	Temperature		
		15 °C	25 °C	35 °C
Langmuir	R^2	0.9981	0.9965	0.9976
	K_L (L·mg^{-1})	0.0557	0.0810	0.1241
	q_{max} (mg·g^{-1})	149.92	160.25	170.07
Freundlich	R^2	0.9461	0.8967	0.8542
	K_F (mg·g^{-1})	15.2086	23.3308	35.0130
	n	2.3625	2.7605	3.3278

Table S4. The thermodynamic parameters for the adsorption of Pb (II).

T (K)	ΔG (kJ mol^{-1})	ΔH (kJ mol^{-1})	ΔS (J mol^{-1} K^{-1})
288	-0.80		
298	-1.41	16.70	60.78
308	-2.02		