New Journal of Chemistry

Electronic Supplementary Information

Phosphate-crosslinked β-cyclodextrin polymer for highly efficient removal of Pb(II) from acidic wastewater

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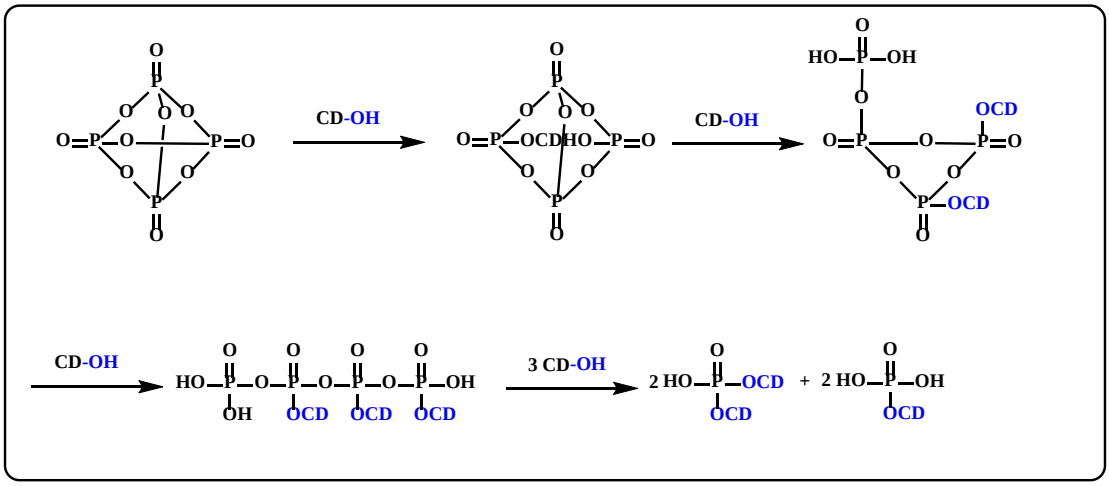

Fig. S1 The synthesis mechanism diagram of β-CDPP.

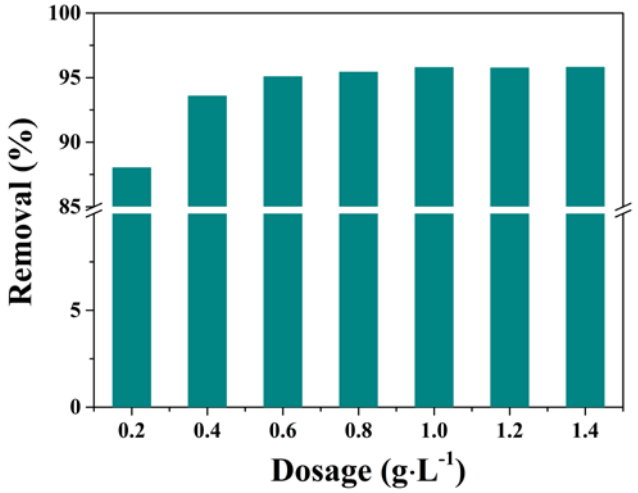

Fig. S2 Effect of adsorbent dosage on the removal ratio of Pb(II) (Pb(II)=100 mg·L^{-1}, pH=3, 25 °C).

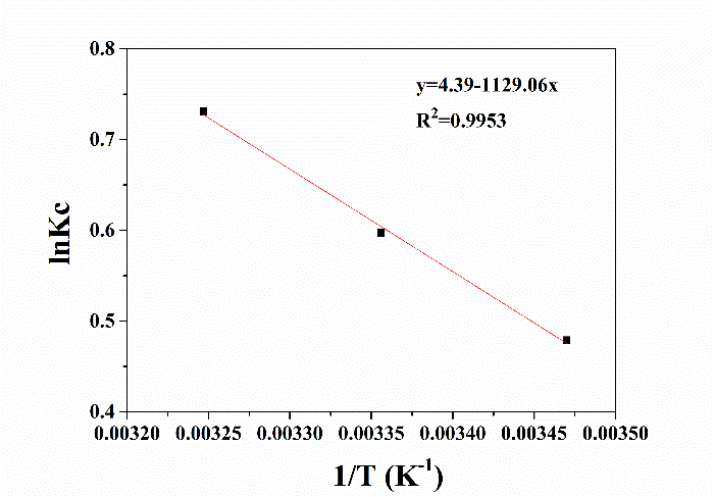

Fig. S3 Fitting plot between 1/T and lnKc.

Table S1. The amount of solid product under different feeding ratios (β-CD=2 g).

β-CD:P_2O_5 (molar ratio)	1:5	1:6	1:8	1:10	1:12	1:14	1:20
Solid product (g)	0	0.02	1.19	2.50	1.88	1.46	0

Table S2. Related parameters from kinetics equation.

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^{2+}	100	95.0	0.3842	90.0	0.9108	0.0054	101.5	0.9887

Table S3. Parameters of non-linear Langmuir, Freundlich, Redlich-Peterson and Sips 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	0.9831	0.9715	0.9680
	K_L (L·mg^{-1})	0.0192	0.0285	0.0587
	q_{max} (mg·g^{-1})	602.11	602.02	578.29
Freundlich	R^2	0.8895	0.8837	0.8620
	K_F (mg·g^{-1})	64.1136	89.4064	128.8998
	n	2.6635	3.0356	3.6550
Redlich-Peterson	R^2	0.9920	0.9765	0.9634
	a_R (mg^{-1})	0.0035	0.0071	0.0399
	K_R (L·g^{-1})	8.5496	12.7052	30.1098
	β	1.2409	1.1937	1.0494
Sips	R^2	0.9861	0.9675	0.9623
	β_S	1.2144	1.1290	1.0780
	K_S (L·mg^{-1})	0.0101	0.0197	0.0490
	q_{ms} (mg·g^{-1})	553.34	576.92	566.85

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	-1.12		
298	-1.49	9.39	36.50
308	-1.85		

Table S5. The removal rate and distribution coefficients of β-CDPP for various metal ions.

Metal ion	Pb(II)	Cu(II)	Cd(II)	Zn(II)	Co(II)	Ni(II)
M^{n+} removal (%)	89.4	64.6	61.6	55.2	46.0	42.4
K_d (mL·g^{-1})	8.48	1.83	1.59	1.23	0.85	0.72

Table S6. The P leaching amount of adsorbent at different pH values.

pH	1	2	3	4	5	6
P content (ppm)	0	0	0	0	0	0