Electronic Supporting Information

Amidoxime-functionalized magnetic mesoporous silica for selective sorption of U(VI)

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Materials

2-Cyanoethyltriethoxysilane (CTES) was purchased from J&K Scientific Co., Ltd. $FeCl_3 \cdot 6H_2O$, NaAc, ethylene glycol, trisodium citrate (Na_3Cit), polyethylene glycol, ethanol, $NH_3 \cdot H_2O$, tetraethyl orthosilicate (TEOS), cetyltrimethylammonium bromide (CTAB), NH_4NO_3, $NH_2OH \cdot HCl$ and K_2CO_3 were purchased from Sinopharm Chemical Reagent Co., Ltd. All reagents were used without further purification.

Preparation of silica-coated magnetic nanoparticles (Fe_3O_4@$nSiO_2$)

The magnetic Fe_3O_4 core was prepared by the solvothermal method. Briefly, 1.35 g $FeCl_3 \cdot 6H_2O$ was dissolved in 40 mL ethylene glycol followed by the addition of 3.6 g NaAc and 1.0 g polyethylene glycol. The mixture was stirred until the solution became transparent, sealed in an autoclave, heated to 180 °C and maintained at 180 °C for 8 h. The resulted products were washed with Milli-Q water and ethanol alternatively, and dried in vacuum at 60 °C. The core-shell structured Fe_3O_4@nSiO_2 microspheres were synthesized through a modified Stöber method. In a typical process, 0.1 g of the as-prepared Fe_3O_4 particles were dispersed in a mixture of ethanol (100 mL), Milli-Q water (25 mL), and $NH_3 \cdot H_2O$ (1.5 mL) with the help of ultrasonication. Afterward, 1 mL TEOS was added dropwise and the reaction was allowed to proceed for 6 h under stirring. The product was collected by centrifugation and rinsed with Milli-Q water and ethanol several times, and then dried under vacuum at 60 °C for 6 h prior to further use.

Leaching and regeneration experiments

To carry out the leaching experiment, 20 mg of adsorbents was dispersed in 50 ml of HCl solutions with different concentrations. After specific contact time, the suspension was separated and the leached iron concentration in the supernatant was determined by AAS. For desorption experiments, the solid residue of sorption experiments was thoroughly rinsed with Milli-Q water and mixed with HCl solutions at 25 °C under vibrating condition for 24 h. After magnetic separation, the remaining U(VI) concentration in the supernatant was measured to evaluate the desorption percentage. The regenerated MMS-AO was washed thoroughly with Milli-Q water and then used for the next sorption-desorption cycle.

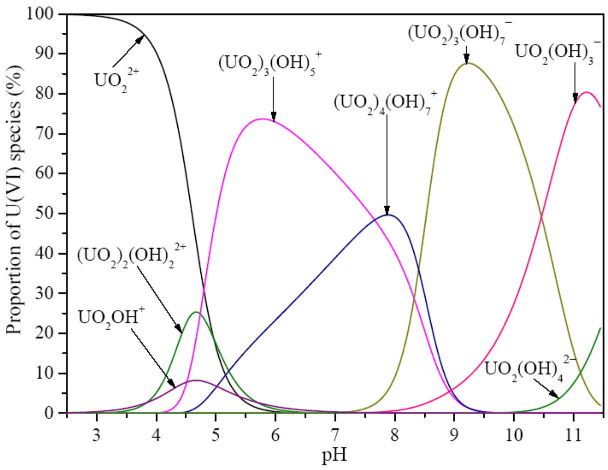

Fig. S1 Relative proportion of U(VI) species in 0.01 mol L^{-1} $NaClO_4$ calculated using Visual MINTEQ version 2.51 (J.P. Gustafsson, Visual MINTEQ version 2.51, 2006.). $T = 298$ K, $C_{(U(VI))initial} = 0.2$ mmol L^{-1}.

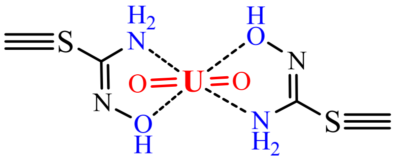

Fig. S2. Schematic diagram for UO_2^{2+} chelation with amidoxime functional groups (A.Y. Zhang, T. Asakura, G. Uchiyama, The adsorption mechanism of uranium(VI) from seawater on a macroporous fibrous polymeric adsorbent containing amidoxime chelating functional group,React. Funct. Polym. 57 (2003) 67–76.).

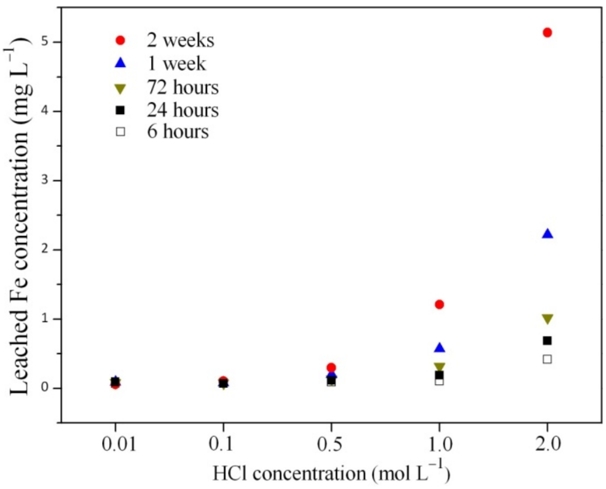

Fig. S3 Leaching of Fe by HCl solutions.