Supplementary Materials

Fast and efficient removal of uranium onto a magnetic hydroxyapatite composite: Mechanism and process evaluation

Tao Ou [1,2], Hairong Peng [1,2], Minhua Su [1,2,*], Qingpu Shi [1,2], Jinfeng Tang [2,*], Nan Chen [1,2], Diyun Chen [1,2]

[1] *Guangdong Provincial Key Laboratory of radionuclides pollution control and resources, Guangzhou University*, *Guangzhou 510006, China.*

[2] *School of Environmental Science and Engineering, Guangzhou University, Guangzhou 510006, China.*

*** Corresponding authors**: Dr. Minhua Su, email: mhsu@gzhu.edu.cn; Dr. Jinfeng Tang, email: jinfeng@gzhu.edu.cn.

Text S1 The preparation of nano-sized HAP

The nano-sized HAP that used as a precursor was prepared via a chemical precipitation method described in our previous study. Briefly, 52.54 g of citric acid was added to 250 mL of ultrapure water and stirred by a magnetic stirrer until dissolved. After that, the solution pH was monitored and adjusted to 10.0 ± 0.1 using aqua ammonia. Next, 4.72 g of calcium nitrate was gradually added, forming Solution A. Later, 100 mL of solution containing 2.64 g of diammonium hydrogen phosphate was mixed with Solution A and left after stirring, forming Solution B. The Solution B was subsequently placed in a water bath whose temperature was 70 °C and stirred for 24 h, allowing hydroxyapatite to settle. The obtained suspension was filtered and washed

multiple times with alcohol and ultrapure water to obtain the white power which is nano-HAP. The wet nano-HAP powder was placed in a thermostatic drying oven in which it was dried for 4 h at 60 °C.

Text S2 The Scherer equation

The Scherer equation (**Eq. S1**):

$$D = \frac{K*\lambda}{\beta*COS\theta} \quad (1)$$

where K (0.9) is the Scherrer constant and λ (1.5406 Å) X-ray wavelength, respectively; β and θ are the FWHM (rad) and the Bragg angle (degree), respectively

Text S3 Adsorption isotherms

The Langmuir (**Eq. S2**) and Freundlich (**Eq. S3**) isotherms:

$$q_e = q_{max}\frac{K_L C_e}{1+K_L C_e} \quad (2)$$

$$q_e = K_F C_e^{1/n} \quad (3)$$

where q_{max} is the maximum sorption amount on the surface of adsorbent based on monolayer adsorption (mg/g); q_e is the equilibrium sorption amount (mg/g); C_e is the equilibrium concentration (mg/L); K_L is the equilibrium constant of Langmuir isotherm (as measured in L/mg); K_F ((mg/g)/(L/mg)^n) is the sorption parameter of Freundlich isotherm model; n is the constant related to the affinity with the intensity or the degree of the sorption.

Text S4 Adsorption kinetics

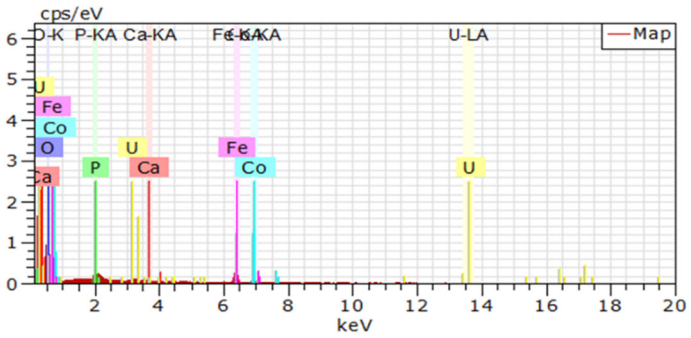
The pseudo-first-order (**Eq. S4**) and the pseudo-second-order (**Eq. S5**) kinetics have been implemented for obtaining adsorption kinetic information.

$$q_t = q_e(1 - e^{1-k_1 t}) \quad (4)$$

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

where q_t (mg/g) denotes the adsorption capacity at time t (measured in min), q_e (mg/g) denotes the adsorption capacity at equilibrium, and k_1 (1/min) and k_2 (g/(mg ·min)) are the pseudo-first and pseudo-second order rate constants, respectively.

Figure



Element	Weight percentage (%)	Atomic percentage (%)
Ca	0.05	0.03
P	3.97	3.21
O	50.26	78.64
Co	9.41	4.00
Fe	30.07	13.48
U	6.25	0.66
Total	100	

Figure S1. EDS image of U(VI) loaded HAP@$CoFe_2O_4$.

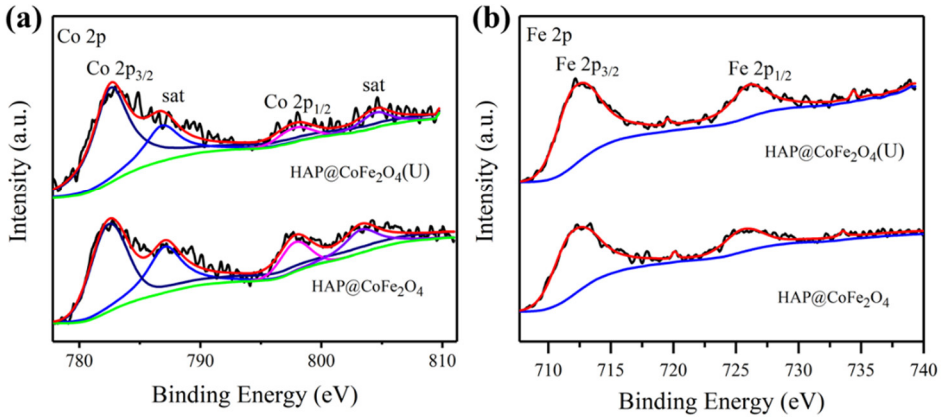


Figure S2. (a) Co 2p, and (b) Fe 2p XPS spectra of the HAP@$CoFe_2O_4$ composite before and after the removal of U(VI).