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Supplementary Information

One pot synthesis of tunable Fe_3O_4-MnO_2 core-shell nanoplates and its applications for water purification

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Additional results

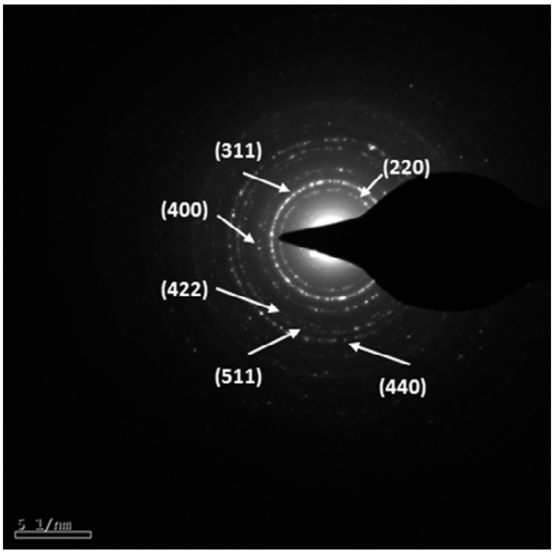

Fig. S1 the selected area diffraction (SEAD) pattern of the sample 1.

The Langmuir (Eq. S1) and Freundlich (Eq. S2) models were used to correlate the experimental data.

$$q_e = \frac{q_m K_a C_e}{1 + K_a C_e} \tag{S1}$$

$$q_e = K_F C_e^{(1/n)} \tag{S2}$$

where q_e is the amount of arsenic adsorbed on the solid phase (mg/g), C_e the equilibrium arsenic concentration in solution phase (mg/L); q_m (mg/g) the maximum adsorption capacity, and K_a (l/mg) Langmuir constants related to energy of adsorption. The K_F and n stand for the Freundlich constants associated with the sorption capacity (mgg^{-1}) and intensity, respectively. The constants of Langmuir and Freundlich isotherm are presented in Table S1.

Table S1. The isotherm parameters for As adsorption of the magnetic nanoplates

Arsenic species	Langmuir model			Freundlich model		
	q_m(mg/g)	k_L(L/mg)	R^2	K_F(mg/g)	n	R^2
As (III)	72.83	0.241	0.917	23.039	0.309	0.990
As (V)	32.13	0.787	0.984	16.371	0.192	0.952

Adsorption kinetic study was carried out to evaluate the reaction rate between the arsenic anion and adsorbent. 750 ml of arsenic solution with fixed arsenic concentration (10 mg L^{-1}) and ion strength (0.01 M $NaNO_3$) was added into a 1000 ml glass vessel. And then 0.15 g adsorbent was added into the solution following the pH of solution was adjusted to 7.0 with the addition of 0.1 M HCl or 0.1 M NaOH to obtain the 0.2 g L^{-1} suspension. The suspension was placed into an air incubator at an agitation speed of 150 rpm and a temperature of 298±1 K. About 5ml solution was sampled by a pipette at different interval time. After that the sample was filtered through a 0.45μm membrane and analyzed by ICP-OES (Perkin Elmer Optima 5300DV, U.S.) to determine the concentration of the arsenic. The pH of the solution was adjusted every 4h with the addition of the acid and base solution to maintain at 7.0 during the run of the experiment. Pseudo-first order (Eq. S3) and pseudo-second order (Eq. S4) models were applied to analyze the kinetics of arsenic adsorption as given below.

$$q_t = q_e\left[1-\exp\left(-k_1 t\right)\right] \tag{S3}$$

$$q_t = \frac{t k_2 q_e^2}{1+k_2 q_e t} \tag{S4}$$

where k_1 (h^{-1}) and k_2 ($gmg^{-1}h^{-1}$) are the pseudo-first order and the pseudo-second order rate constants, respectively; q_t and q_e the amount of arsenic adsorbed at any time (mgg^{-1}) and equilibrium adsorption capacity, and t (h) the reaction time.

The kinetic parameters of pseudo-first order and pseudo-second order models estimated for the sorption here are showed in Table S2.

Table S2. Summary of the kinetic parameters of As adsorption by the magnetic nanoplates

Arsenic species	Initial concentration (mg/L)	Pseudo-first-order model			Pseudo-second-order model		
		k_1	q_e	R^2	k_2	q_e	R^2

As (III)	10	1.333	28.502	0.948	0.058	31.048	0.981
As (V)	10	2.594	23.349	0.870	0.163	24.832	0.956