Supporting information

Two-dimensional Lamellar Magnesium Silicate with large spacing as Excellent Adsorbent for Uranium Immobilization

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Calculation method

The adsorption percentage was described as (equation 1):

$$R = \frac{(C_0 - C_e)}{C_0} 100\% \qquad (1)$$

Where C_0 was the initial U(VI) concentration (mg/L) and C_e was the equilibrium U(VI) concentration (mg/L).

The distribution coefficient (K_d), was defined as (equation 2):

$$K_d = \frac{V(C_0 - C_e)}{m \quad C_e} \qquad (2)$$

Where m (g) was the mass of adsorbent added to the glass vials, V (mL) was the volume of the suspension, C_0 and C_e represent the initial and equilibrium concentrations.

The sorption capacity Q_e (mg/g) was calculated from the following equations:

$$Q_e = \frac{(C_0 - C_e)V}{m} \qquad (3)$$

Where V (mL) was the total volume of the suspension in the test tubes, m (g) was the mass of the adsorbent in the test tube, and C_0 (mg/L) and C_e (mg/L) were the initial and equilibrium U(VI) concentrations after reaction, respectively.

The pseudo-first-order model and pseudo-second-order model

The pseudo-first-order kinetic model is defined as (equation 4):

$$\ln\ (Q_e - Q_t)\ = \ln Q_e - k_1 t \quad (4)$$

The pseudo-second-order kinetic model is defined as (equation 5):

$$\frac{t}{Q_t} = \frac{1}{k_2 Q_e^{\ 2}} + \frac{t}{Q_e} \qquad (5)$$

Where k_1 (min^{-1}) and k_2 (g/mg·min) were the pseudo-first-order and pseudo-second-order rate constant of U(VI) sorption, and t was adsorption time (min). The Q_e and Q_t were the amounts of U(VI) adsorbed (mg/g) at equilibrium and at contact time t, respectively.

The Langmuir and Freundlich models

Langmuir model:

$$Q_e = Q_m \frac{bC_e}{1\ +\ bC_e} \qquad (4)$$

Where C_e denotes the equilibrium concentration of U(VI) (mg/L), b (L/mg) is the Langmuir constant related to the enthalpy of sorption and affinity of adsorbent, Q_e refers to the amount of U(VI) adsorbed per unit weight of the adsorbent at equilibrium (mg/g), Q_m (mg/g) is the maximum adsorption capacity.

Freundlich model:

$$Q_e = k_F C_e^n \qquad (5)$$

Where n and k_F (mg^{1-n} L^{n}g^{-1}) are Freundlich parameters, n is the level depending on

removal equilibrium concentration; k_F is generally related to the adsorption ability of

the adsorbent when the value of the adsorbate concentration is equal to 1.

The thermodynamic studies calculation method

The Gibbs free energy change (ΔG^0) can be expressed by the following equation:

$$\Delta G^0 = -RT ln k^0 \qquad (6)$$

Where R is the ideal gas constant (8.3145 J/mol·K), k^0 was the sorption

equilibrium constant at different temperature.

The average standard enthalpy change (ΔH^0) could be calculated by van't Hoff

equation:

$$ln k^0(T_2) - ln k^0(T_1) = \frac{-\Delta H^0}{R}(\frac{1}{T_2} - \frac{1}{T_1}) \quad (7)$$

The standard entropy change (ΔS^0) was obtained by Eq 8:

$$\Delta S^0 = -\frac{\Delta G^0 - \Delta H^0}{T} \qquad (8)$$

Table S1

Kinetic parameters of U(VI) sorption on magnesium silicate.

Species	Pseudo-first-order			Pseudo-second-order		
	k_1 (min^{-1})	$Q_{e,cal}$ (mg/g)	R^2	k_2 (g/mg·min)	$Q_{e,cal}$ (mg/g)	R^2
U(VI)	0.0599	75.02	0.859	0.0004945	168.35	0.995

Table S2

Comparison of U(VI) sorption capacity on magnesium silicate with other materials.

Adsorbents	T (K)	Q_{max} (mg/g)	ΔG^0 (kJ/mol)	ΔH^0 (kJ/mol)	ΔS^0 (J/mol·K)	Reference
CaTiO$_x$	313.15	294.30	-3.69	0.037	7.85	1
TiO$_{2-x}$	313	45.84	-1.51	7.793	0.03	2
MgFeAl LDH	298	167.61	−13.57	10.23	79.87	3
SiO$_2$@ LDH nanocomposites	298.15	303.1	-11.56	7.16	62.88	4

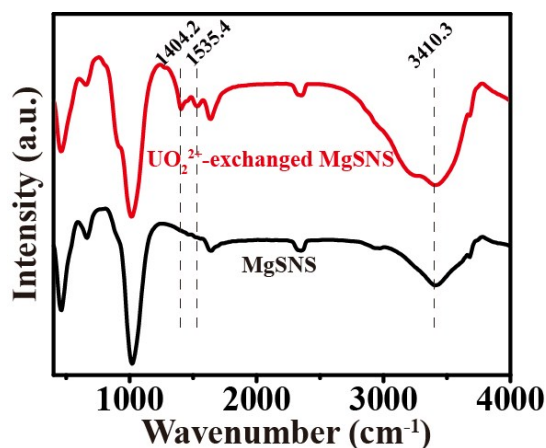|						
Layered titanate nanowires	313	384	-1.74	0.408	6.86	5
Sepiolite	313	15	-9.06	2.23	37.96	6
l-C$_3$N$_4$/PDA/PEI$_3$	298	60.51	-3.36	23.31	89.49	7
nature talc	298	41.6				8
magnesium silicate	313.15	626.92	-12.76	11.43	77.25	This work

(LDH refers to layered double hydroxides)

Fig. S1 FTIR spectra for magnesium silicate and U(VI)-reacted.

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