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# Supplementary information

## Rapid and efficient removal of $Sr^{2+}$ ions by the easy-to-operate and environmentally friendly $KInSnS_4$@collagen fibers aerogel

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**1. Batch adsorption experiments.**

In isothermal adsorption experiments, separate solutions were prepared with different initial concentrations of $Sr^{2+}$ ions ($C_0^{Sr}$ = 5–200 mg/L). The sample to solution ratios (*m/V*) were all 1 g/L (*m*= 9 mg, *V*= 9 *mL*). Adsorption took place for about 12 h at room temperature. The filtered supernatant was diluted with 2% $HNO_3$ solution and finally tested using inductively coupled plasma emission spectroscopy (ICP-OES).

Kinetic experiments were carried out by adding 50 mg of $KInSnS_4$@CFs aerogel to 50 ml of $Sr^{2+}$ ion solution ($C_0^{Sr}$ = 16.15 mg/L) at room temperature. The above mixture was stirred at specific adsorption time such as 1, 2, 3, 5, and 10 min. After that, an appropriate amount of supernatant was sampled, filtered, and then diluted with 2% $HNO_3$ solution. Finally, the $Sr^{2+}$ concentration was determined using ICP-OES.

For pH-dependent studies, the pH of aqueous $Sr^{2+}$ solutions was adjusted to 2 to 12 with $HNO_3$ or NaOH solutions. the initial concentrations of $Sr^{2+}$ ions ranged from 6.79 mg/L to 7.11 mg/L. Adsorption experiments were carried out at room temperature with a *m/V* of 1 g/L (*m* = 9 mg, *V* = 9 mL) and an adsorption time of about 12 h. The supernatant after filtration was diluted with 2% $HNO_3$ solution and finally tested by ICP-OES. The sample product after the adsorption process was separated from the solution, washed several times with water and ethanol and freeze-dried. The stability of $KInSnS_4$@CFs aerogel was tested by PXRD and FTIR under different pH conditions.

Competitive ion adsorption experiments were performed at room temperature (*m/V* = 1 g/L, *m* = 9 mg, *V* = 9 mL), and the adsorption time was 12 h for all of them. $Sr^{2+}$ removal experiments of the $KInSnS_4$@CFs aerogel were performed in the presence of coexisting $Na^+$, $Cs^+$, $Ca^{2+}$, and $Mg^{2+}$ ions. $Sr^{2+}$ removal experiments of $KInSnS_4$@CFs aerogel in actual water samples were simulated by adding $Sr^{2+}$ ions to tap water, river water, and lake water. The filtered supernatant was diluted with 2% $HNO_3$ solution and finally tested by plasma mass spectrometry (ICP-MS) and ICP-OES.

Elution and reuse experiments were carried out as follows. Firstly, a certain amount

of $KInSnS_4$@CFs aerogel was added into 11.02 mg/L $Sr^{2+}$ solution at room temperature and they contacted for 12 h to give the solid adsorption product $KInSnS_4$@CFs-Sr. Secondly, $KInSnS_4$@CFs-Sr was eluted with 1 mol/L KCl solution. Then, the reusability of $KInSnS_4$@CFs aerogels in the subsequent four consecutive cycles was evaluated by adsorbing the same initial concentration of $Sr^{2+}$ ion solution and using 1 mol/L KCl solution for elution. Three adsorption-elution cycle experiments were carried out. The 1 mol/L KCl solution was configured using KCl and deionized water.

**2. Equations.**

The equations for the analysis of adsorption data are summarized as follows:

(1) Adsorption capacity $q$ (mg/g):

$$q = \frac{(C_0 - C_e)V}{m} \quad \text{(Eq. S1)}$$

where $C_0$ (mg/L) and $C_e$ (mg/L) are the initial and equilibrium concentration of target ions, respectively. $m$ (g) and $V$ (mL) are the mass of the adsorbent and the volume of the solution used in the adsorption experiment, respectively.

(2) Adsorption isotherm models：

The classical isotherm models including Langmuir isotherm model, Freundlich isotherm model, and Langmuir-Freundlich isotherm model are used to evaluate the maximum adsorption capacity ($q_{max}$) of the adsorbent for a target ion.

The Langmuir isotherm model is suitable for estimating monolayer chemisorption and localized physical adsorption on homogeneous surfaces with little interaction between adsorbates. Langmuir isotherm model is shown in below:[1]

$$q = q_{max}\frac{K_L C_e}{1 + bC_e} \quad \text{(Eq. S2)}$$

The Freundlich isotherm model typically describes multilayer adsorption on heterogeneous surfaces with an uncertain number of active binding sites. Freundlich isotherm model is shown in below:[1]

$$q = K_F C_e^{\frac{1}{n}} \quad \text{(Eq. S3)}$$

The Langmuir-Freundlich isotherm model is an extension of the Langmuir and Freundlich isotherm model, which is simplified to Langmuir isotherm model with high surface coverage and Freundlich isotherm model with low surface coverage. Langmuir-Freundlich isotherm model is shown in below:[2]

$$q = q_{max}\frac{(K_L C_e)^{\frac{1}{n}}}{1 + (K_L C_e)^{\frac{1}{n}}} \quad \text{(Eq. S4)}$$

where $q_m$ is the maximum adsorption capacity (mg/g); $K_L$ is the Langmuir constant related to the affinity of the ion for the adsorbent (L/mg), and $n$ is the density constant

at the adsorption site. $K_F$ ($mg^{1-1/n} \cdot L^{1/n}/g$) is the fitting parameter related to the adsorption capacity.

(3) Removal rate *R* (%):

$$R = \frac{(C_0 - C_e)}{C_0} \times 100\% \quad \text{(Eq. S5)}$$

(4) Kinetics model:

Pseudo-first-order kinetics model is shown in below,[3]

$$ln\frac{(q_e - q)}{q_e} = -k_1 t \quad \text{(Eq. S6)}$$

Pseudo-second-order kinetics model is shown in below,[4]

$$\frac{t}{q} = \frac{1}{k_2 q_e^2} + \frac{1}{q_e} t \quad \text{(Eq. S7)}$$

where $k_1$ and $k_2$ are pseudo-first-order and the pseudo-second-order rate constant of kinetics models, respectively. The pseudo-second-order rate expression has been widely applied to the adsorption of pollutants from aqueous solutions.

(5) Coefficient $K_d$ (mL/g):

$$K_d = \frac{V(C_0 - C_e)}{m \quad C_0} \quad \text{(Eq. S8)}$$

(6) The column adsorption process of $Sr^{2+}$ by $KInSnS_4$@CFs aerogel was further studied through Thomas models analysis.[5]

$$\frac{C_t}{C_0} = \frac{1}{1 + exp\left(K_T q_e m/Q - K_T C_0 t\right)} \quad \text{(Eq. S9)}$$

Where $C_0$ (mg/L) and $C_t$ (mg/L) are the concentrations at the initial and time *t* (min), respectively. $K_T$ ($L \cdot min^{-1} \cdot mg^{-1}$) is the rate constant in the Thomas model. $q_e$ (mg/g) is the maximum adsorption capacity of the adsorbent, *Q* (L/min) is the volume flow rate, and m (g) is the mass of the adsorbent in the adsorption column.

**3. Figure S1–Figure S13.**

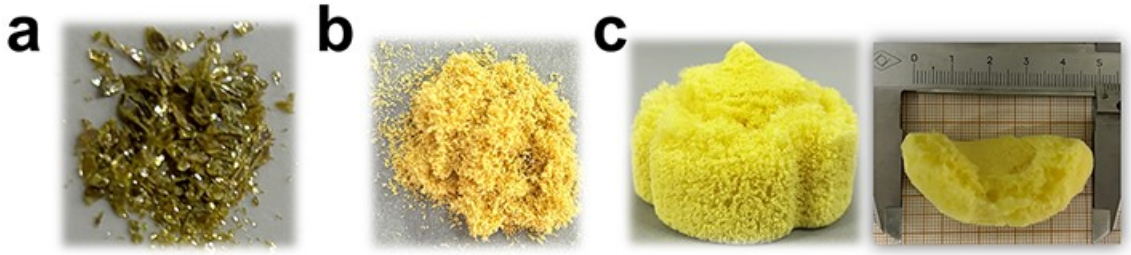


**Figure S1.** Photographs of $KInSnS_4$ crystals (a), CFs (b), and $KInSnS_4$@CFs aerogel (c).

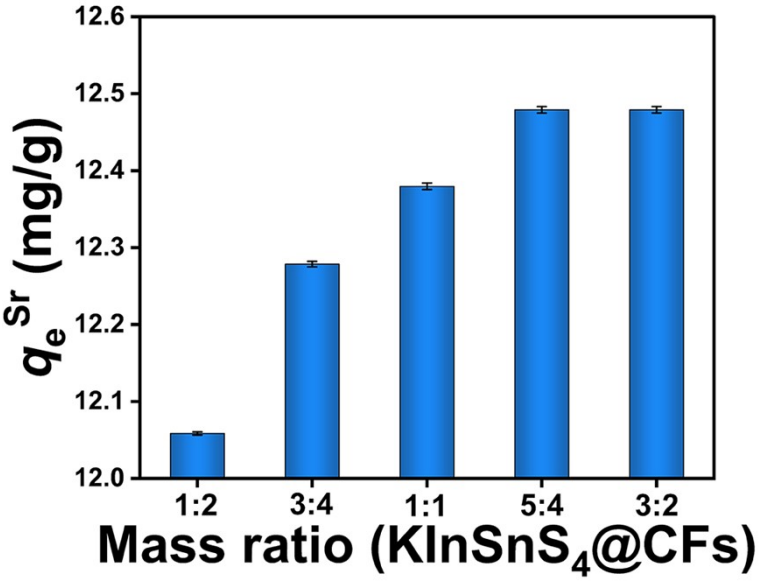


**Figure S2.** $q_e$ of $Sr^{2+}$ ions removal by $KInSnS_4$@CFs aerogel with different mass ratios.

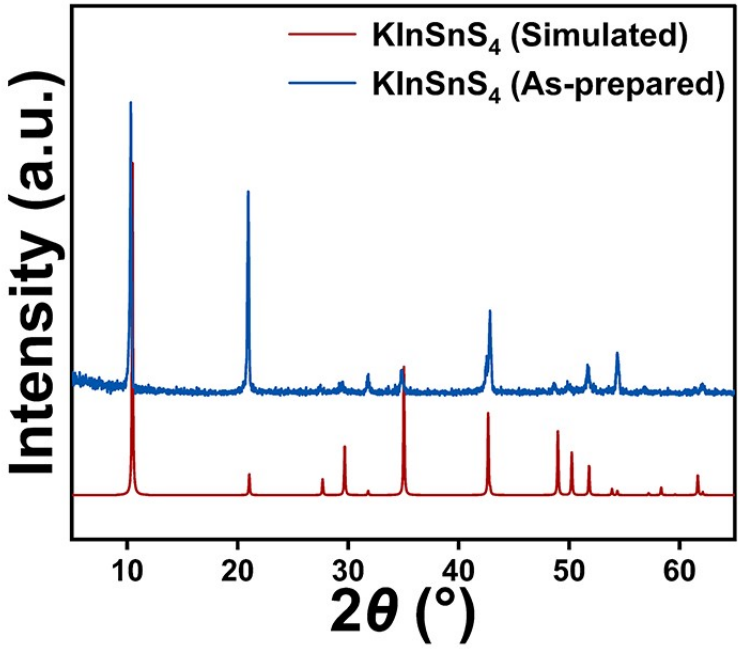


**Figure S3.** The simulated and as-prepared PXRD patterns of $KInSnS_4$.

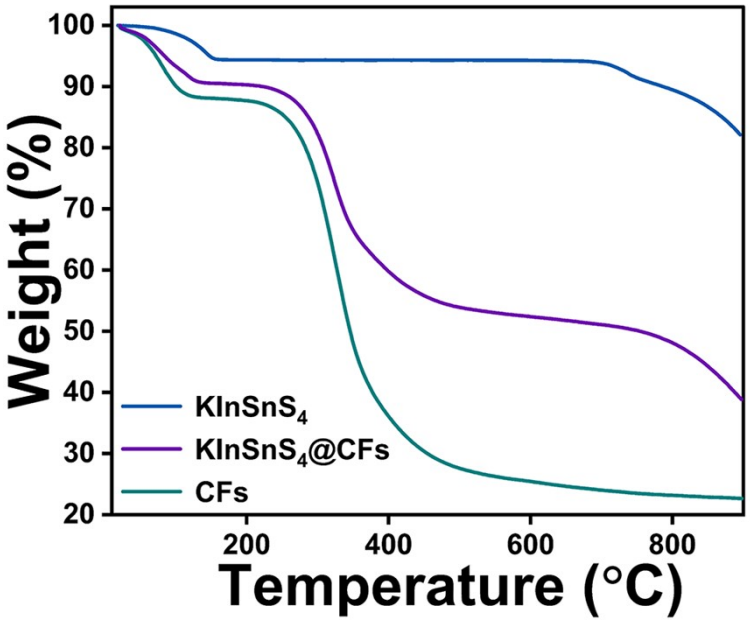


**Figure S4.** Thermogravimetric curves of $KInSnS_4$, CFs, and $KInSnS_4$@CFs aerogel.

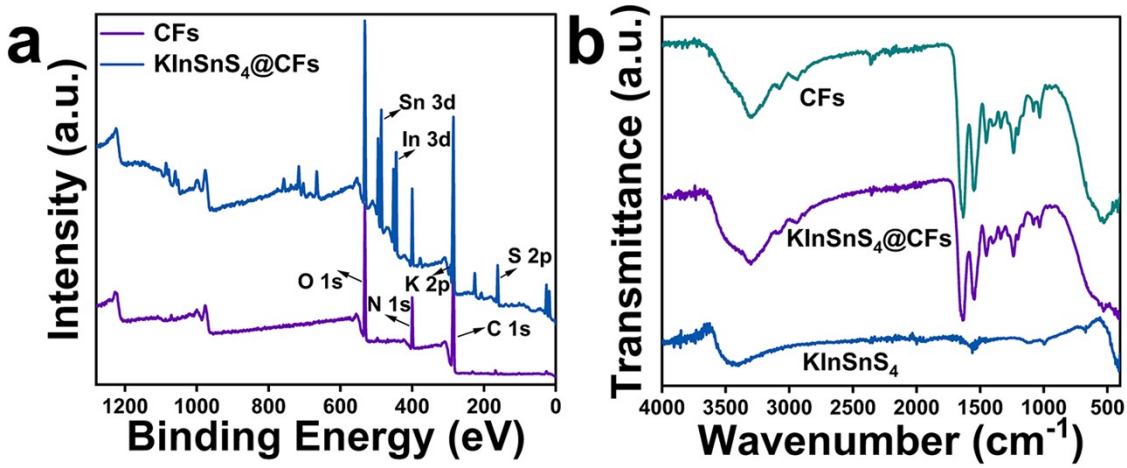


**Figure S5.** (a) XPS full spectra of CFs and $KInSnS_4$@CFs aerogel. (b) FTIR spectra of $KInSnS_4$, CFs, and $KInSnS_4$@CFs aerogel.

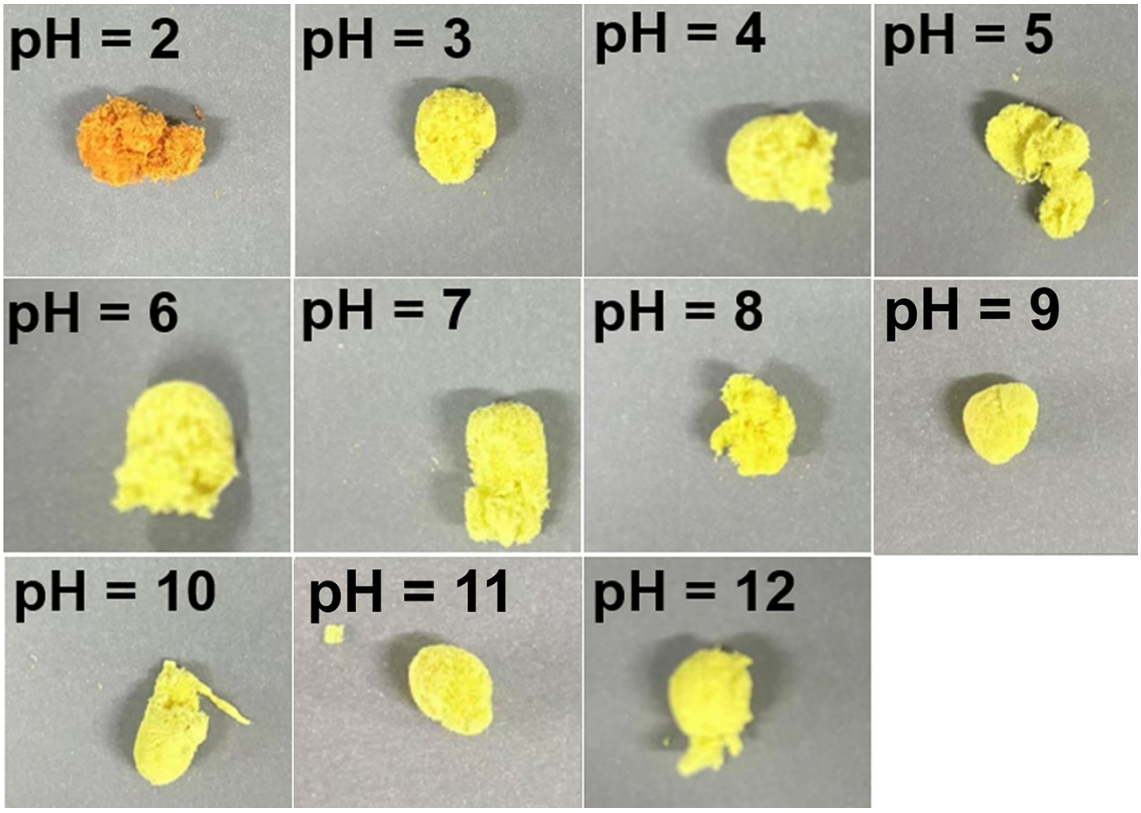


**Figure S6.** Photographs for products of $KInSnS_4$@CFs aerogel after the treatment of $Sr^{2+}$ ions solutions with different pH values.

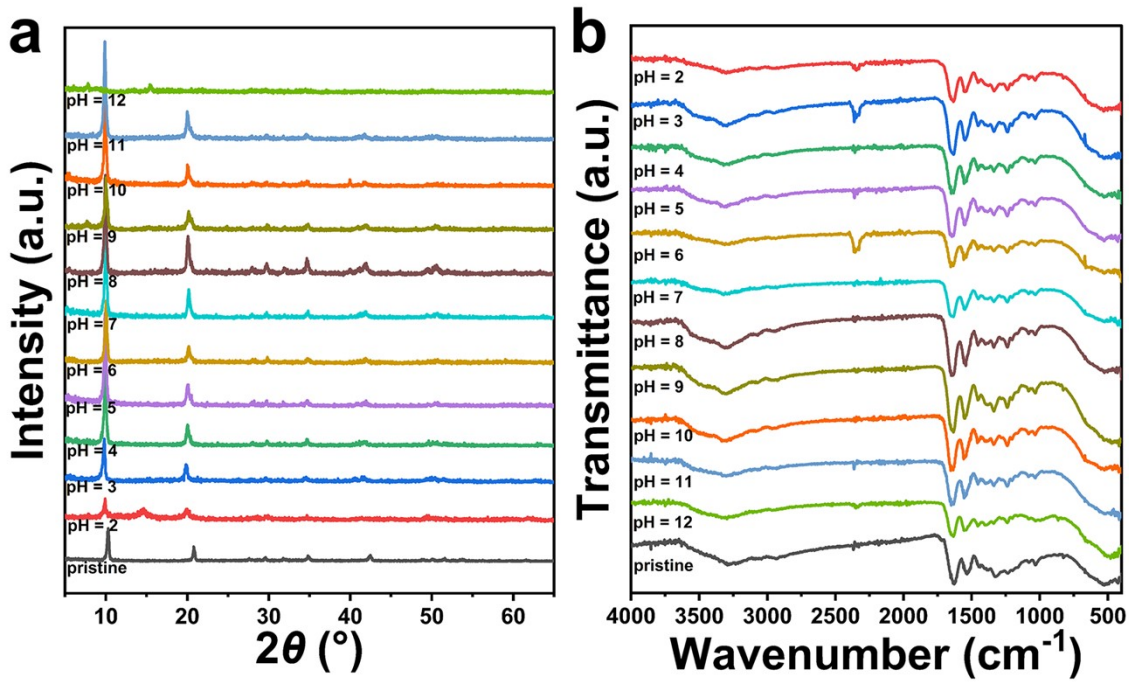


**Figure S7.** PXRD (a) and FTIR (b) patterns of the pristine $KInSnS_4$@CFs aerogel and those samples treating at different pH values.

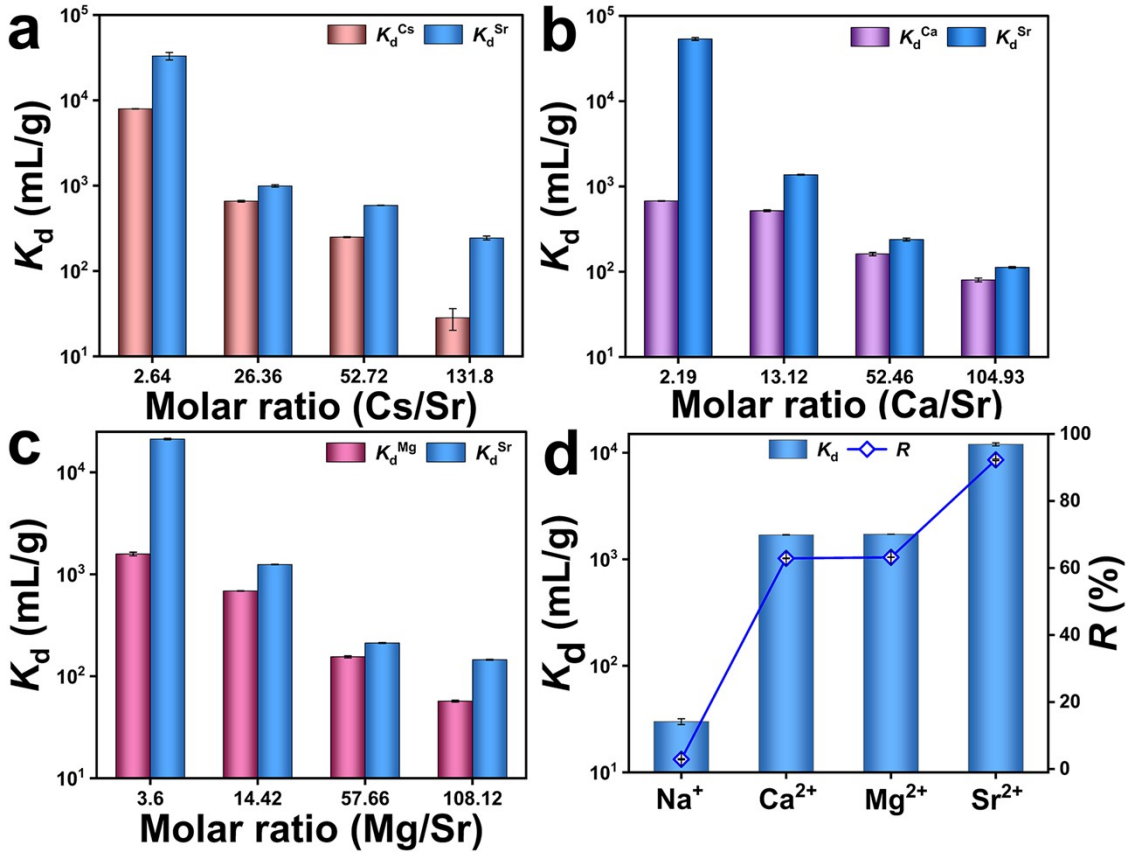


**Figure S8.** (a) $K_d$ of $Cs^+$ and $Sr^{2+}$ ions by $KInSnS_4$@CFs aerogel with different $Cs^+/Sr^{2+}$ molar ratios. (b) $K_d$ of $Ca^{2+}$ and $Sr^{2+}$ ions by $KInSnS_4$@CFs aerogel with different $Ca^{2+}/Sr^{2+}$ molar ratios. (c) $K_d$ of $Mg^{2+}$ and $Sr^{2+}$ ions by $KInSnS_4$@CFs aerogel with different $Mg^{2+}/Sr^{2+}$ molar ratios. (d) $K_d$ and $R$ of various ions by $KInSnS_4$@CFs aerogel at equal mass concentration of $Na^+$, $Ca^{2+}$, $Mg^{2+}$, and $Sr^{2+}$.

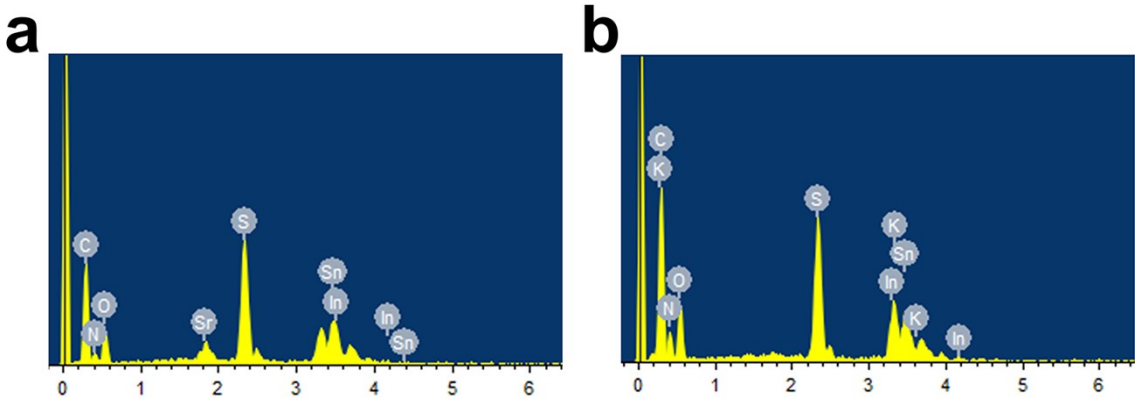


**Figure S9.** (a) EDS analysis results of $KInSnS_4$@CFs-Sr. (b) EDS analysis results of $KInSnS_4$@CFs-Sr after elution with 1 mol/L KCl solution.

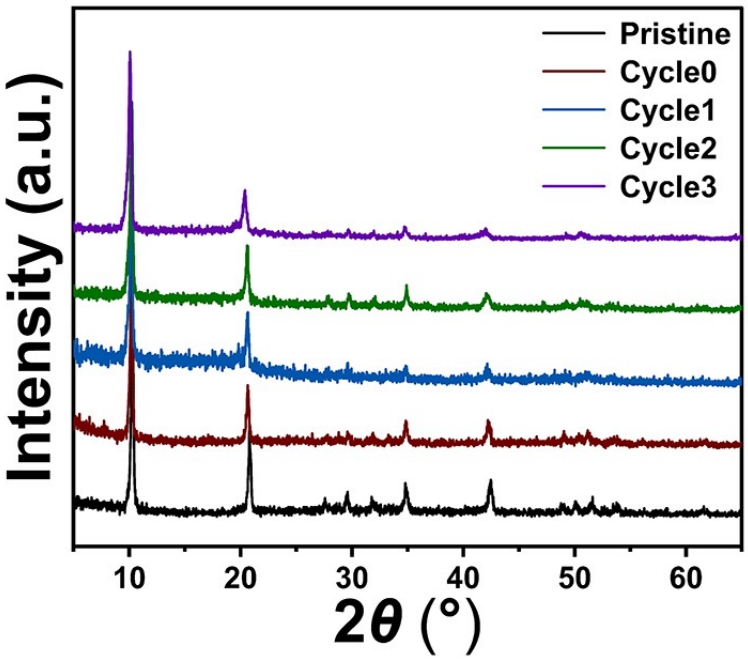


**Figure S10.** PXRD patterns of the pristine and the samples after each cycle

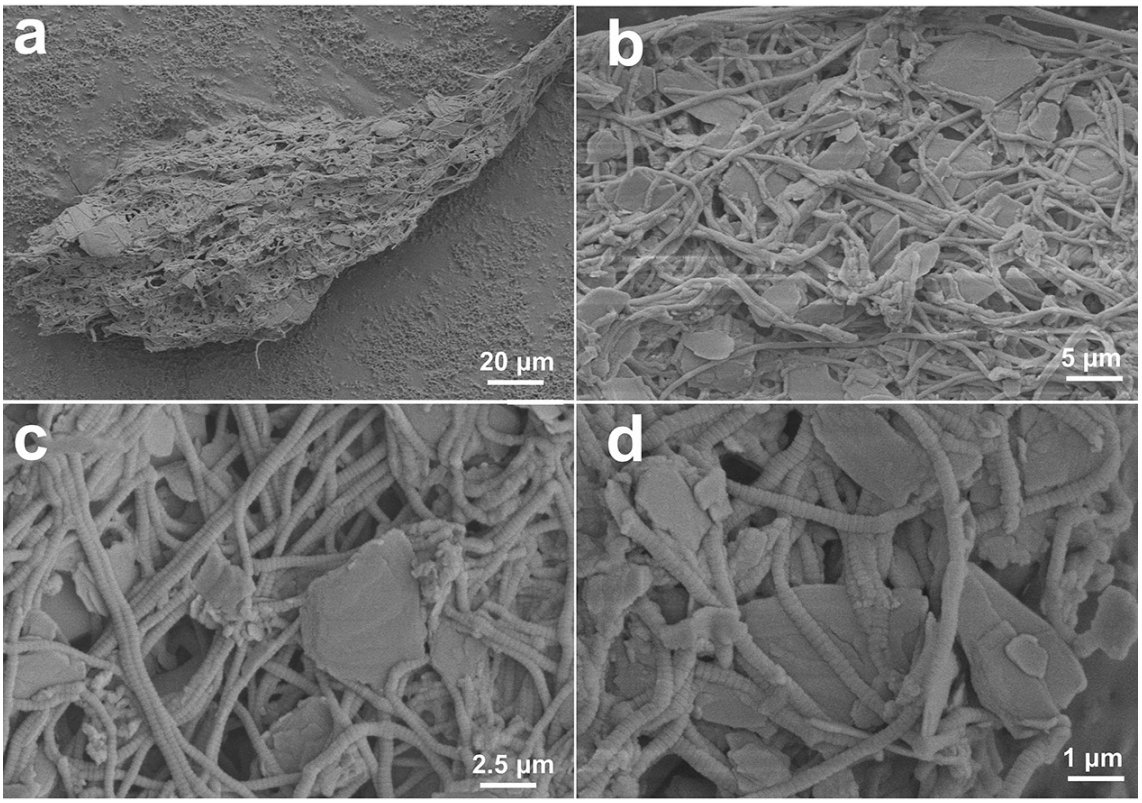


**Figure S11.** SEM images of $KInSnS_4$@CFs aerogel with different resolutions, 2.5 k (a), 10 k (b), 20 k (c) and 30 k (d), respectively.

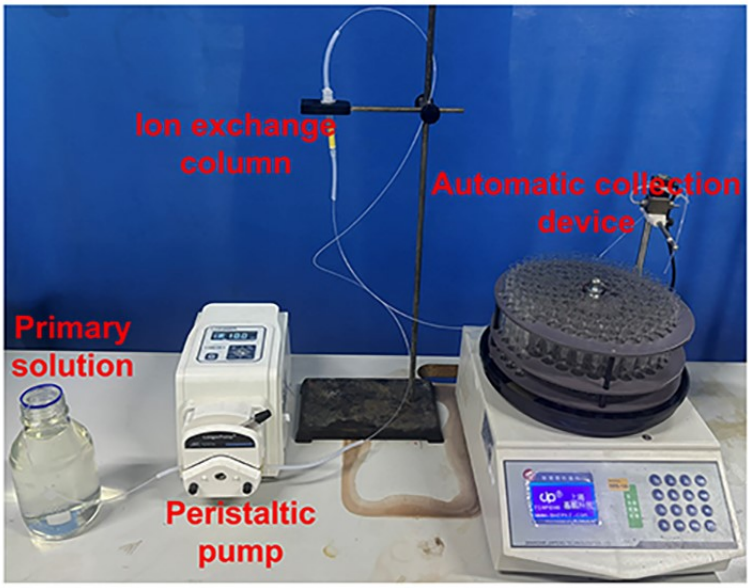


**Figure S12.** Experimental setup for the dynamic capture of $Sr^{2+}$ ions using a column packed with $KInSnS_4$@CFs aerogel.

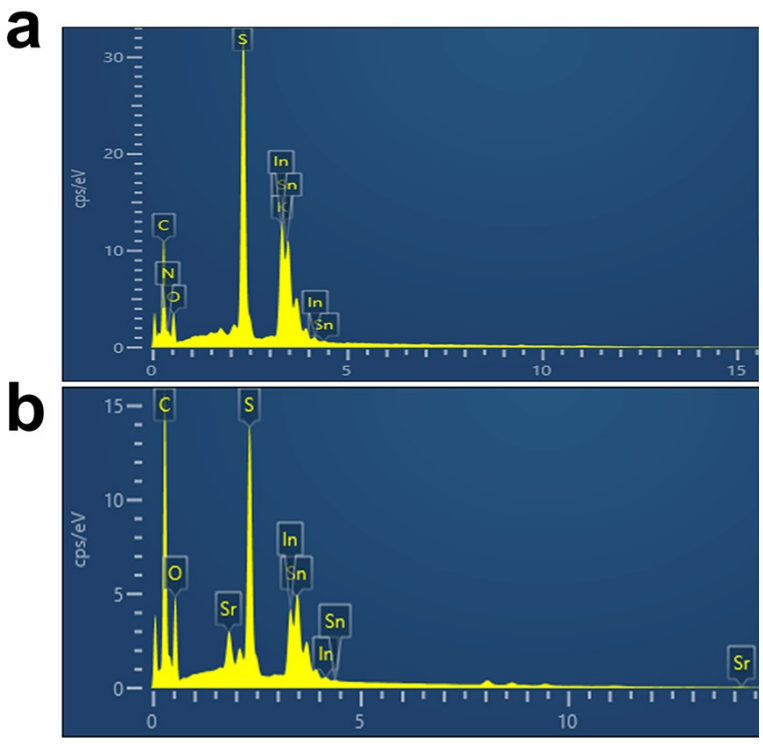


**Figure S13.** EDS analysis results of $KInSnS_4$@CFs aerogel (a) and $KInSnS_4$@CFs-Sr (b).

**4. Table S1–Table S19.**

**Table S1.** Experimental results of adsorption capacity studies of $KInSnS_4$@CFs aerogels with different mass ratios (*m/V* = 1000 mg/L, room temperature and 12 h contact time).

| $KInSnS_4$@CFs mass ratio | $C_0^{Sr}$ (mg/L) | $C_e^{Sr}$ (mg/L) | $q_e^{Sr}$ (mg/g) |
|---|---|---|---|
| 1:2 | 12.66 ± 0.0064 | 0.61 ± 0.0085 | 12.06 ± 0.0021 |
| 3:4 | 12.66 ± 0.0064 | 0.39 ± 0.0028 | 12.28 ± 0.0035 |
| 1:1 | 12.66 ± 0.0064 | 0.29 ± 0.0021 | 12.38 ± 0.0042 |
| 5:4 | 12.66 ± 0.0064 | 0.19 ± 0.0021 | 12.48 ± 0.0042 |
| 3:2 | 12.66 ± 0.0064 | 0.19 ± 0.0021 | 12.48 ± 0.0042 |

**Table S2.** Experimental results of the adsorption capacity study of $KInSnS_4$@CFs aerogel, $KInSnS_4$, and CFs (*m/V* = 1000 mg/L, at room temperature and 12 h contact time).

| Sample | $C_0^{Sr}$ (mg/L) | $C_e^{Sr}$ (mg/L) | $q_e^{Sr}$ (mg/g) |
|---|---|---|---|
| $KInSnS_4$@CFs aerogel | 7.23 ± 0.070 | 0.0011 ± 0.00040 | 7.23 ± 0.070 |
| | 14.58 ± 0.16 | 0.075 ± 0.0038 | 14.50 ± 0.17 |
| | 30.00 ± 0.20 | 0.94 ± 0.00 | 29.06 ± 0.20 |
| | 63.78 ± 0.25 | 26.76 ± 0.23 | 37.02 ± 0.030 |
| | 95.69 ± 1.06 | 59.14 ± 0.057 | 36.55 ± 1.12 |
| | 235.33 ± 0.10 | 196.73 ± 0.32 | 38.60 ± 0.21 |
| $KInSnS_4$ | 4.59 ± 0.00 | 0.30 ± 0.055 | 4.29 ± 0.055 |
| | 9.68 ± 0.028 | 0.26 ± 0.0040 | 9.42 ± 0.024 |
| | 31.20 ± 0.17 | 0.54 ± 0.0010 | 30.66 ± 0.17 |
| | 50.49 ± 0.55 | 0.81 ± 0.0040 | 49.68 ± 0.56 |
| | 105.95 ± 1.13 | 25.54 ± 0.14 | 80.41 ± 1.27 |
| | 149.5 ± 1.84 | 70.09 ± 1.46 | 79.42 ± 0.37 |
| | 202.00 ± 0.99 | 119.60 ± 0.78 | 82.45 ± 1.77 |
| CFs | 0.24 ± 0.00 | 0.22 ± 0.0042 | 0.023 ± 0.0042 |
| | 0.45 ± 0.00 | 0.42 ± 0.0014 | 0.033 ± 0.0014 |
| | 0.77 ± 0.0057 | 0.73 ± 0.00 | 0.038 ± 0.0057 |
| | 1.07 ± 0.0028 | 1.06 ± 0.0014 | 0.012 ± 0.011 |
| | 3.20 ± 0.025 | 3.18 ± 0.0071 | 0.025 ± 0.033 |

**Table S3.** Adsorption constants obtained by fitting isotherm data with Langmuir model, Freundlich model and Langmuir-Freundlich model.

| Samples | Adsorption isotherm model | Langmuir model | Langmuir-Freundlich model | Freundlich model |
|---|---|---|---|---|
| $KInSnS_4$@CFs aerogel | $R^2$ | 0.911 | 0.967 | 0.885 |
| | $q_{max}^{Sr}$(mg/g) | 36.74 ± 2.16 | 41.48 ± 3.77 | |
| | *b* (L/mg) | 7.53 ± 3.43 | 5.49 ± 4.19 | |
| | *n* | | 2.58 ± 0.68 | 9.04 ± 1.90 |
| | $k_F$ | | | 23.41 ± 2.30 |
| $KInSnS_4$ | $R^2$ | 0.923 | 0.992 | 0.773 |
| | $q_{max}^{Sr}$ (mg/g) | 83.06 ± 5.75 | 80.7 ± 1.71 | |
| | *b* (L/mg) | 0.97 ± 0.30 | 1.50 ± 0.070 | |
| | *n* | | 0.38 ± 0.045 | 4.53 ± 1.27 |
| | $k_F$ | | | 31.58 ± 7.85 |

**Table S4.** Sn elemental contents in $KInSnS_4$ and $KInSnS_4$@CFs aerogel.

| Sample | Sn content (mg/g) |
|---|---|
| $KInSnS_4$ | 284.25 ± 20.15 |
| $KInSnS_4$@CFs aerogel | 125.25 ± 7.42 |

**Table S5.** The $Sr^{2+}$ adsorption kinetics results of $KInSnS_4$@CFs aerogel (*m/V* = 1000 mg/L, at room temperature).

| *t* (min) | $C_e^{Sr}$ (mg/L) | $R^{Sr}$ (%) |
|---|---|---|
| 0 | 16.15 ± 0.071 | 0.00 |
| 1 | 3.87 ± 0.014 | 76.04 ± 0.017 |
| 2 | 1.30 ± 0.0071 | 91.98 ± 0.0087 |
| 3 | 1.16 ± 0.00 | 92.82 ± 0.031 |
| 5 | 1.12 ± 0.0071 | 93.10 ± 0.014 |
| 7 | 1.11 ± 0.00 | 93.13 ± 0.030 |
| 10 | 1.12 ± 0.0071 | 93.10 ± 0.074 |
| 15 | 1.11 ± 0.00 | 93.13 ± 0.030 |
| 30 | 1.09 ± 0.00 | 93.25 ± 0.030 |
| 60 | 1.1 ± 0.00 | 93.19 ± 0.030 |
| 120 | 1.1 ± 0.0071 | 93.22 ± 0.014 |
| 180 | 1.1 ± 0.00 | 93.19 ± 0.030 |
| 300 | 1.09 ± 0.014 | 93.25 ± 0.058 |
| 420 | 1.09 ±0.00 | 93.25 ± 0.030 |

**Table S6.** Kinetic fitting parameters of $KInSnS_4$@CFs aerogel for $Sr^{2+}$ removal. (*m/V* = 1000 mg/L, at room temperature).

| | $k_1$ ($min^{-1}$) | $k_2$ ($g \cdot mg^{-1} \cdot min^{-1}$) | $q_e^{Sr}$ ($mg \cdot L^{-1}$) | $R^2$ |
|---|---|---|---|---|
| Pseudo-first-order model | 1.72 | - | 15.12 | 0.99 |
| Pseudo-second-order model | - | 0.066 | 0.0026 | 1.00 |

**Table S7.** The pH-dependent adsorption results of $KInSnS_4$@CFs aerogel for $Sr^{2+}$ removal (*m/V* = 1000 mg/L, at room temperature and 12 h contact time).

| pH | $C_0^{Sr}$ (mg/L) | $C_e^{Sr}$ (mg/L) | $K_d^{Sr}$ (mL/g) | $R^{Sr}$ (%) |
|---|---|---|---|---|
| 2 | 7.01 ± 0.014 | 2.01 ± 0.0057 | $2.49 \times 10^3$ ± 16.88 | 71.36 ± 0.14 |
| 3 | 7.04 ± 0.00 | 0.41 ± 0.0028 | $1.62 \times 10^4$ ± 118.46 | 94.18 ± 0.040 |
| 4 | 7.07 ± 0.071 | 0.13 ± 0.0013 | $5.30 \times 10^4$ ± 15.80 | 98.15 ± 0.00054 |
| 5 | 7.11 ± 0.071 | 0.12 ± 0.00085 | $5.97 \times 10^4$ ± 164.12 | 98.35 ± 0.0045 |
| 6 | 6.98 ± 0.11 | 0.15 ±0.00057 | $4.69 \times 10^4$ ± 590.23 | 97.91 ± 0.026 |
| 7 | 7.06 ± 0.00 | 0.13 ±0.00071 | $5.52 \times 10^4$ ± 315.96 | 98.22 ± 0.010 |
| 8 | 7.08 ± 0.028 | 0.13 ±0.00029 | $5.36 \times 10^4$ ± 337.47 | 98.17 ± 0.011 |
| 9 | 7.02 ± 0.028 | 0.18 ±0.00071 | $3.85 \times 10^4$ ± 316.37 | 97.47 ± 0.020 |
| 10 | 7.04 ± 0.11 | 0.12 ±0.00042 | $5.93 \times 10^4$ ± 1188.79 | 98.34 ± 0.033 |
| 11 | 7.08 ± 0.057 | 0.34 ± 0.00 | $2.00 \times 10^4$ ± 167.56 | 95.23 ± 0.038 |
| 12 | 6.79 ± 0.042 | 0.75 ± 0.0071 | $8.11 \times 10^3$ ± 29.56 | 89.02 ± 0.036 |

**Table S8.** The adsorption results of $KInSnS_4$@CFs aerogel under different $Na^+/Sr^{2+}$ molar ratios (*m/V* = 1000 mg/L, at room temperature and 12 h contact time).

| Molar ratio ($Na^+/Sr^{2+}$) | M | $C_0^M$ (mg/L) | $C_e^M$ (mg/L) | $K_d^M$ (mL/g) | $R^M$ (%) |
|---|---|---|---|---|---|
| 3.81 | $Na^+$ | 6.43 ± 0.11 | 5.66 ± 0.30 | 138.15 ± 41.19 | 12.08 ± 3.18 |
| | $Sr^{2+}$ | 4.97 ± 0.070 | 0.040 ± 0.0085 | $1.26 \times 10^5$ ± 29.00 | 99.19 ± 0.18 |
| 15.24 | $Na^+$ | 20.88 ± 0.020 | 18.31 ± 0.11 | 140.11 ± 8.20 | 12.29 ± 0.63 |
| | $Sr^{2+}$ | 5.00 ± 0.028 | 0.040 ± 0.0021 | $1.26 \times 10^5$ ± 61.00 | 99.21 ± 0.038 |
| 53.35 | $Na^+$ | 70.57 ± 0.25 | 63.69 ± 0.54 | 108.13 ± 5.48 | 9.76 ± 0.45 |
| | $Sr^{2+}$ | 5.04 ± 0.028 | 0.097± 0.0028 | $5.10 \times 10^4$ ± 12.00 | 98.08 ± 0.045 |
| 152.44 | $Na^+$ | 200.00 ± 0.85 | 190.50 ± 0.99 | 49.87 ± 1.00 | 4.75 ± 0.091 |
| | $Sr^{2+}$ | 5.03 ± 0.028 | 0.35 ± 0.0014 | $1.34 \times 10^4$ ± 22.64 | 93.06 ± 0.010 |

**Table S9.** The adsorption results of $KInSnS_4$@CFs aerogel under different $Cs^+/Sr^{2+}$ molar ratios (*m/V* = 1000 mg/L, at room temperature and 12 h contact time).

| Molar ratio ($Cs^+/Sr^{2+}$) | M | $C_0^M$ (mg/L) | $C_e^M$ (mg/L) | $K_d^M$ (mL/g) | $R^M$ (%) |
|---|---|---|---|---|---|
| 2.64 | $Cs^+$ | 18.60 ± 0.057 | 2.08 ± 0.00 | $7.94 \times 10^3$ ± 27.19 | 88.82 ± 0.034 |
| | $Sr^{2+}$ | 5.08 ± 0.014 | 0.15 ± 0.014 | $3.30 \times 10^4$ ± 3302.00 | 97.05 ± 0.29 |
| 26.36 | $Cs^+$ | 185.60 ± 0.57 | 112.00 ± 0.57 | $6.57\times 10^2$ ± 13.42 | 39.65 ± 0.49 |
| | $Sr^{2+}$ | 5.28 ± 0.028 | 2.65 ± 0.028 | $9.92 \times 10^2$ ± 31.94 | 49.81 ± 0.80 |
| 52.72 | $Cs^+$ | 374.80 ± 0.57 | 300.00 ± 1.13 | $2.50 \times 10^2$ ± 2.83 | 19.96 ± 0.18 |
| | $Sr^{2+}$ | 5.25 ± 0.028 | 3.31 ± 0.021 | $5.88 \times 10^2$ ± 1.64 | 37.05 ± 0.065 |
| 131.80 | $Cs^+$ | 910.00 ± 5.66 | 885.00 ± 1.41 | 28.26 ± 8.04 | 2.71 ± 0.76 |
| | $Sr^{2+}$ | 5.13 ± 0.035 | 4.12 ± 0.014 | $2.44 \times 10^2$ ± 12.85 | 19.61 ± 0.83 |

**Table S10.** The adsorption results of $KInSnS_4$@CFs aerogel under different $Ca^{2+}/Sr^{2+}$ molar ratios (*m/V* = 1000 mg/L, at room temperature and 12 h contact time).

| Molar ratio ($Ca^{2+}/Sr^{2+}$) | M | $C_0^M$ (mg/L) | $C_e^M$ (mg/L) | $K_d^M$ (mL/g) | $R^M$ (%) |
|---|---|---|---|---|---|
| 2.19 | $Ca^{2+}$ | 12.06 ± 0.035 | 7.20 ± 0.042 | $6.74 \times 10^2$ ± 4.96 | 40.27 ± 0.18 |
| | $Sr^{2+}$ | 5.05 ± 0.00 | 0.092 ± 0.0030 | $5.36 \times 10^4$ ± 21.00 | 98.17 ± 0.070 |
| 13.12 | $Ca^{2+}$ | 32.51 ± 0.13 | 21.40 ± 0.092 | $5.19 \times 10^2$ ± 12.81 | 34.18 ± 0.55 |
| | $Sr^{2+}$ | 5.04 ± 0.021 | 2.13 ± 0.0070 | $1.40 \times 10^3$ ± 17.87 | 57.8 ± 0.32 |
| 52.46 | $Ca^{2+}$ | 109.60 ± 0.99 | 94.38 ± 0.28 | $1.61 \times 10^2$ ± 7.10 | 13.89 ± 0.53 |
| | $Sr^{2+}$ | 5.04 ± 0.064 | 4.07 ± 0.021 | $2.38 \times 10^2$ ± 9.20 | 19.26 ± 0.60 |
| 104.93 | $Ca^{2+}$ | 211.60 ± 0.57 | 195.90 ± 1.27 | 80.16 ± 4.13 | 7.42 ± 0.35 |
| | $Sr^{2+}$ | 5.00 ± 0.028 | 4.50 ± 0.035 | 112.36 ± 2.46 | 10.10 ± 0.20 |

**Table S11.** The adsorption results of $KInSnS_4$@CFs aerogel under different $Mg^{2+}/Sr^{2+}$ molar ratios (*m/V* = 1000 mg/L, at room temperature and 12 h contact time).

| Molar ratio ($Mg^{2+}/Sr^{2+}$) | M | $C_0^M$ (mg/L) | $C_e^M$ (mg/L) | $K_d^M$ (mL/g) | $R^M$ (%) |
|---|---|---|---|---|---|
| 3.60 | $Mg^{2+}$ | 7.00 ± 0.28 | 2.71 ± 0.042 | $1.58 \times 10^3 \pm 63.94$ | 61.27 ± 0.96 |
| | $Sr^{2+}$ | 4.96 ± 0.028 | 0.22 ± 0.0050 | $2.12 \times 10^4 \pm 365.02$ | 95.49 ± 0.070 |
| 14.42 | $Mg^{2+}$ | 21.36 ± 0.050 | 12.67 ± 0.00 | $6.85 \times 10^2 \pm 3.91$ | 40.67 ± 0.14 |
| | $Sr^{2+}$ | 5.17 ± 0.014 | 2.30 ± 0.00 | $1.25 \times 10^3 \pm 6.15$ | 55.51 ± 0.12 |
| 57.66 | $Mg^{2+}$ | 77.47 ± 0.58 | 67.06 ± 0.29 | $1.55 \times 10^2 \pm 3.65$ | 13.42 ± 0.27 |
| | $Sr^{2+}$ | 4.98 ± 0.035 | 4.11 ± 0.021 | $2.12 \times 10^2 \pm 2.35$ | 17.49 ± 0.16 |
| 108.12 | $Mg^{2+}$ | 139.05 ± 0.071 | 131.55 ± 0.21 | 57.01 ± 1.17 | 5.39 ± 0.10 |
| | $Sr^{2+}$ | 5.09 ± 0.0071 | 4.44 ± 0.00 | $1.45 \times 10^2 \pm 1.59$ | 12.68 ± 0.12 |

**Table S12.** The adsorption results of $KInSnS_4$@CFs aerogel at equal molar ions concentration of $Na^+$, $Ca^{2+}$, $Mg^{2+}$ and $Sr^{2+}$ (*m/V* = 1000 mg/L, at room temperature and 12 h contact time).

| M | $C_0^M$ (mg/L) | $C_e^M$ (mg/L) | $R^M$ (%) | $K_d^M$ (mL/g) |
|---|---|---|---|---|
| $Na^+$ | 1.61 ± 0.0040 | 1.59 ± 0.00 | 1.40 ± 0.20 | 14.15 ± 2.20 |
| $Ca^{2+}$ | 2.45 ± 0.020 | 1.57 ± 0.030 | 35.94 ± 1.60 | $5.61\times 10^2 \pm 39.80$ |
| $Mg^{2+}$ | 1.76 ± 0.0060 | 0.52 ± 0.020 | 70.28 ± 1.10 | $2.37\times 10^3 \pm 3.50$ |
| $Sr^{2+}$ | 4.93 ± 0.030 | 0.10 ± 0.010 | 97.99 ± 0.20 | $4.90 \times 10^4 \pm 13.40$ |

**Table S13.** The adsorption results by $KInSnS_4$@CFs aerogel at equal mass ions concentration of $Na^+$, $Ca^{2+}$, $Mg^{2+}$ and $Sr^{2+}$ (*m/V* = 1000 mg/L, at room temperature and 12 h contact time).

| M | $C_0^M$ (mg/L) | $C_e^M$ (mg/L) | $R^M$ (%) | $K_d^M$ (mL/g) |
|---|---|---|---|---|
| $Na^+$ | 5.76 ± 0.02 | 5.59 ± 0.011 | 2.91 ± 0.17 | 29.98 ± 1.84 |
| $Ca^{2+}$ | 5.71 ± 0.028 | 2.12 ± 0.0035 | 62.88 ± 0.12 | $1.69 \times 10^3 \pm 8.86$ |
| $Mg^{2+}$ | 5.51 ± 0.035 | 2.03 ± 0.011 | 63.20 ± 0.040 | $1.72 \times 10^3 \pm 3.22$ |
| $Sr^{2+}$ | 5.13 ± 0.0070 | 0.40 ± 0.011 | 92.30 ± 0.23 | $1.20 \times 10^4 \pm 382.88$ |

**Table S14.** The results on $Sr^{2+}$ ions removal by $KInSnS_4$@CFs aerogel in actual water samples contaminated with $Sr^{2+}$ ions (*m/V* = 1000 mg/L, at room temperature and 12 h contact time).

| Water | $C_0^{Sr}$ (mg/L) | $C_e^{Sr}$ (mg/L) | $K_d^{Sr}$ (mL/g) | $R^{Sr}$ (%) |
|---|---|---|---|---|
| Tap water (Fuzhou, Fujian) | 5.38 ± 0.025 | 0.41 ± 0.016 | $1.22 \times 10^4 \pm 44.00$ | 92.40 ± 0.25 |
| Lake water (Qishan Lake, Fuzhou) | 5.33 ± 0.00 | 1.19 ± 0.0070 | $3.50 \times 10^3 \pm 26.85$ | 77.78 ± 0.13 |
| River water (Fuzhou, Fujian) | 5.29 ± 0.02 | 0.32 ± 0.0030 | $1.55 \times 10^4 \pm 102.00$ | 93.94 ± 0.038 |

**Table S15.** The concentration of $K^+$, $Na^+$, $Ca^{2+}$, and $Mg^{2+}$ ions in tap water, lake water, and river water.

| Water | $C_0^K$(mg/L) | $C_0^{Na}$(mg/L) | $C_0^{Ca}$(mg/L) | $C_0^{Mg}$(mg/L) |
|---|---|---|---|---|
| Tap water (Fuzhou, Fujian) | 3.40 ± 0.092 | 9.85 ± 0.028 | 10.46 ± 0.050 | 1.71 ± 0.021 |
| Lake water (Qishan Lake, Fuzhou) | 5.06 ± 0.21 | 14.57 ± 0.050 | 14.64 ± 0.050 | 2.54 ± 0.0071 |
| River water (Fuzhou, Fujian) | 2.35 ± 0.29 | 6.59 ± 0.0071 | 12.16 ± 0.014 | 1.85 ± 0.0071 |

**Table S16.** The results on $Sr^{2+}$ ions removal by $KInSnS_4$@CFs aerogel in the cyclic experiments (*m/V* = 1000 mg/L, at room temperature and 12 h contact time).

| Cycles | $C_0^{Sr}$ (mg/L) | $C_e^{Sr}$ (mg/L) | $R^{Sr}$ (%) |
|---|---|---|---|
| 1 | 11.02 ± 0.078 | 0.079 ± 0.00040 | 99.28 ± 0.0090 |
| 2 | 11.02 ± 0.078 | 0.12 ± 0.00040 | 98.88 ± 0.010 |
| 3 | 11.02 ± 0.078 | 0.11 ± 0.00010 | 99.04 ± 0.0056 |

**Table S17.** Results of adsorption column experiments of $KInSnS_4$@CFs aerogel ($C_0^{Sr}$ = 10.425 mg/L, room temperature).

| $t$ (min) | $C_t$ (mg/L) | $C_t/C_0$ | $R^{Sr}$ (%) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 2.5 | 0.062 ± 0.013 | 0.0059 ± 0.0012 | 99.41 ± 0.12 |
| 12.5 | 0.042 ± 0.0048 | 0.0041 ± 0.00045 | 99.60 ± 0.045 |
| 17.5 | 0.043 ± 0.00028 | 0.0041 ±0.000036 | 99.59 ± 0.0036 |
| 32.5 | 0.039 ± 0.000071 | 0.0037 ± 0.00000074 | 99.63 ± 0.000074 |
| 42.5 | 0.041 ± 0.00035 | 0.0039 ± 0.000026 | 99.61 ± 0.0026 |
| 52.5 | 0.039 ± 0.00035 | 0.0038 ± 0.000042 | 99.62 ± 0.0042 |
| 62.5 | 0.037 ± 0.00092 | 0.0036 ± 0.000081 | 99.64 ± 0.0054 |
| 87.5 | 0.038 ± 0.00064 | 0.0036 ± 0.000054 | 99.64 ± 0.00061 |
| 97.5 | 0.038 ± 0.00014 | 0.0037 ± 0.0000061 | 99.63 ± 0.00014 |
| 107.5 | 0.039 ± 0.00085 | 0.0037 ± 0.0000074 | 99.63 ± 0.0074 |
| 132.5 | 0.075 ± 0.0018 | 0.0072 ± 0.00016 | 99.28 ± 0.0016 |
| 137.5 | 0.08 ± 0.0026 | 0.0077 ± 0.00024 | 99.23 ± 0.0024 |
| 147.5 | 0.14 ± 0.00064 | 0.014 ± 0.000089 | 98.65 ± 0.0089 |
| 157.5 | 0.21 ± 0.00099 | 0.021 ± 0.00014 | 97.94 ± 0.014 |
| 172.5 | 0.36 ± 0.0023 | 0.034 ± 0.00029 | 96.57 ± 0.029 |
| 182.5 | 0.46 ± 0.0018 | 0.044 ± 0.00026 | 95.57 ± 0.026 |
| 197.5 | 0.57 ± 0.0015 | 0.055 ± 0.00025 | 94.52 ± 0.025 |
| 202.5 | 0.63 ± 0.0036 | 0.060 ± 0.00022 | 93.96 ± 0.022 |
| 242.5 | 0.89 ± 0.013 | 0.086 ± 0.0014 | 91.44 ± 0.088 |
| 272.5 | 1.06 ± 0.0071 | 0.10 ± 0.00088 | 89.88 ± 0.18 |
| 347.5 | 2.02 ± 0.014 | 0.19 ± 0.0018 | 80.62 ± 0.54 |
| 422.5 | 3.36 ± 0.050 | 0.32 ± 0.0054 | 67.82 ± 0.82 |
| 452.5 | 3.89 ± 0.078 | 0.37 ± 0.0082 | 62.73 ± 0.18 |
| 497.5 | 4.56 ± 0.028 | 0.44 ± 0.0018 | 56.26 ± 0.12 |
| 617.5 | 6.00 ± 0.00 | 0.58 ± 0.0012 | 42.45 ± 0.73 |
| 632.5 | 6.10 ± 0.063 | 0.58 ± 0.0073 | 41.53 ± 0.26 |
| 647.5 | 6.45 ± 0.014 | 0.62 ± 0.0026 | 38.13 ± 0.14 |
| 652.5 | 6.53 ± 0.028 | 0.63 ± 0.0014 | 37.36 ± 0.66 |
| 852.5 | 9.54 ± 0.05 | 0.91 ± 0.0066 | 8.54 ± 0.051 |
| 872.5 | 9.55 ± 0.014 | 0.92 ± 0.00051 | 8.40 ± 0.56 |
| 897.5 | 9.63 ± 0.078 | 0.92 ± 0.0056 | 7.67 ± 0.078 |

**Table S18.** Thomas model fitting parameters for column experimental data at room temperature.

| Solution | $K_T$ ($L \cdot min^{-1} \cdot mg^{-1}$) | $q_e$ (mg/g) | $R^2$ |
|---|---|---|---|
| 10.43 ± 0.024 mg/L $Sr^{2+}$ | $7.03 \times 10^{-4} \pm 2.66 \times 10^{-5}$ | 58.64 ± 0.64 | 0.99 |

**Table S19.** The concentration of $Sr^{2+}$ and $K^{+}$ ions in solution after $Sr^{2+}$ adsorption by $KInSnS_4$@CFs aerogel.

| Ion | $C_0^M$ (mg/L) | $C_e^M$ (mg/L) |
|---|---|---|
| $Sr^{2+}$ | 46.54 ± 0.37 | 26.28 ± 0.26 |
| $K^{+}$ | 0.020 ± 0.00078 | 17.67 ± 0.17 |

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