

Supplementary information

Synthesis of Copper Nanoparticles from Cu²⁺-Spiked Wastewater via Adsorptive Separation and Subsequent Chemical Reduction

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[Adsorption Kinetic Models]

Pseudo-second order adsorption kinetic model is described as follows:

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

where Q_t and Q_e (mg/cm³) is adsorbed Cu²⁺ on PEI-CNF aerogels at time t (h) and equilibrium, respectively. k_2 represents pseudo-second order adsorption kinetic constants. h is the value reflects the initial adsorption rate on the adsorbent.

Intra-particle diffusion model equation can be expressed:

$$q_t = k_p t^{0.5} + X_i \quad (2)$$

where k_p represents reaction rate constant and X_i is related to thickness of the boundary layer.

Table S1. Cu²⁺ adsorption kinetic model parameters on PEI@CNF aerogel in batch and column operation mode

| | Pseudo-second order model | | | Intraparticle diffusion model | | |
|-----------------------------------|---------------------------|--------|--------|-------------------------------|--------|--------|
| | q_e | k_2 | R^2 | X_i | k_p | R^2 |
| Batch adsorption test | 3.94 | 0.204 | 0.9996 | 1.519 | 0.431 | 0.7334 |
| Continuous adsorption test | 0.0748 | 0.4919 | 0.9225 | 0.004 | 0.0073 | 0.9933 |