Simultaneous Adsorption of Cesium, Strontium and Rhodamine B through Generation of Multi-functional Core-shell Adsorbents

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In this study, we design and synthesize multi-functional adsorbents using a customized needle injector and determine the simultaneous adsorption performance toward hazardous materials, including radioactive cesium (Cs^+), strontium (Sr^{2+}), and chemical dye rhodamine B (Rh B). To generate monodisperse multi-functional adsorbents, a tri-functional core is synthesized using a tetrapod needle injector, which is equipped with an aligner and a supporter to align the syringe needles, to rapidly realize a one-step encapsulation of functional reagents including Prussian blue, hydroxyapatite, and MXene. Results show that the simultaneous adsorption behaviors of the adsorbents toward the three hazardous materials are consistent with the Langmuir model, where maximum adsorption capacities of 8.631, 6.389, and 9.363 mg g^{-1} are recorded for Cs^+, Sr^{2+}, and Rh B, respectively. In addition, the adsorbents are separated from the aqueous solution within 5 s by the introduction of external magnetic fields, which can be applied to magnetic actuation.