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Synthesis of aluminum pyrophosphate for efficient sorption of U(VI)

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Abstract. In this study, aluminium pyrophosphate ($\text{Al}_4(\text{P}_2\text{O}_7)_3$) was synthesized successfully and applied to adsorb radioactive uranyl ions from aqueous solutions. The material displayed an excellent sorption capacity of removing U(VI) ($12.83 \text{ mg}\cdot\text{g}^{-1}$), achieved a relatively high adsorption percentage (71%) within an hour. In order to reveal its adsorption mechanism, the materials before and after adsorption of U(VI) were characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD) and Fourier transformed infrared spectroscopy (FT-IR). The factors affecting the adsorption performance, such as shaking time, pH value, ionic strength, temperature and so on, were investigated. Based on the above research, the results demonstrated that the chemical adsorption plays a leading role in the process of adsorption, the adsorption process is more suitable to monolayer adsorption, and the adsorption thermodynamics results suggested the adsorption process was spontaneous ($\Delta G^\circ < 0$) and exothermic ($\Delta H^\circ > 0$). Moreover, the ionic strength and pH have important influence on the sorption of U(VI). Those researches may be valuable for the application of aluminum pyrophosphate in the area of radioactive water pollution governance.

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