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Ordered mesoporous polymer–carbon composites containing amidoxime groups for uranium removal from aqueous solutions

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Abstract: Ordered mesoporous polymer-carbon composites containing amidoxime groups (AO-OMC) were successfully synthesized via in-situ polymerizing 2-Butenenitrile onto the external and internal surface of ordered mesoporous carbon (CMK-3). The characterization of small-angle X-ray diffraction, N_2 adsorption-desorption isotherms and TEM confirmed that the polyacrylamidoxime was only coated on the mesopore walls with a thin layer rather than occupied the whole pores. The AO-OMC containing 16.8% polyacrylamidoxime (0.2AO-OMC) showed the highest adsorption capacity for U(VI) (322.6 $mg \cdot g^{-1}$ at pH = 5.0 and T = 298.15 K), which was significantly higher than CMK-3 (43.4 $mg \cdot g^{-1}$). XPS analysis suggested that the high adsorption capacity of 0.2AO-OMC was mainly attributed to the combination of U(VI) with abundant amidoxime groups via surface complexation and electrostatic interactions. The U(VI) selectivity was above 60% in a wide pH range from 3.0 to 5.0, which has not been reported to date, and reached the highest selectivity of 72.4% at pH = 4.0. The thermodynamic parameters calculated from temperature-dependent adsorption isotherms suggested that uranium adsorption onto 0.2AO-OMC was an endothermic and spontaneous process, and the 0.2AO-OMC exhibited excellent reusability and structural stability without any significant changes