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Efficient remediation of radiodine with silver-functionalized silica aerogel

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Various volatile radionuclides are being released into gas streams and aqueous solutions during reprocessing of used nuclear fuel and vitrification of radioactive waste. Radioactive iodine-129 is of a particular concern because of its long half-life of 15.7 million years and the potential for biological processes to concentrate iodine. A number of materials are being developed worldwide to capture and immobilize iodine in a waste form of a high chemical durability; however, none of them can be used as both a sorbent and a viable waste form. They can either encapsulate iodine-loaded sorbent or sequester iodine that was removed from it. In the U.S., the current benchmark for radioiodine capture is reduced silver mordenite (AgZ) and that for the waste form is AgZ immobilized in a low-temperature glass composite material. However, the primary alternative option is a silver-functionalized silica aerogel (Ag-aerogel). Ag-aerogel exhibits high capture efficiency (~ 500 mg/g) and selectivity for iodine (DF> 10000), and good resistance against aging in nuclear fuel reprocessing off-gas streams. Its sorption performance is retained in deionized water and in a dilute salt solution with neutral pH containing iodide or iodate. A key advantage of an Ag-aerogel is that, after loading with iodine, it can be consolidated into a dense and high-iodine-loaded silica-based waste form by simultaneous application of the heat and pressure. Presentation will discuss the sorption performance of Ag-aerogel in different environments and provide an overview on the development of waste form.

Summary

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