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Silver-functionalized iodine filters directly convertible into a phosphomolybdic glass matrix

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Abstract

The use of nuclear energy required fuels, the lifespan of which is limited. They are reprocessed by some countries to retrieve valuable materials. However, the reprocessing of these fuels generates ultimate waste composed of minor actinides and fission products. Among the released radioactive compounds, there are gaseous ¹³¹I and ¹²⁹I isotopes, high-level waste and long-live radionuclide respectively. In addition, iodine is known to be volatile and mobile in the environment. The management of radioactive iodine is thus complicated and none current treatment process is commonly accepted. Nevertheless, a solution consisting in storing such waste in a deep geological repository is emerging. This management would allow durable confinement of those radionuclides but required the trapping of gaseous iodine and the development of conditioning matrices resistant to the targeted geological environment.

Within this framework, we developed a new type of phosphomolybdic-based sorbents directly convertible in a conditioning matrix. These sorbents are made by using an organic sacrificial template synthesis which has two advantages. First, this two-step method allows the synthesis of monolithic materials with controlled shape and then, an in-situ functionalization with metallic silver as a sorption site of iodine is obtained (AgI formation). Iodine capture tests carried out under static conditions at 110 °C prove the effectiveness of these sorbents with a capture rate of 280 mg per gram of sorbent. The iodine-loaded sorbents were subsequently vitrified at 600 °C without any further addition. The results indicate that no iodine volatilization occurred during the thermal treatment and a complete incorporation of AgI into the phosphomolybdic glassy matrix was achieved. This work finally demonstrates the possibility of a direct conversion of such iodine-loaded sorbents into conditioning matrices without iodine volatilization.