Hot isostatic pressing of simulant radioactive wastes from the Fukushima and Sellafield sites.

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Decommissioning and clean up of nuclear facilities requires the development of new technologies to condition radioactive wastes, producing passively safe waste packages of minimal volume, to reduce storage and disposal costs. We have applied hot isostatic pressing to demonstrate conceptual wasteforms for plutonium residues, ion exchange materials, and sludges present on the Sellafield site, UK, and Fukushima site, Japan. This approach yields durable glass, glass-ceramic, and ceramic wasteforms, with minimal voidage and porosity, in which the radionuclide partitioning between glass and ceramic phases can be controlled by wasteform composition and processing parameters.

Keywords: **Waste forms, Glass, Ceramic, Glass-Ceramic, Hot Isostatic Pressing.**

1. Introduction.

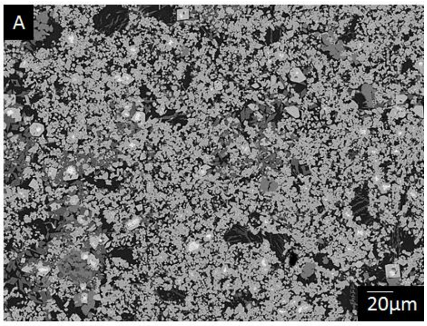
Hot Isostatic Pressing (HIPing) utilises a combination of high temperature and applied pressure (argon gas, 10-200 MPa) to achieve incorporation of radionuclides into a ceramic or glass host phase, by melting or solid state reaction, with simultaneous exclusion of entrained porosity to achieve near theoretical density of the final packaged product. We have successfully developed glass-ceramic formulations to immobilize simulant plutonium residues, sludges and ion exchange materials by hot isostatic pressing.

2. Method & Experimental

Wasteforms typically underwent a high temperature (600 °C) overnight calcination or in-canister bake out and were HIPed at 1250 °C, 100 MPa with a 4 hr dwell. The materials were analysed by SEM/EDX and XRD.

3. Results & Conclusion

The glass ceramic formulation designed for immobilization of plutonium residues comprises 70wt% zirconolite ($CaZrTi_2O_7$) which incorporates Ce as a Pu surrogate; this is encapsulated in 30wt% $Na_2Al_{1+x}B_{1-x}Si_6O_8$ glass (light and dark grey phases, respectively, in SEM image, right). The zirconolite yield is controlled by the glass / ceramic ratio and Al / B ratio in the glass phase. Applying the HIP approach to ion exchange materials utilized on the Sellafield and Fukushima sites we have achieved durable glass-ceramics with ca. 100 % waste loading.



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