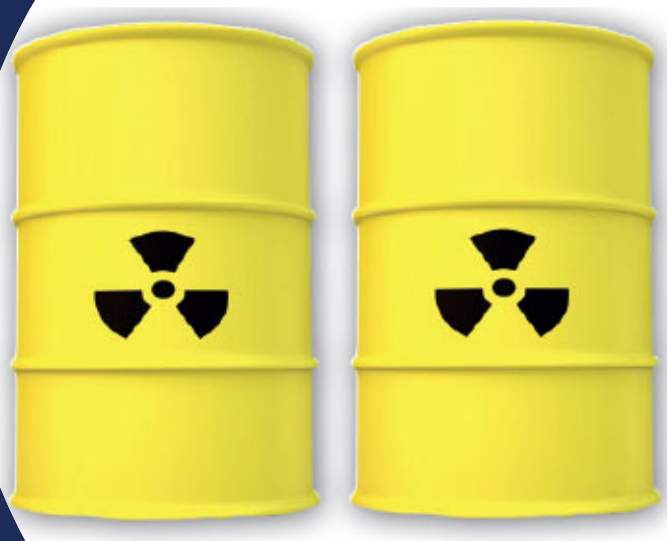
diamond

Nuclear

CASE STUDY

Look but don’t touch; non-invasive analysis of ILW containment

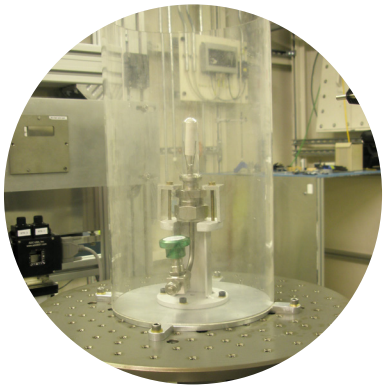


Uranium (U) metal, attached to Magnox cladding and removed from spent fuel prior to reprocessing, is a key component of the UK’s intermediate level waste (ILW). It is encapsulated in grout and sealed within stainless steel canisters in preparation for interim storage and eventual disposal.

Understanding corrosion processes that may occur in these U-containing waste canisters is critical to ensuring the safe long term containment of this ILW (>100 years).

University of BRISTOL

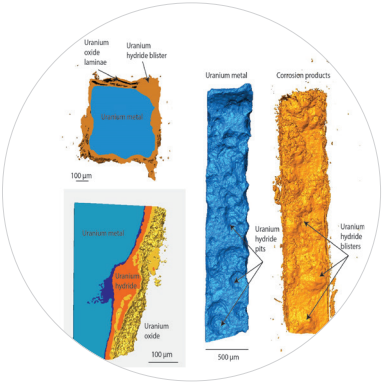
The Challenge



Two key concerns exist when considering corrosion products in these materials. Uranium oxide (UO_2) and uranium hydride (UH_3) occupy ~1.75 times the volume of an equivalent amount of U metal, so the internal stresses caused by significant corrosion could lead to fracturing and cracking of the grout and steel drum.

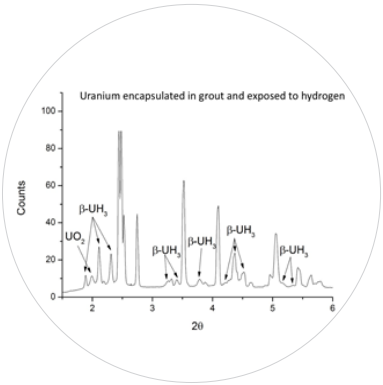
An additional safety challenge is posed by the potential production of pyrophoric compounds in oxidation and corrosion degradation processes. These radioactive materials can be flammable on contact with air which makes them extremely challenging to analyse. A specialist *in situ*, non-invasive technique was required to monitor the corrosion process and identify the corrosion products.

The Solution



The researchers worked with Diamond scientists to develop special containment and encapsulation protocols to allow measurements of active samples. Non-irradiated U matchsticks encapsulated in grout were imaged with full tomography scans using beamline I12. Regions of varying density were identified to locate the products of the corrosion process. A smaller beam size was used in the exact location of the lower density regions and diffraction experiments performed. Diffraction experiments allowed identification of species present and could discern UO_2 from UH_3.

The Benefits



The experiments have demonstrated that it is possible to use a combination of synchrotron tomography and diffraction to observe the evolution of corrosion products of U samples encapsulated in grout in a non-invasive manner. The results provided high spatial resolution reconstructions of sample volumes and geometries along with diffraction analysis for phase identification.

"Without access to the beamline and expert staff at Diamond we simply could not have achieved this research" **Dr Tom Scott, University of Bristol**

For further information

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