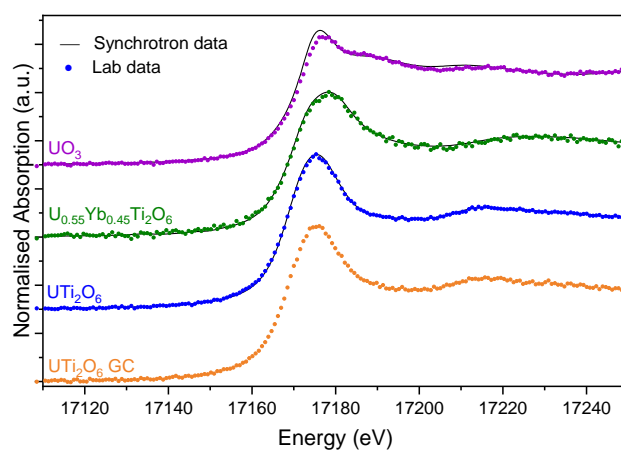


# Developing laboratory based X-ray Absorption Spectroscopy for nuclear waste management

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X-ray absorption spectroscopy (XAS) provides a unique and sensitive probe of element speciation and local environment in materials relevant to the nuclear fuel cycle and security. Hitherto, this technique has primarily required access to a synchrotron radiation facility as a broadband X-ray source of high brilliance, which has limited application for routine and high throughput studies. This of particular challenge for the field of nuclear materials where scientific opportunity may be constrained by the absence of an accessible synchrotron source or sample containment requirements and inventory limits. Here, we report our exploitation of a newly available commercial XAS spectrometer, based on the design of Seidler *et al* [1-4], utilising spherically bent crystal analysers to acquire XAS data in the range 5 - 18 keV resolution from actinide, nuclear and radiological materials. We show that XAS data may be acquired in a few hours, or less in favourable circumstances, from moderately dilute to concentrated absorbers to address routine questions of element speciation and co-ordination of particular relevance to radioactive waste immobilisation. These data and analyses are compared with counterpart synchrotron studies, on an identical sample suite, to highlight both the potential opportunities and limitations of laboratory XAS, and feasibility of routine application.



**Figure 1:** Comparison of laboratory (points) and synchrotron (black solid line) U L<sub>3</sub> XANES data from reference compounds incorporating U<sup>4+</sup> - UTi<sub>2</sub>O<sub>6</sub>, U<sup>5+</sup> - U<sub>0.55</sub>Yb<sub>0.45</sub>Ti<sub>2</sub>O<sub>6</sub>, U<sup>6+</sup> - UO<sub>3</sub>, and a brannerite glass ceramic with unknown U oxidation state; note: laboratory data were corrected for “leakage effects”; GC - glass ceramic.

## References

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