



	<b>Experiment title: Resonant Inelastic X-ray Scattering of uranium compounds</b>	<b>Experiment number:</b> CH-2870
<b>Beamline:</b> ID26	<b>Date of experiment:</b> from: 06.05.2009 to: 12.05.2008	<b>Date of report:</b> 23-06-2009
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**Report:**

The original title of the proposal CH-2870 was In-Situ RIXS studies of the possibilities of the existence of Pu(V) in plutonium dioxide. Due to complications during the sample preparation the plutonium dioxide was not made before the beginning of the experiment. We use the granted beamtime to study the electronic structure of uranium compounds using X-ray absorption near-edge spectroscopy (XANES) and resonant inelastic X-ray scattering (RIXS) across  $L_3$  U edge.

XANES and RIXS experiments were performed for two uranium systems with different oxidation states: uranium dioxide ( $\text{UO}_2$ ) and uranyl dinitrate trihydrate ( $\text{UO}_2(\text{NO}_3)_2(\text{H}_2\text{O})_3$ ). Spectra were recorded using soft X-ray emission spectrometer based on a vertical Rowland circle geometry, exploiting the (8 8 0) reflection of four spherically bent 2m radius Si crystal analyzers for the core-to-core RIXS experiment and (10 10 0) reflection for the valence band RIXS measurements.

Figure 1 shows the high resolution fluorescence detected (HERFD) spectra of  $\text{UO}_2$  and  $\text{UO}_2(\text{NO}_3)_2(\text{H}_2\text{O})_3$  across the  $L_3$  edge compared with the standard XANES spectra. The uranium  $2p_{3/2}$  core hole has a natural line width of 7.4 eV, which limits the observation of additional features in conventional XANES spectra. HERFD spectra measured at fixed U emission energy ( $L\alpha_1 = 13614$  eV) allow the recording of absorption spectra with an energy resolution determined predominantly by the experimental resolution since the core hole lifetime broadening is suppressed. Comparison between XANES and HERFD shows a clear improvement of the resolution in the pre-edge region in contrast with previously reported U XANES at the  $L_3$  edge.

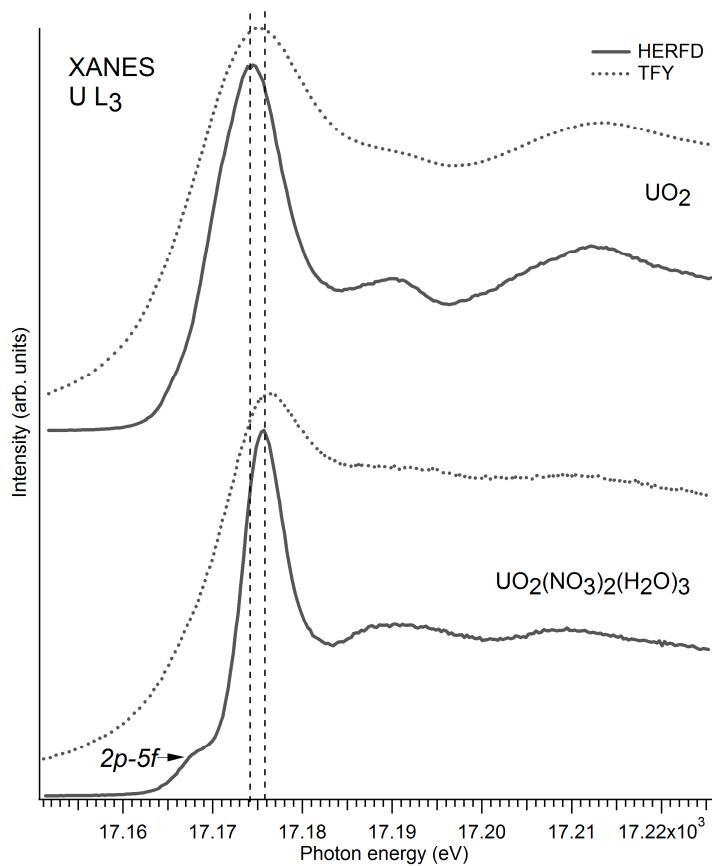


Figure 1 . Uranium high resolution fluorescence detection (HERFD) and total fluorescence yield (TFY) across the  $L_3$  edge of uranium dioxide and uranyl dinitrate trihydrate measured simultaneously

We also performed RIXS measurements in the case where the radiative decay occurs from the core state to another core state. Figure 2 shows the example where U  $3d$  to  $2p$  transitions following the  $2p$  to  $5d$  excitations.

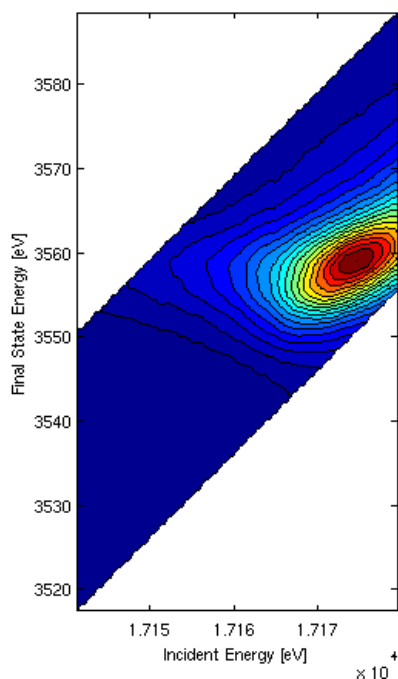


Figure 2a. Core-to-core RIXS of uranium dioxide

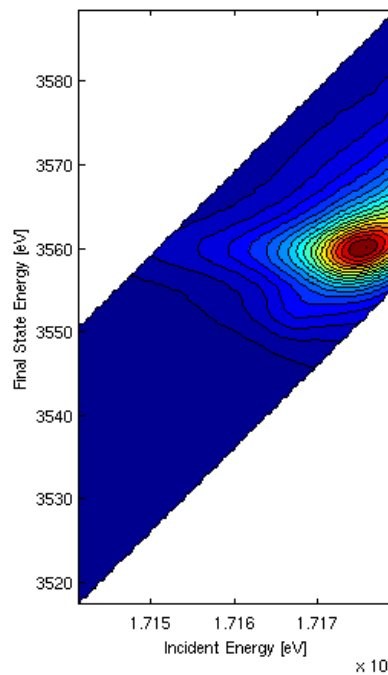


Figure 2b. Core-to-core RIXS of uranyl dinitrate trihydrate

[1] K.O. Kvashnina, S. M. Butoin, J. Vegelius, T. Behrends, T. Vitova, M. Denecke and P. Glatzel, to be published