Prospects for Actinide STXM

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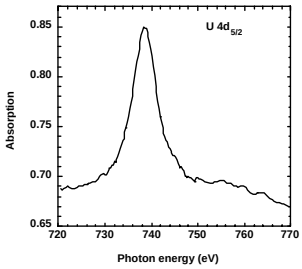
In assessing the migration behavior of actinides and other radionuclides in the environment it is of great importance to have detailed knowledge of the chemical interactions between the migrating actinide species with surrounding minerals, as well as with particulates present in transporting groundwater. There are several methods used to experimentally gain such information such as laboratory sorption experiments and hard x-ray absorption fine structure (XAFS). Recently, scanning transmission x-ray microscopy (STXM) has been utilized with actinides and shows the ability to give spatially-resolved chemical information from high-resolution near-edge XAFS (NEXAFS) on the 25 nm length scale. The STXM atmospheric working pressure and requirements for very small amount of samples greatly simplifies the handling of radioactive materials.

The results from the initial studies of the common uranium, neptunium, and plutonium oxides will be presented, demonstrating the capabilities and limitations of soft x-ray STXM spectromicroscopy for the investigations of actinide systems. The actinide 4d edges are employed for both imaging and for oxidation state determination. Additional information can be obtained from light element edges, such as the oxygen K-edge. The results from the initial investigation of actinide colloids and actinide sorption on particles will be shown. Actinide sample preparation methods, as well as sample radiation damage considerations, will be described and discussed. The prospects for future actinide investigations by STXM will be critically evaluated.



NEXAFS spectrum collected at the U $4d_{5/2}$ edge from a 35 nm edge region of a UO_2 particle.