X-ray Spectroscopy for Actinide Science

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X-ray spectroscopy is a widely used technique at synchrotron radiation sources for analyses of the electronic and structural parameters of materials. This includes the determination of the oxidation state and local symmetry of the absorbing atom. This lecture aimed at PhD students and postdocs who are interested in learning about the principles and practicalities of X-ray spectroscopy, as applied to actinide science. Experimental measurements can be performed on materials in a variety of states, including liquids and solids. The high intensity and tunability of X-rays allow the investigation of a wide range of materials, including thin films, nanoparticles, amorphous materials, solutions, disordered minerals and soils. Moreover, I will provide an overview of the advanced spectroscopic techniques, such as resonant inelastic X-ray scattering (RIXS) and high-energy-resolution fluorescence detected (HERFD) absorption spectroscopy (XAS) that are available at the synchrotrons for studies of actinide systems. I will cover basic principles of X-ray spectroscopy theory and instrumental setups and I will show several examples of the studies performed on the uranium, thorium and plutonium containing materials in the hard and tender X-ray range.