

Actinide Molecular Environmental Science Utilizing Synchrotron Radiation Techniques

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Synchrotron radiation (SR) methods have been utilized with increasing frequency over the past several years to study scientific issues in actinide science, ranging from those of a fundamental nature to those that address a specifically targeted technical need. The actinide molecular environmental science research community has been able to capitalize on SR methodologies for investigations of radioactive materials because of improved radiological safety infrastructure, progress in detector technology, and the capability to perform experiments with a small amount of material. In particular, the emergence of microspectroscopic techniques has enabled complex investigations of actinides and can additionally provide an important component of information: spatial distribution.

Several examples from Lawrence Berkeley National Laboratory x-ray SR investigations will be presented including x-ray absorption fine structure (XAFS) studies of the speciation of radionuclides/neutron absorbers in waste form glasses and the chemistry of technetium in highly alkaline solution pertinent to the disposition of waste tank supernate. Another thrust of the actinide molecular environmental science SR program develops and utilizes soft x-ray SR for the investigations of actinide and light element speciation. The results from XAFS studies of light elements in glasses and from x-ray emission spectroscopy investigations of the uranium oxides will be discussed. These vignettes illustrate the capabilities and opportunities that SR, both in the x-ray and soft x-ray regions, provides for actinide molecular environmental science investigations into the future.

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