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### **Characterization of Sorbed Strontium(II) on Monosodium Titanate**

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Beamline(s) X26A and X23A2

**Introduction:** Approximately 130 million L of High-Level Radioactive Waste (HLW) material, the waste product associated with the dissolution of spent fuel rods for the recovery of plutonium, resides in carbon steel subsurface tanks awaiting treatment at the Savannah River Site (SRS). The currently proposed designs for the Salt Processing Facility at the SRS include use of monosodium titanate (MST) to remove the strontium (Sr) and actinides from the HLW. Solid phases such as the titanates have a strong affinity for dissolved  $\text{Sr}^{2+}$  and actinides under conditions relevant to processing of highly alkaline HLW salt solutions but the mechanism of  $\text{Sr}^{2+}$  uptake by MST is not known. Although the salt solutions contain high levels of  $\text{Na}^+$  (several M) which is a potential competitor with  $\text{Sr}^{2+}$  for sorption sites on MST,  $\text{Sr}^{2+}$  is preferred over  $\text{Na}^+$  by MST. This preference for  $\text{Sr}^{2+}$  is not understood and the structure of MST is poorly characterized.

**Methods and Materials:** We characterized  $\text{Sr}^{2+}$  sorption on MST in HLW salt solutions using X-ray absorption fine-structure (XAFS) spectroscopic techniques. Data collection was conducted at the K absorption edge of Sr in fluorescence using a Lytle detector.

**Results:** The speciation of sorbed  $\text{Sr}^{2+}$  on MST does not change over the range of surface  $\text{Sr}^{2+}$  loadings examined in this study. The presence of Ti in the second coordination shell of the sorbed  $\text{Sr}^{2+}$  on the MST suggests that specific adsorption is the predominant mechanism and that electrostatic bonding (also known as ion exchange of hydrated surface-associated species such as dissolved  $\text{Na}^+$ ) does not occur. A 30% decrease on the first shell oxygen coordination number suggests that  $\text{Sr}^{2+}$  undergoes partial dehydration upon sorption to MST. Some structural incorporation of  $\text{Sr}^{2+}$  (as a replacement for structural  $\text{Na}^+$ ) may be operative but there are not enough Ti atoms in the second shell to suggest that this is the primary mechanism of uptake. Interpretations of the EXAFS data and EXAFS-based molecular modeling suggest  $\text{Sr}^{2+}$  may associate with more than one  $\text{TiO}_6$  octahedra (assuming the presence of Ti octahedra because the structure of MST is not known) as a partially hydrated ion. WSRC-MS-2001-00727.