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Characteristics of Uranium species when U(III) in a LiCl-KCl molten salt was leached out with water and ionic liquid

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As a type of spent nuclear fuel treatment, the pyrochemical process is well known for its non-proliferation of nuclear fuel cycles, separation of long-term radioactive nuclides during processing, the recovery of uranium for re-use as a nuclear fuel, and a significant volume-reduction of high-level wastes. After the complete pyrochemical processing is finished, a remaining small amount of salt waste, apart from the salt for recycling purposes, will be stored for the long term and is composed of some actinides and lanthanide species (mainly exist as 3+ ions) dissolved in molten salt. In this study, we investigated the behavior of U(III) dissolved in LiCl-KCl molten salt, when U(III) was leached out with water compared to ionic liquid, to obtain better understandable information for long-term waste salt storage.
A U(III) in LiCl-KCl eutectic salt was prepared from the reaction of uranium metal with cadmium chloride in a LiCl-KCl mixture (44 wt.% LiCl) at 450 oC in an Ar-atmosphere glove box. For a characteristic study of U(III) under stable and unstable conditions, the U(III) in the LiCl-KCl eutectic salt was first dissolved in an appropriate ionic liquid and water.
U(III) is unstable (oxidized) in alkali fluoride molten salt or under general conditions but is stable in LiCl-KCl molten salt. Moreover, the ionic liquid (1-hexyl-3-methyl-imidazolium chloride) used in this research did not cause an oxidation or reduction of U(III) like water does. The behavior of U(III) in LiCl-KCl is dependent on the contacted solvent (ionic liquid or water), and the results, including the actual assignment of each peak of the spectroscopic spectra, were conclusive.

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