Glenn T. Seaborg Center Seminar

Actinides in Aqueous Solution

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4:00 - 5:00 pm
Building 70, Room 3377

The aqueous chemistry of the actinide elements is of fundamental interest and finds applications in nuclear fuels, spent fuel reprocessing, and sequestration of the waste from these processes. Of interest are the hydrolysis reactions of these ions from thorium to curium. Unlike the lanthanides which are predominantly trivalent, the actinides provide a multitude of oxidation states spanning the trivalent to the heptavalent. This diversity of oxidation states both across the series as well as with singular elements allows for a full understanding of both the ion's aqueous chemistry, and the aqueous chemistry of the actinides and their context in the Periodic Table.

The most fundamental of the reactions between a metal ion and water is the hydrolysis reaction. Because of their relative hardness as cations, the actinides form both mononuclear and polynuclear complexes as a consequence of their hydrolysis reactions. These reactions are similar to those observed with the well known reactions of the early second and third row transition metals where polynuclear complex formation is ubiquitous.

We have undertaken a study of the polynuclear complexes of the tetravalent actinides in aqueous solution. These studies necessarily begin with an understanding of the nascent solvated ion progressing through dimeric, hexameric, and larger dissolved species. By coupling synthetic techniques for the preparation and crystallization of the hydrolysis species with X-ray scattering studies of the dissolved complexes in aqueous solution we are able to understand both the hydration, geometry, and oligomerization mechanisms of these species.

Results from our study of Th(IV) in aqueous solution will be presented covering the range of hydrolytic reactions from the aqua ion to the well known thorium colloid. Additionally data from studies on, U(VI), Pu(IV), and Pu(III) will be presented along with a discussion of the opportunities for future work in the field aqueous transuranium chemistry and its relevance.

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