

Complexing Carbon: Pursuing Rare Carbon-Actinide Bonding Motifs

Seminar

Monday,
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3:00 – 4:00 p.m.

Beaupre Center,
Room 105



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The actinides are technologically important elements, specifically in applications related to carbon-free nuclear energy production and nuclear deterrence. Unlike the localized 4f orbitals of the lanthanides, the 5f orbitals of the early actinide series (Th–Am) extend into the valence shell as a consequence of heavy element relativistic effects. This extension should, in principle, make the 5f orbitals chemically accessible, allowing for unique chemistry distinct from that of transition metals. However, eliciting the participation of the 5f-orbitals in chemical bonding still remains poorly understood and a challenge. To this end, our group has been investigating the synthesis of complexes with actinide-carbon bonds to better understand the chemistry and electronic properties of actinide-carbon donor-acceptor bonding interactions. For instance, we have synthesized a series of 4f- and 5f-element complexes in which the metals are tethered to an arene ring, revealing distinctive differences in metal-arene contact distances that are shorter for the actinides. These shorter actinide-arene distances may be suggestive of covalent contributions that are absent in their 4f-analogs. Interestingly, the actinide-arene distance increases across the early actinide series (U – Pu), counter to expected ionic radii trends. This trend suggests that uranium may exhibit particularly unique bonding characteristics within the actinides, highlighting covalent contributions that set it apart from its heavier counterparts.