JAMES MADISON UNIVERSITY

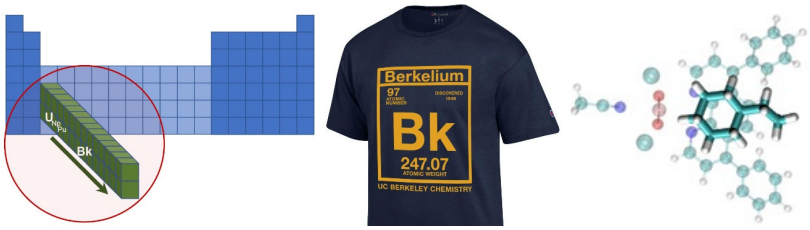
SEMINAR
Monday, Nov. 3, 2025

Dr. Polly L. Arnold

UC Berkeley
Lawrence Berkeley National Laboratory

Organometallic Actinide Chemistry in High Oxidation States

Abstract: The f-block comprises two rows of elements. The first are the lanthanides, or ‚rare-earths' which are essential to many energy technologies and catalysis. The second row are the actinides, present in varied amounts in civil nuclear waste, and a legacy that we have an essential duty to safeguard. To safely manipulate, separate, and recycle these elements, we need a better understanding of the subtleties of their electronic structure and reactivity. This is still poorly-understood due to their large size, and the radioactivity of the actinides, which complicate both computational predictions and experimental manipulation.



We will show some of our work to make unusual new molecules of these metals that makes it easier to manipulate the bonding electrons, study the subtle bonding differences, and demonstrate new reactivity patterns that were previously unanticipated for these metals.

In the earlier actinides, restricting the access of air and water to the traditionally inert actinide dioxo dications such as the uranyl ion, which comprises 98.5% of nuclear waste, opens up previously unobserved, and unexpected, oxo group chemistry including their oxidation of inert alkane C-H bonds.

To study the later actinides, we work on sub-microgram scales in order to isolate new compounds, for example safely making and oxidising new molecules containing the extremely rare berkelium (Bk) isotope,* revealing a surprise in the extent of involvement of the 5f orbitals in the reactivity.

These results contribute to our understanding of these metals that are so important for providing energy justice and a better environment for the future.

References:

Ligand-Directed Actinide Oxo-Bond Manipulation in Actinyl Thiacalix[4]arene Complexes. *Angew. Chem., Int. Ed.* 2025, e202422974. 10.1002/anie.202422974.

The effect of ancillary ligands on hydrocarbon C–H bond functionalization by uranyl photocatalysts. *Chem. Sci.* 2024, 15, 6965-6978. 10.1039/D4SC01310G.

Berkelium–carbon bonding in a tetravalent berkelocene. *Science* 2025, 387, 974-978. doi:10.1126/science.adr3346.

* unfortunately the t-shirt cannon is currently unavailable.

Lunch 12:00 pm, King 259

Seminar 12:30 pm, King 259