CHEMISTRY & BIOCHEMISTRY

UC MERCED

DATE	TIME	LOCATION
09/26/2025	10:30am	GLCR 150

CHEMISTRY & BIOCHEMISTRY SEMINAR SERIES: Organometallic Actinide Chemistry in High Oxidation States

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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.

We will show how we work at sub-microgram scales in order to isolate new compounds of the extremely rare berkelium (Bk) isotope,* and safely strip away its electrons, revealing a surprise in the extent of involvement of the 5f orbitals in the reactivity.

In the earlier actinides, we are finding that restricting access to air and water enables us to understand and now control the activation and functionalization of the oxo groups of the ubiquitous uranyl ion, ligands which are normally considered inert. We will show some reactions that lead to oxo functionalization and rearrangement, and the cleavage of inert hydrocarbon C-H bonds with just visible light photoexcitation.

These results form part of the jigsaw of understanding these important metals that is important for providing energy justice and a better environment for the future.

References:

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

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

* unfortunately the t-shirt cannon is currently unavailable.

About the Speaker:

Polly is a professor of chemistry at the University of California, Berkeley and director of the Chemical Sciences Division at Lawrence Berkeley National Laboratory. Prior to her move in 2020, she held the Crum Brown chair of Chemistry at the University of Edinburgh in Scotland.

Her group studies exploratory synthesis and catalysis with the earth abundant lanthanides, and the electronically fascinating actinides, providing fundamental contributions to our understanding of structure and bonding in the f block.

Last year, she was elected to the American Academy of Arts and Sciences.

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