INORGANIC SEMINAR

Rewriting the Periodic Properties of the *f*-Elements: Fundamental Chemistry of QIS and National Security

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The advent of the nuclear age transformed our society. However, fundamental chemical control of the bonding, reactivity, and electronic properties of the *f*-elements (the lanthanides and actinides) – the elements that drove this initial technological revolution – is still developing. As a result, fulfilling the promise of the nuclear age and rising to the challenge of the quantum information revolution requires solving the fundamental chemical challenge of these elements. How do the remarkable physical and chemical properties of these elements arise from their valence electronic structure? In my research, this broad question is addressed through the synthesis and study of lanthanide and actinide complexes and materials. Despite the market scarcity of many of these elements, *f*-element materials and complexes already play a significant technological role in our society and are deeply ingrained in our economy. My program expands the detailed understanding of the chemical and physical behavior of the *f*-elements and rewrites the fundamental model of the periodic properties of these elements. This new insight into electronic structure and reactivity leads to design principles to enable quantum information technologies and to novel solutions to critical technical issues in national security. In this talk, I will discuss my groups synthetic, spectroscopic (X-ray and neutron scattering), and static and dynamic magnetism studies of high-valent lanthanide and actinide ions in molecular and extended solid systems. This presentation will include discussion of ligand development, redox studies, and consideration of intermediate coupling in the single-ion properties in the physical and chemical properties of these ions in unusual oxidation states and coordination geometries.

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