

SESSION I: SPEAKER ABSTRACTS

Molecular Gymnastics for Bioinspired Energy Transduction

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Metalloproteins represent the redox engines of biology and are responsible for performing thermodynamically and kinetically challenging reactions that underpin global geochemical cycling. With specificities and catalytic efficiencies not yet matched by synthetic systems, our general understanding of how proteins control the formation of high-energy intermediates remains incomplete. Intriguingly, metalloenzyme function is nearly always coupled to conformational changes in which mechanical motions of the protein backbone lead to the selective activation or deactivation of metal ions. Though common in biology, this mechanistic pathway is largely absent from synthetic and artificial inorganic systems. Research in the Olshansky lab aims to mimic this pathway, using mechanical motion to interconvert photochemical, chemical, and electrochemical potential energies. We seek to interrogate, and then harness the interplay between macroscopic conformational changes and angstrom-level or subatomic rearrangements at a metal ion.

Biomimetic metal complexes prepared synthetically are incorporated into stimulus-responsive ligand scaffolds and protein architectures capable of undergoing distinct and observable conformational changes. These changes in conformation result in modulation of metal ion coordination geometry and secondary sphere interactions to affect changes in reactivity. Leveraging energy transduction to do work, applications include solar energy conversion and storage, and the generation of biocompatible 'smart' catalysts and materials for targeted therapeutics and sensing. By developing conformationally dynamic synthetic systems, we seek to drive a new paradigm in catalyst, protein and materials design; one in which conformational changes act as a vehicle for the efficient interconversion of different forms of energy.

