**Title:** Bioorganometallic Redox Catalysis

**Abstract:**

Catalytic disproportionation of 2 H2O2 into 2 H2O and O2 by catalase is an essential redox-neutral reaction that protects cells from damage that would otherwise be caused by accumulation of reactive oxygen species (ROS). Although synthetic manganese complexes have been prepared which mimic the reactivity of catalase/superoxide dismutase, many of these complexes suffer from low activity and poor stability. In addition, these complexes also exhibit significant peroxidase-like reactivity, in which H2O2 is reduced to H2O using a terminal reductant other than H2O2, which can lead to cytotoxic pro-oxidant effects in cells. The dual catalase/peroxidase reactivity of these complexes derives from a common high-valent metal–oxo or –hydroxo intermediate.

The Tennyson Lab previously reported the catalytic reduction of radicals at biologically-relevant potentials in aqueous media using an organometallic ruthenium complex (**Ru1**) using, as terminal reductants, any biomolecule that contains a CH–OH moiety, and even H2O2 itself. Building on mechanistic insights gained during these studies, we demonstrated that **Ru1** could catalyze H2O2 disproportionation into ½ O2 + H2O through a conserved mechanism. Notably, **Ru1** exhibited turnover frequency and turnover number values 11.9- and 120-fold greater than the best-performing manganese-based system. Furthermore, Ru1 exhibited catalase reactivity nearly 4 orders of magnitude higher than its peroxidase reactivity, a ratio nearly 90-fold greater than the highest value observed with manganese-based systems.