Multi-electron photo-catalysts

Our ultimate goal is to develop light-driven, multi-electron, transition-metal catalysts for producing Solar Fuels as a replacement for fossil oil. A fundamental unresolved problem in catalysis research is the direct experimental correlation of reaction kinetics with the electronic-vibrational dynamics of the catalyst. To address this, we are developing a new experimental methodology that allows photon-controlled step-wise access to catalytic intermediates.

We have recently demonstrated intramolecular light-induced activation of a Salen-Mn$^{III}$ epoxidation catalyst by a ruthenium polypyridyl photosensitizer. This project will involve synthesis of the Ru$^{III}$-Salen-Mn$^{III}$ photosensitizer–catalyst and utilise a purpose-built CCD spectrograph to (i) investigate and model the light-driven kinetics of Mn$^{IV}$ formation, and (ii) characterize a catalyst intermediate that absorbs in the near IR region. Investigations of reaction conditions required to drive product formation, in particular targeting water activation as the oxygen atom source for the two-electron epoxidation reaction can also form part of the project.