# Chemical, Electrochemical, and Photochemical Studies of Fuel-Forming Catalysis

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Sustainable fuels and useful chemicals could be generated by catalytic technologies that harness renewable feedstocks like water and carbon dioxide. Transition metal catalysts can orchestrate the bond-breaking and -making steps in these complex transformations, but more efficient and selective catalysts are needed. In the Blakemore group, we aim to develop new catalysts and study the mechanism(s) by which catalysts operate, with the goal of gaining insights that will enable preparation of more effective systems.

In one project of current interest, various rhenium and manganese carbonyl complexes are being synthesized, characterized, and tested as catalysts for $CO_2$ reduction. In this project, students will carry out synthesis of ligand environments that support transition metals, prepare metal complexes, and characterize them by NMR, X-ray crystallography, and mass spectrometry. The complexes will then be studied by chemical and electrochemical means, to determine their utility as $CO_2$-reduction catalysts. Suitable catalysts will then be used to generate fuel or fuel precursors, which can be measured by gas chromatography.

In order to carry out these experiments, REU students working in the Blakemore Lab are mentored in the needed experimental techniques. These include air- and moisture-free techniques, enabled by use of Schlenk lines, inert atmosphere gloveboxes, and custom-made glassware. Advanced equipment available at KU, including EPR spectroscopy, electrochemistry, and photochemical apparatus, will be used to study the reactivity of the new compounds.

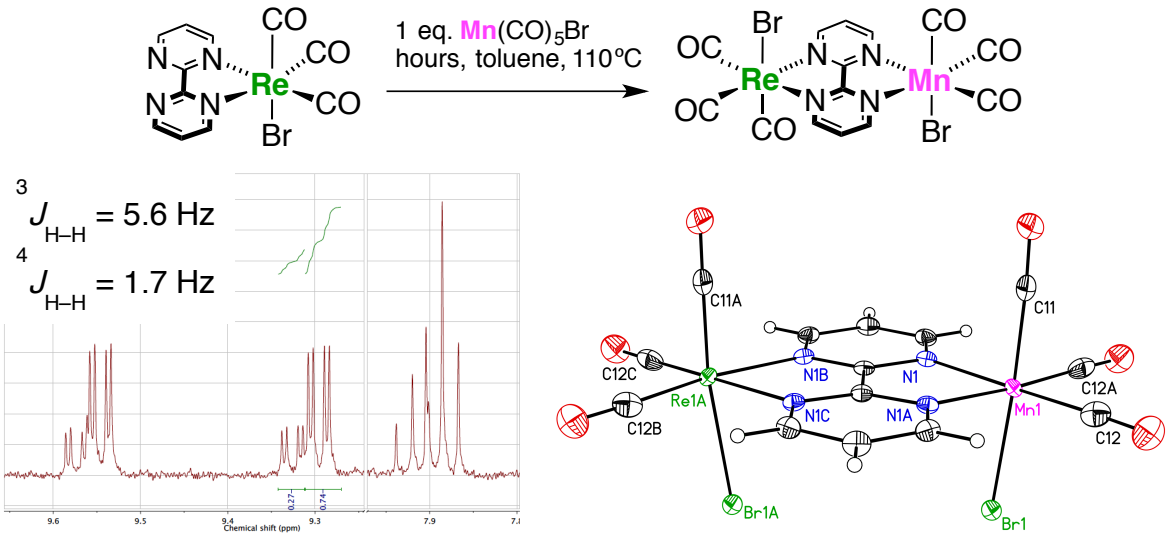


*Figure shows synthetic route for preparation of a new heterobimetallic manganese and rhenium compound. NMR spectroscopy and X-ray crystallography are both applied to understand the nature of the synthesized material.*