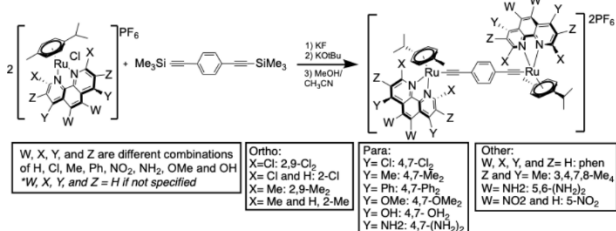


The Utility of Organometallic Chemistry – Molecular Wires and Electron Transfers

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The use of organometallic transition metal complexes has had a significant impact in the field of organic chemistry as these complexes function as catalysts, and now nearly all organic syntheses of any complexity include at least one metal-catalyzed reaction. More recently, metal containing complexes are being recognized for biological roles and are 1) being explored for medicinal

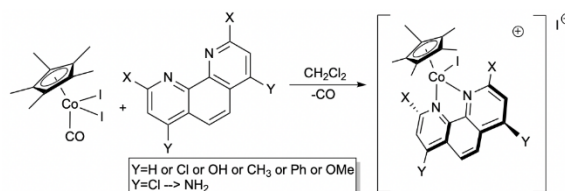
purposes and 2) design of electron transfer mimics (e.g., artificial photosynthesis). These latter two examples are related to the proposed chemistry below as both the Ru and Co compounds (see below) could potentially be utilized as anti-cancer agents and/or in electron transfer reactions.



Scheme 1

two projects. Project 1 is the synthesis of electronically tunable molecular wires involving ruthenium (Scheme 1). The Ru ions in these compounds are proposed to electronically communicate with one another via the bridging doubly deprotonated 1,4-diethynylbenzene (DEB) ligand to result in what is called a mixed valent system. The tunable nature of the compound will initially be accomplished through the bidentate phenanthroline (phen) ligand, where the W, X, Y, and Z groups can be readily changed. Two potential applications of these compounds involve either exploring them as anti-cancer agents or serve as mixed valent compounds in dye-sensitized solar cells. Project 2 is the synthesis of electronically tunable electrocatalysts involving cobalt (Scheme 2). The Co ions in these compounds have shown an irreversible Co(III) to Co(IV) oxidation, which could be used to drive high-potential chemical transformations, such as catalytic water oxidation (i.e., the oxygen evolution reaction). The tunable nature of the compound will initially be accomplished through the bidentate phenanthroline (phen) ligand that can be readily changed to observe a change in the Co(III) to Co(IV) oxidation. Two potential applications of these compounds involve either exploring them as anti-cancer agents or serving as electron transfer mediators. Regardless of project, your primary goal will be in the development (and optimization) of syntheses of these type compounds. You will also learn both new advanced analytical techniques and structure elucidation, such as cyclic voltammetry used to explore electron transfer reactions and single-crystal X-ray crystallography, respectively.

In addition to working on current challenges in inorganic chemistry, you will learn synthetic inorganic and organometallic chemistry, including air-free chemistry in a nitrogen filled glove box and Schlenk techniques. A significant amount of the Department's instrumentation will be used for characterization, which includes NMR spectroscopy, infrared and UV-vis spectroscopy, cyclic voltammetry (electrochemistry), and single-crystal X-ray diffraction through an external collaboration. In addition, you will be encouraged to present your work at either a Regional or National meeting of the American Chemical Society.



Scheme 2

Students in my group have gone on to pursue a PhD in chemistry at UTK, Texas A&M and Delaware, pursue professional degrees in medicine and pharmacy at UT Memphis, and have found positions in industry immediately after graduation. These students have presented at regional and national meetings of the American Chemical Society and in some cases had their results published in peer-reviewed journals such as *Polyhedron* and *Journal of Coordination Chemistry*.