Understanding the redox chemistry of organometallic molecular species is the fundamental research initiative of the Ringenberg group. Electrochemistry is a key factor to studying to every complexes of interest. While electrochemistry can give us both quantitative and qualitative information about the various complexes, there is still critical information missing from the measurement and this is especially relevant when the organometallic systems contain multiple redox active species, i.e., redox-active non-innocent ligands. By performing the electrochemistry in side of the spectrometer we can gain valuable electronic and structural information to help us better understand the different redox events.

While both electrochemistry and spectroscopy may be difficult to understand, a hand on experience is often the best way to master the concept. Students are not expected to be experts, instead curiosity and excitement to learn are typically all that is required. In the end “Don’t Panic!”, I will alway be available to discuss results and hopefully together we can learn and understand something new and exciting.

Literature:

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Redox-active/Non-Innocent Ligands and Organometallic Complexes

The main theme of the Ringenberg Lab is molecular organometallic chemistry of complexes containing redox-active non-innocent ligands and spectro-electrochemistry. This means that there is a redox active group bound to a transition metal atom. When these species are oxidized or reduced, it is not always clear where this redox event takes place, resulting in distribution of charge over several atoms. This distribution helps to stabilize unpaired electrons and often results in interesting reactivity.

Ferrocene based ligands are the primary interest as they can act to stabilize unpaired electrons through distribution of charge over the central metal atom and the iron atom in the ligand. We are also interested in “classic” ligands such as carbonyl, cyanide, nitrosyl, etc, because they can also be used to stabilize different charge states but more importantly they are excellent reporter ligands that provide information about the electronic state and structural information.

Literature:
Angew. Chemie Int. Ed. 2012, 51, 10228
Inorg. Chem. 2017, 56, 7501

What to expected as a bachelor project?

Bachelor projects involve at least some synthesis of (sensitive) complexes; the amount depends on the complexity of the target compound. Students are expected to learn and do electrochemistry independently. Spectroelectrochemistry and analysis will be performed together with an expert (myself or a Phd student). EPR will be performed by myself or in collaboration with other working groups. Each student is expected to have at least one complex fully characterized (i.e. elemental analysis, IR, UV-Vis, and NMR (1H, 3P etc), and crystals when possible). Computational analysis (DFT) is also often required and will also be performed when relevant. Only one fully characterized new complex is expected for a Bachelorarbeit/FP, when possible more compounds are always welcomed, and maybe of interest once you understand how to perform all the different techniques, although this depends on time.

What is the work schedule?

All students are expected to work safely. The main goal is to have clean products in the end, yields are not as important. The first two months are spent working in the lab. Writing can be starting from the first successful synthesis, however, the first month is primarily establishing synthesis and learning techniques. The second month is used to measure voltammetry and the spectroscopy. The final two months are usually used to understand the results and writing up the results. A full draft (English or German) is expected at least 1 month before the thesis to be handed in. This allows for ample time to revise and to make sure all complexes/measurements meet the standards for publication.