

The objective of this research project is to synthesize (make) new and novel materials (polymers) and chemical complexes. The complex to be synthesized will be cyclopentadiene tris benzyl isocyanide iron (I) hexafluorophosphate. Organometallic chemistry is a special area of chemistry between organic (carbon and hydrogen containing compounds) and inorganic (compounds that contain metals).

The project will start by taking a commercially available compound, ferrocene, also referred to as a “sandwich compound” because it consists of an iron atom sandwiched between 2 rings of 5 carbons called cyclopentadiene. It will be oxidized to go from the neutral compound to the cation (positively charged form) called ferrocenium ion. Then, it will be reacted with another molecule called a ligand-the ligand that will be used is benzyl isocyanide.



Benzyl isocyanide is a 6-carbon ring where the carbons are connected to each other with alternating single and double bonds. This benzyl ring is then attached to an isocyanide that is a nitrogen atom triple bonded to carbon atom. The reaction of the ferrocenium ion with the isocyanide will cause 1 of the cyclopentadienyl rings on the ferrocenium ion to be removed and 3 of the isocyanide will take its place. The resulting complex is called a “ferrocene piano stool” because the complex has 1 cyclopentadienyl ring (seat of the stool) connected to the iron atom (base of the stool) that then has 3 ligands (three legs of the stool).

The apprentice will make this complex – then, they will purify the complex and perform the analysis to confirm the structure of the compound using the various instruments: Ultraviolet-Visible Spectrophotometer (UV-Vis), Fourier Transform Infrared Spectroscopy (FT-IR), Nuclear Magnetic Resonance (NMR), elemental analysis and cyclic voltammetry analysis. The resulting ferrocene piano stool is of interest in providing fundamental information about charge transfer reactions that are the processes used in photosynthesis. Similar complexes to this have also been found to have useful characteristics due to their electrochemical, electronic, optoelectronic, catalytic and biological properties.

#### References:

- <sup>1</sup>Mahmoud A. Hussein & Abdullah M Asiri (2012) Organometallic Ferrocene-and Phosphorus-Containing Poymers: Synthesis and Characterization, *Designed Monomers and Polymers*, **15:3**, 207-251, DOI: 10.1163/156855511X615650
- <sup>2</sup>Rudolf Pietschnig, Polymers with Pendent Ferrocene, *Chem. Soc. Rev.*, 2016, **45**, 5216-5231 DOI: 10.1039/C6CS00196C
- <sup>3</sup>B.D. Humphrey, R.E. Castillo, A.H. Vega, A Feliciano, M. E. Squires, The Synthesis and Cyclic Voltammetry of Select Ferrocene Piano-Stool Isocyanide Complexes, 2011, *Inorganic Chimica Acta*, **368**: 1, 271-271 DOI: 10.1016/j.ica.2011.01.02

