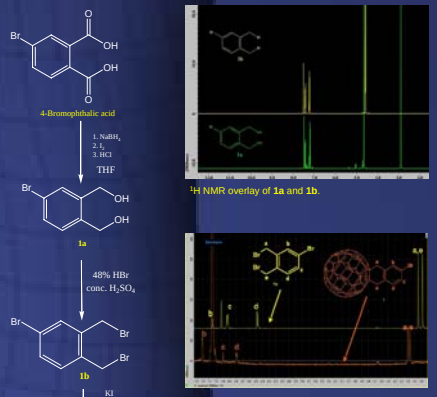
Synthesis of a novel fullerene-bipyridine ligand for photoelectric applications

Joel Deye Faculty Mentor: Keith A. Walters
Department of Chemistry, Northern Kentucky University, Highland Heights, KY 41099

Objective: The primary objective of our research is to synthesize supramolecular systems that move electrons efficiently when excited by a photon of light. One such system is in development: two fullerene "handles" connected through a conjugated bipyridine "bridge." Fullerenes (C_{60}) have large cross areas which enable them to absorb photons of light. Fullerenes also have extensive conjugated pi systems, allowing them to be "dumping grounds" for excess electrons. Our supramolecular system (molecule 2), when coordinated with a transition metal, has great potential for photon induced charge transfer applications. The fullerenes accept a photon of light, exciting electrons to a higher energy state, and transfer those electrons to the coordinated metal which conducts the charge out of the system, or vice-versa. Practical uses for our system include solar cells, molecular devices, computer applications, or other areas where molecules need to interact with light.

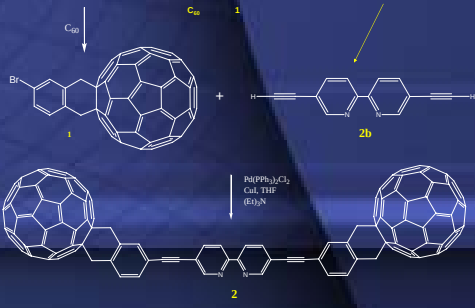
Fullerene "Handle" Synthesis

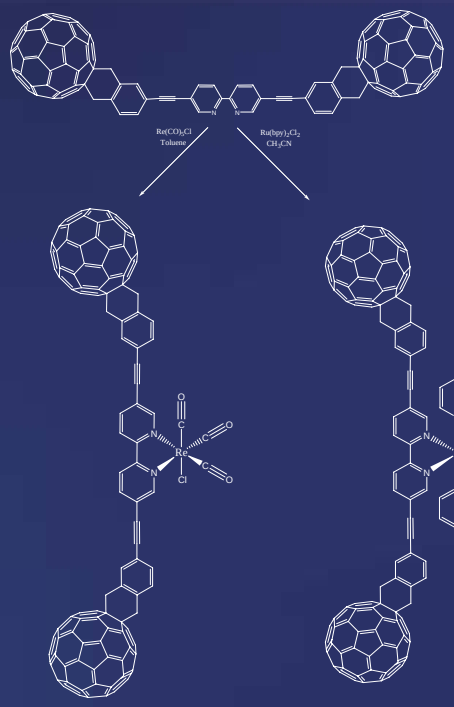


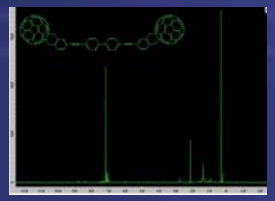
^{1}H NMR overlay of **1a** and **1b**.

^{1}H NMR overlay of **1b** and **1**.

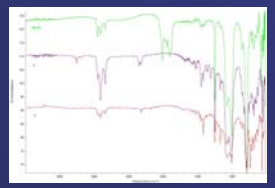
Bipyridine "Bridge" Synthesis[8]
See neighboring poster by Celeste Morris* & Sean Goins*







^{1}H NMR of ligand **2**.

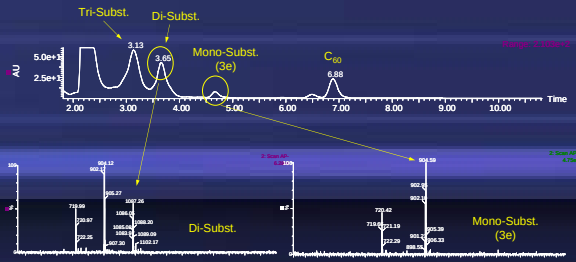


ATR-FTIR overlay of "handle **1**, ligand **2**, and the **2M-Re** complex.

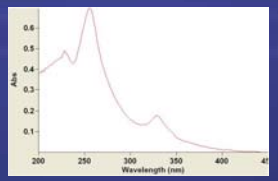
As shown in the IR overlay above, the telltale stretches associated with the fullerene are consistent throughout supporting successful syntheses. Also, the carbonyl stretches from the rhenium complex are quite evident, further indicating success.

The Ultraviolet-visible spectra at right show the expected emission(s) for fullerene.[10] However, the rhenium complex shows additional emission which could be evidence of some kind of "communication" between the fullerene and the metal.[9] This is very exciting as the main goal of this project is to construct a system that allows for such interaction between fullerenes and transition metals.

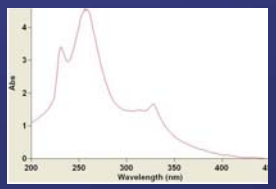
HPLC/MS (IPA/Hexanes) of 1



UV-Vis Absorption Spectra

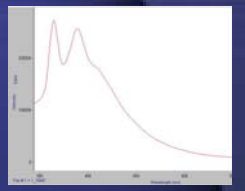


1 in $MeCl_2$

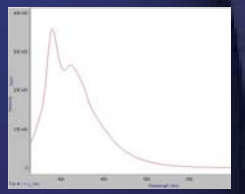


2 in $MeCl_2$

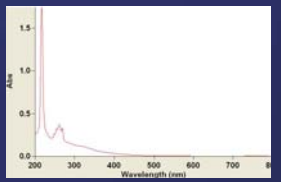
UV-Vis Emission Spectra



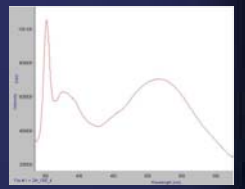
1 in $MeCl_2$



2 in $MeCl_2$



2M-Re in THF



2M-Re in THF

Next Steps: The next phases of the project are to characterize the metal complexes of 2 and investigate the photochemical properties of these complexes. Studies to be performed include transient absorption (Nd-YAG laser!) and Stark spectroscopy. This next phase is fast approaching and will be achieved within the next year, making this an exciting time to be involved with the Walters Research Group.

Acknowledgements

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