James Wilkes

Synthesis of a Benzyl Modified Nickel Cyclam for CO_2 Reduction

This presentation describes the successful attempt to synthesize a hybrid photocatalysis capable of reducing carbon dioxide into carbon monoxide, an efficient solar fuel when paired with hydrogen gas. Solar fuels are energy rich complexes (ex. hydrocarbons, hydrogen, or ammonia) that can be synthesized using solar energy through abundant precursors (CO_2, water, nitrogen). Many breakthroughs in pathways converting solar energy to electrical energy have been made, but solar fuels involve making liquid and gaseous forms of energy, something that has not been studies as extensively or with as much success. Specifically, this project is designed to synthesize and tests the effects that linkers have on the photocatalytic rates of solar fuels production for the nickel photocatalysts. The idea being that the closer the molecular catalyst is to the light absorbing species, the higher the turnover numbers of CO production, thus a higher photocatalytic rate of the solar fuel. The primary research in this thesis is to synthesize the transition metal molecular photocatalyst, with a linker attached. The nickel centered catalyst is bound with a cyclam backbone and the linker is a benzyl group. This complex was successfully synthesized and characterized using ^{1}H NMR and previous crystallography with a cobalt complex in the same cyclam backbone. Since only one species was synthesized, the comparison of different species was not done. The synthetic procedure resulted in poor yields that leads this to be a good project down the line to smooth out the steps to get a higher yield and test the effectiveness of the carbon dioxide conversion.