Development of silver catalysts for renewable energy storage
Mohammed Chowdhury, 2025

The emission of greenhouse gasses from anthropogenic activity puts our planet at risk. Global average surface temperatures rose about 1 C since the pre-industrial era (Lindsey & Dahlman, 2024). Such warming leads to rising sea levels, more severe natural disasters, loss of species, and more. Accounting for over 75% of global greenhouse gas emissions, fossil fuels are the largest contributor to global warming (Causes and Effects, n.d.).

Synthetic hydrocarbon fuels produced through a carbon-neutral cycle can be part of the solution (Figure 1). First, an input of electricity from a renewable source splits water into oxygen and hydrogen subunits. Then, a catalyst, or facilitatory molecule, helps hydrogen gas react with carbon dioxide to form liquid fuel. When burned, this fuel releases energy and carbon dioxide. Since this cycle removes carbon dioxide to begin with, the overall process remains carbon-neutral. By providing energy with net-zero greenhouse gas emissions, synthetic hydrocarbon fuels can help tackle climate change.

This summer, I worked to develop a catalyst to facilitate the combination of hydrogen and carbon dioxide into liquid fuel. While there are several types of catalysts that are known to activate hydrogen, significant challenges remain in advancing the reaction with carbon dioxide. Due to their chemical properties, transition metals show great potential as a building block. To create the catalyst, I conducted protocols in a stepwise fashion—I took NMRs to identify products from preceding protocols to use in subsequent protocols. Since this method often leads to losses in yield, I explored techniques to preserve more yield. By the end of the summer, I synthesized 6Dipp-Ag-Br on a larger scale than previously achieved. 6Dipp-Ag-Br is the precursor to amide, alkoxide, and fluoride catalysts. I can use this 6Dipp-Ag-Br in future research to synthesize these catalysts and investigate their effectiveness in hydrocarbon fuel formation.

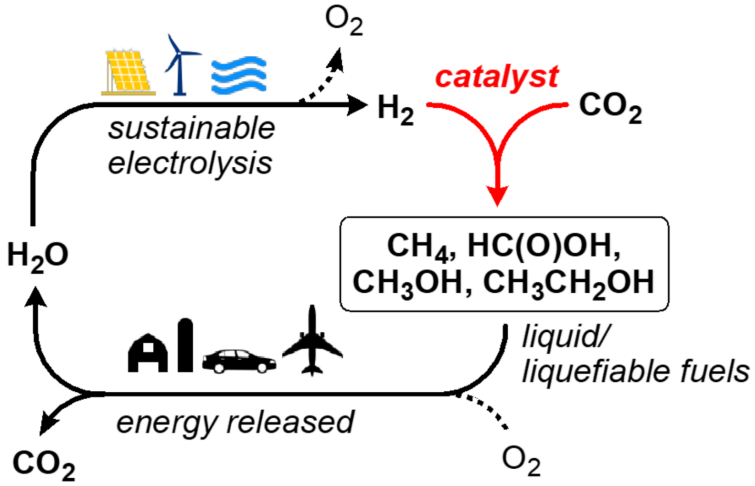

Figure 1. Hydrogen is derived from the splitting of water. This hydrogen combines with carbon dioxide to store and release energy in a carbon-neutral cycle. Represented by the red segment, the ultimate goal of this research project is to create a silver catalyst to facilitate the reaction between hydrogen and carbon dioxide.

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References:

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