

## Synthesis of Bimetallic Catalyst for Hydrogen Activation

Eliana Roberts, Class of 2023

A growing amount of chemical research and development is in the area of activating hydrogen gas ( $H_2$ ) towards reactions with carbon dioxide ( $CO_2$ ) by using hydrogen ( $H_2$ ) as a reagent in a process called hydrogenation. With increasing concern about climate change and the detrimental effects of burning fossil fuels, efficient hydrogenation of  $CO_2$  would enable sustainable production of carbon-neutral fuels, consisting primarily of simple hydrocarbons for the storage of renewable energy (Figure 1). However, the hydrogenation of  $CO_2$  is a slow and challenging process in the absence of a catalyst, a reagent that allows for the reaction to progress faster and under industrially accessible conditions.

**Figure 1.** The cycle by which hydrogenation of  $CO_2$  results in carbon neutral fuel<sup>1</sup>

This project focuses on the synthesis a bimetallic catalyst, or a catalyst consisting of an organic compound bonded to two separate metal centers of different identities. Our desired ligand is a compound first published by Green et al.<sup>2</sup> in 2004 (Figure 2).

**Figure 2.** Proposed bifunctional ligand inspired by Green et al.<sup>2</sup>

Over the course of the summer, previous work from an independent study in the spring of 2022 was expanded upon in the synthesis of our desired bifunctional ligand. In the reaction scheme shown below (Figure 3), the total reaction scheme for the production of the tert-butyl substituted precursor ligand. Following the procedure outlined by Green et al.<sup>2</sup> with slight alterations, the overall yield of the reaction has been improved. These alterations include the use of a one-pot synthesis combining step 1 and step 2 of the

