

Evaluation of Copper Photo-Catalysts in the Synthesis of Chiral Molecules

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In contemporary chemistry, and especially in the pharmaceutical/biomedical field, photoredox catalysis has proven to be an important strategy in the synthesis of new compounds. In reactions utilizing photoredox catalysis, visible light is absorbed by the catalyst to promote it into an excited state, where then a free radical-driven electron transfer reaction is initiated. Previously published reports of this technique have primarily used ruthenium and iridium-based photoredox catalysts; unfortunately, these elements are both expensive rare-earth metals and are thus unsustainable for long-term use. However, potential solutions to this problem exist: certain complexes formed from copper metal have shown promise in their ability to exhibit similar photophysical properties as those formed from ruthenium, and copper is known to be vastly earth-abundant and relatively inexpensive. For these reasons, the Jensen lab has focused on evaluating the effect of bis(phenanthroline) copper(I) derivatives in the catalysis of enantioselective alpha-alkylation of aldehydes – a reaction that is facilitated by a chiral catalyst to control facial selectivity. In the course of this ongoing investigation, a number of copper(I) complexes have been tested under a range of differing reaction conditions, including those with varied solvents, light sources, and work-up procedures. Our initial results suggest that ligand substitution has a significant effect on reactant conversion, product yield, and enantiomeric excess. In this presentation, we will present collective data from our trials, explain how yield may have been affected by the experimental factors listed above, and provide a comparison of this reaction mechanism against those conventionally used in larger industrial applications.