

The Photochemical Reduction of CO₂ Using Organic Photocatalysts

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Project Direction: The large reorganizational energy required to reduce CO₂ necessitates the use of high-energy starting materials or largely negative reduction potentials for such transformations into its reduced products. We aim to use *N*-heterocyclic carbenes (NHCs) as a catalyst to assist in the reduction of CO₂ by forming zwitterionic adducts known collectively as imidazolium carboxylates (NHC-CO₂). Fluorescence quenching data of various organic sensitizers with 1,3-dimethylimidazolium carboxylate suggest the initial electron transfer step is exergonic. Our proposed mechanism includes homolysis of the reduced imidazolium carboxylate which, in some cases leads to generation of the formate ion. Our next goals include, but are not limited to:

- Identifying the E_{ox}^* at which the initial electron transfer step becomes unfavorable.
- Finding the right solvent/compound ratios/photolysis time conditions at which the production of formate/oxalate is best by analysis of ¹H and ¹³C NMR.
- Modification of the NHCs (steric and electronic) which may increase the rate of the proposed homolysis step in our mechanism.
- Identifying the imidazolium carboxylate radical anion by Laser Flash Photolysis.

