

Project 2.2 CO₂CHEM – redox-neutral photocatalytic C-H carboxylation of hydrocarbons with CO₂

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Unit: Group XV

www: https://ww2.icho.edu.pl/gryko_group/index.html

Background:

Biological photosynthesis is the essential molecular process for life on earth converting solar energy into energy-enriched molecules. Recent years have seen large efforts in mimicking this process by technical methods, some of which e.g. H₂, CH₄, or CH₃OH from the reduction of CO₂ or syngas (H₂/ CO) have already reached high technological levels up to pilot plants. In contrast, the solar-driven synthesis of other valuable chemicals using CO₂ is still at a very early stage of development. So far, CO₂ is only used to a small extent as a raw material in chemical synthesis. Chemical activation of CO₂ in these reactions requires reactive reaction partners. Solar-driven reactions may therefore provide advantageous alternatives.

Aim:

The general goal of this proposal is to develop the synthetic and mechanistic basis for the photocatalytic, redox-neutral C-H carboxylation of saturated hydrocarbons with CO₂. To address this challenge, we propose new synthetic strategies based on photocatalytically generated alkyl radicals and earth-abundant metal complexes to provide C-H carboxylation in an overall redox-neutral process.

Within this PhD project, the goal is to develop an efficient photo-organo-metal catalyzed C-H carbonylation with CO generated in situ. This will also include design and synthesis of cobalt-complexes for collaborators.

The project will be realized in strong collaboration with prof. B König from the Faculty of Chemistry and Pharmacy, University of Regensburg, Germany.

In particular, the main tasks will involve:

- design and synthesis of cobalt-complexes and their evaluation in photo-organo-metal catalyzed C-H carbonylation with CO generated in situ;
- investigations on the photo-organo-metal catalyzed C-H carbonylation with CO generated in situ;
- mechanistic investigation on the most interesting C-H carboxylations;
- scope and limitation studies;
- preparation of manuscripts.

Requirements:

- Master's degree in chemistry;
- experience in organic or related;
- other skills include analysis and interpretation of experimental data (NMR, MS, UV/Vis);
- demonstrated experience in research work will be an asset;
- effective written and oral communication in English