Project 2.3 CO_2CHEM – wykorzystanie CO_2 w redoks neutralnym C-H karboksylowaniu na drodze fotokatalitycznej.

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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 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.
In particular, the goal of a PhD will study a model C-H carboxylation of aliphatic hydrocarbons via single electron-reduction of CO2. This will include choosing a suitable dye for the C-H carboxylation of aliphatic hydrocarbons via single electron-reduction of CO2.
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 photocatalysts absorbing in the red light and determination of their optical properties;
- choosing a suitable dye for the C-H carboxylation of aliphatic hydrocarbons via single electron-reduction of CO2;
- investigations on the photocatalytic generation of the radical anion of CO2;
- design and synthesis of cobalt-complexes for C-H carboxylation of aliphatic hydrocarbons via addition of CO2 to Co-C bonds;
- evaluation of the binding of CO2 directly from the atmosphere and it's fixation in the form of fine-chemicals into developed reactions;
- preparation of manuscripts.

Requirements:

- master 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