

## Bachelorthesis

*cand. B. Sc. XXXXXXXX*  
*Matrikelnummer: XXXXXXXX*

### Synthesis and characterisation of a redox-functional MOF electrode coating for electro-biotechnological applications

#### Background:

Electrification of chemical syntheses in the pharmaceutical and petrochemical industries is aimed at reducing CO<sub>2</sub> emissions. However, purely electrochemical synthesis is usually not feasible for many products. A promising alternative is the coupling of electrodes with biotechnological systems, which opens up ways to more sustainable industrial processes. Some industrially relevant products can already be synthesised by enzymes (e.g. green catalysts) in biological reactions, but expensive co-factors such as NADH and FAD are usually required. An elegant solution is the electrochemical regeneration of these co-factors by means of redox-media-tors at an electrode in order to reduce the costs for the use of co-factors. Accordingly, an efficient transfer of electrons from the electrode to the mediator and via the mediator to the co-factor or enzyme can take place via a rever-sible redox reaction.

The aim of this work is to develop novel, biohybrid materials that concentrate redox mediators together with biological components locally in close proximity to the electrode in a porous, structured layer. The key component of this layer is a metal-organic framework (MOF), which serves as a scaffold and enables the retention of redox mediators as well as biological compounds such as enzymes and their co-factors. By fine-tuning the pore size and hydrophobicity of the MOF, the aim is for the mediators to accumulate strongly in the pores of the MOF, allowing the mediator to diffuse to the electrode surface to transfer its electrons. This enables an increase in the electrochemical regeneration of the co-factor, which then drives the enzymatic reactions to produce industrially relevant, value-added compounds such as active pharmaceutical ingredients (APIs).

#### Task definition:

The aim of the bachelor thesis is the synthesis and electrochemical characterisation of a novel self-assembling, redox-functional MOF electrode coating:

- Synthesis of a MOF coating for an electrode surface
- Characterisation of the electrode coating using scanning electron microscopy (SEM)
- Electrochemical characterisation of the electrode with a model reaction
- Investigation of the loading of the electrode layer with mediators and initial preliminary investigations for use in the electro-enzymatic system

#### Supervision:

In addition to the scientific supervision by Prof. Dr Matthias Franzreb, XXXX is supported in the practical implementation of the work by Dr Hartmut Gliemann, Dr André Tschöpe and Michael Abt.



Prof. Dr.-Ing. habil Matthias Franzreb

Startdate:

Enddate: