Inorganic Materials & catalysis

Research Project

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INORGANIC MATERIALS & CATALYSIS

CO_2 reduction to ethylene and ethanol with Cu-based electrocatalysts

Background:

The current global energy demand is mainly met with fossil fuels. However, this source of energy does not provide great prospects for the future due to its rapid depletion and polluting nature (e.g. emission of greenhouse gases such as CO_2). Renewable energy sources, like solar and wind energy, might be more promising alternatives. Yet, the fluctuation of generated energy over time, caused by for example differences in sun radiation and wind power, should be taken into account. At peak moments, the excess energy should ideally be stored somewhere else. This might be in batteries, but another powerful approach is to utilize this energy together with CO_2 and convert it to more valuable chemicals such as ethylene and ethanol.

Copper was found to be the only transition metal that achieves reasonable faradaic efficiencies for the reduction of CO_2 to longer chain hydrocarbons and alcohols. The products that could be formed depends on for example the nature of the electrolyte, the diffusion mechanisms of CO_2 and the morphology of the catalyst [1,2].

The aim of this project is to synthesize highly efficient and stable Cu-based electrocatalysts for industrially relevant conditions to produce ethylene and ethanol. These catalysts need to be implemented gas diffusion electrodes (GDEs) (see **Figure 1**) to achieve reasonable current densities [2]. Consequently, the systems will be characterized and tested in an electrochemical flow cell [3] to gain more insight in the active sites and stability of the catalyst.

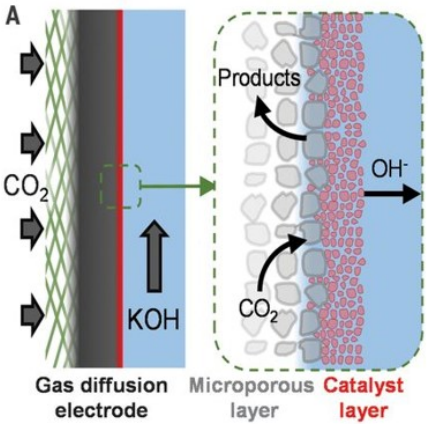

***Figure 1**. Schematic illustration of a cathode in a GDE for the CO_2 reduction reaction [2].*

Research goals:

- Synthesis of Cu-based catalysts for the electrochemical reduction of CO_2 to valuable C_{2+} products.
- Integration of the electrocatalysts in GDEs.
- Study of the evolution of the active sites of fresh and used catalysts by utilizing conventional electrochemical methods (e.g. cyclic voltammetry, linear sweep voltammetry) as well as XPS, XRD, SEM, RAMAN and IR spectroscopy.
- Investigation of the activity and stability of the catalysts in flow cells for electrochemical conditions (e.g. pH and potential).

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References:

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