Electrochemical reduction of CO_2 into C2/C3 alcohols on tailored designed copper catalysts

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The electrochemical reduction of CO_2 (in the following referred to as CO_2RR) into products of higher value offers the unique chance to make a significant contribution to the closing of the anthropogenic CO_2 cycle and is therefore currently in the focus of research activities worldwide. Energy is needed for such electro-conversion processes might originate from excesses of renewables like hydro, wind and solar energy (power to value concept). A key challenge of the process development remains the product selectivity of the CO_2RR which can be directed by the choice of the catalyst required for such an electrochemical CO_2 conversion. Among the vast number of materials screened so far, it is Cu which deserves particular attention since it is the only catalyst which is capable to convert CO_2 into hydrocarbons and alcohols in considerable amounts.

In this study we focus on improved Cu catalysts which were obtained by an electrodeposition approach using 2D Cu meshes as technical supports. The catalysts were physically characterized by scanning electron microscopy (SEM), energy dispersive X-Ray spectroscopy (EDAX), X-Ray diffraction (XRD) and transmission electron microscopy (TEM). Potentiostatic electrolysis was carried out in CO_2 saturated aqueous 0.5 M $KHCO_3$ electrolyte. CO_2RR products were analyzed by gas chromatography (GC) and ion chromatography (IC) techniques.

We will demonstrate a superior activity of our Cu catalysts with highly valuable C2 (ethanol) and C3 (propanol) alcohols as CO_2RR products reaching a total faradaic efficiency of $FE_{alcohol} \sim 25\%$ at a moderate overpotential. High-resolution identical location SEM inspection was carried out prior and after the CO_2RR demonstrating that the actually active catalyst is formed only under *operando* condition of an ongoing CO_2RR.

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