

## Electrochemical reduction of CO<sub>2</sub> into C2/C3 alcohols on tailored designed copper catalysts

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The electrochemical reduction of CO<sub>2</sub> (in the following referred to as CO<sub>2</sub>RR) into products of higher value offers the unique chance to make a significant contribution to the closing of the anthropogenic CO<sub>2</sub> 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<sub>2</sub>RR which can be directed by the choice of the catalyst required for such an electrochemical CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> saturated aqueous 0.5 M KHCO<sub>3</sub> electrolyte. CO<sub>2</sub>RR 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<sub>2</sub>RR products reaching a total faradaic efficiency of  $FE_{\text{alcohol}} \sim 25\%$  at a moderate overpotential. High-resolution identical location SEM inspection was carried out prior and after the CO<sub>2</sub>RR demonstrating that the actually active catalyst is formed only under *operando* condition of an ongoing CO<sub>2</sub>RR.

[1] Y. Hori, A. Murata, R. Takahashi, *J. Chem. Soc., Faraday Trans.*, **1989**, 85, 2309–2326

[2] S. Ma, M. Sadakiyo, R. Luo, M. Heima, M. Yamauchi, P. J. A. Kenis, *J. Power Source*, **2016**, 301, 219-228

[3] A. Dutta, M. Rahaman, N. C. Luedi, M. Mohos, and P. Broekmann, *ACS Catal.*, **2016**, 6 (6), 3804–3814