École polytechnique fédérale de Lausanne (EPFL) Valais/Wallis
Institute of Chemical Sciences and Engineering (ISIC)
Basic Science Faculty (SB)
Energypolis, Rue de l'Industrie 17, CH-1950 Sion, Switzerland

ENERGYPOLIS SEMINAR

10. 11. 2016, 16:00 - 17:00, ENERGYPOLIS Sion, 4th floor, Seminar room

The effect of morphology and process conditions on the performance of Cu based electrodes in electrochemical CO_2 reduction

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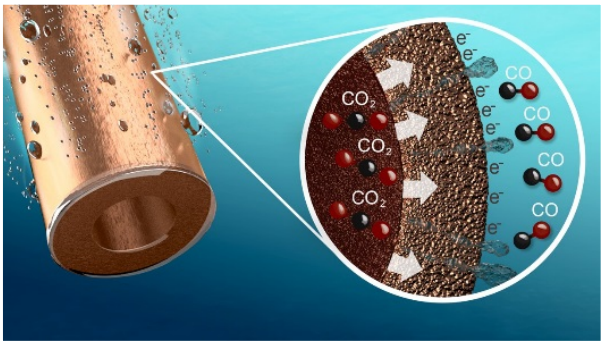
Electrochemistry is a technology that sees a revival in the number of applications and publications, because of fluctuations in renewable electricity production, with periods of over-capacity, resulting in low, or even negative electricity prices. To utilize this electricity the PCS group of the University of Twente conducts research to effectively convert CO_2. Three aspects of Cu catalyzed CO_2 reduction will be discussed during the presentation. i) The structure and oxidation state of Cu_2O derived Cu electrodes when active in CO_2 reduction will be addressed[1]. It will be shown that the selectivity of CO_2 reduction largely depends on the thickness of the parent Cu_2O film, rather than on the initial crystal orientation. It will also be shown by online mass spectroscopy studies combined with X-ray diffraction and Raman data that reduction of the Cu_2O films in the presence of CO_2, generating a nanoparticulate Cu morphology, occurs prior to the production of hydrogen, CO, and hydrocarbons. ii) The effect of process conditions on the electrocatalytic selectivity and stability will be discussed. An identical electrode covered with copper nanoparticles can yield either predominantly ethylene or methane. Methane is favored at high $KHCO_3$ electrolyte concentration (0.5 M), and low CO_2 pressure, whereas ethylene is formed predominantly at low $KHCO_3$ electrolyte concentration (0.1 M) and high CO_2 pressure (9 atm)[2]. These observations will be explained on the basis of differences in pH near the electrode surface. iii) A means to prevent mass transport limitations in electrocatalytic conversion of CO_2 to CO will be demonstrated[3]. The cartoon highlights a novel electrode design in which gas is purged through a porous wall of a sintered metal tube (hollow fiber). The excellent results obtained by using such morphology will be discussed.



Ref.: 1. R. Kas, R. Kortlever, A. Milbrat, M. T. M. Koper, G. Mul and J. Baltrusaitis, *Phys. Chem. Chem. Phys.*, 2014, **16**, 12194-12201. 2. R. Kas, R. Kortlever, H. Yilmaz, M. T. M. Koper and G. Mul, *ChemElectroChem*, 2015, **2**, 354-358. 3. R. Kas, K. K. Hummadi, R. Kortlever, P. de Wit, A. Milbrat, M. W. J. Luiten-Olieman, N. E. Benes, M. T. M. Koper and G. Mul, *Nat. Commun.*, 2016, **7**, 7.

CV: Prof. Dr. Guido Mul

Guido Mul obtained his masters degree in chemistry from Utrecht University in 1992. He received his PhD in 1997 from the Delft University of Technology on the *in situ* DRIFT analysis of catalytic oxidation of (diesel) soot. After a Post-Doc position at SRI-International (Stanford Research Institute) in California, USA (1997-1999), he was awarded a fellowship of the Royal Netherlands Academy of Arts and Sciences to work at the Delft University of Technology (TUD), where he was appointed associate professor in 2007. He was appointed full professor to conduct research in the field of 'Photocatalytic Synthesis' at the University of Twente in 2010.

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