Fakultät für Naturwissenschaften

Institut für Chemie

lädt ein

gemeinsam mit der Gesellschaft Deutscher Chemiker zum

GDCh
GESELLSCHAFT DEUTSCHER CHEMIKER

Vortrag

von Herrn

Prof. Elias Klemm

Institute of Technical Chemistry
University of Stuttgart

"Electrocatalytic CO2 reduction to formic acid / formate: catalyst design, electrode engineering, and process concepts"

am: 28. November 2024

um: 16:00 Uhr

wo: im Raum 1/232

Die kleine Kaffeerunde vor dem Vortrag beginnt um 15:30 Uhr im Raum 1/232.
Das Mitbringen von eigenen Trinkgefäßen ist erwünscht.

Gäste sind herzlich willkommen!

TECHNISCHE UNIVERSITÄT
IN DER KULTURHAUPTSTADT EUROPAS
CHEMNITZ

Prof. Dr. Michael Sommer
Telefon: 0371 / 531 32507
E-Mail: michael.sommer@chemie.tu-chemnitz.de

Fakultät für Naturwissenschaften

Institut für Chemie

Prof. Elias Klemm

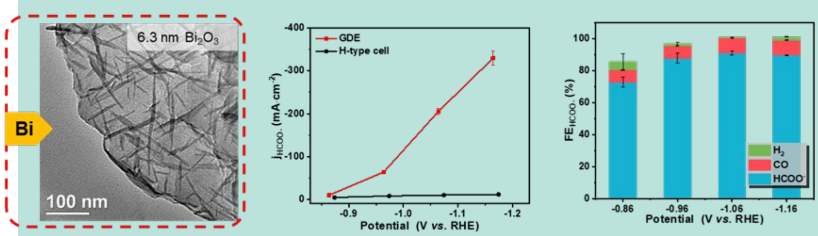
Institute of Technical Chemistry

University of Stuttgart

GDCh GESELLSCHAFT DEUTSCHER CHEMIKER

Electrocatalytic CO2 reduction to formic acid / formate: catalyst design, electrode engineering, and process concepts

The use of CO2 as raw material can be a significant contribution to closing the carbon cycle, which is also called CCU (Carbon Capture and Utilization). One possible route is the conversion of CO2 with green hydrogen to certain hydrocarbons such as methanol or mixtures of hydrocarbons such as Fischer-Tropsch products. This route is pursued by so-called e-refineries which needs huge amounts of green hydrogen and captured CO2. CHEMampere, which is a Stuttgart Research Partnership (see: www.chemampere.com, [1]), follows the concept of decentralized and distributed CO2-neutral production of chemicals and synthetic food, given that renewable electricity production is itself decentralized and that the largest renewable electricity power plants are capable of producing electricity only in the order of several Gigawatts (GW). Formic acid is a suitable intermediate for such a decentralized chemical production, because it is an intermediate for various future downstream processes such as fermentation [2], C-C coupling, transfer hydrogenations or carbonylations. Furthermore, it can be directly produced from CO2 and renewable electricity by electrocatalytic reduction. Sn, Bi, and In are the preferred active sites for this reaction which need to be present in a large amount and simultaneously supplied through a large three phase boundary (TPB) by electrons, CO2, and electrolyte. This results in a complex optimization problem of the catalyst (structure, morphology) [3], the electrode (wetting, local concentrations) [4], and reaction conditions (temperature, residence time) [5] which will be exemplarily shown in this presentation. Last but not least, a CO2 neutral production of formic acid comprises the avoidance of Faradic and non-Faradic side products such as H2, CO and bicarbonate/carbonate, as well as the separation and recirculation of the electrolyte and CO2, that has not been converted. Finally, formic acid must meet the desired target concentration, e.g. 80 wt.%. The process energy required for this must not be of fossil origin, but should also come from renewable sources. Thus, an „all-electric" process based on renewable electricity is preferred and will be demonstrated.



References

[1] E. Klemm, C. Lobo, A. Löwe, V. Schallhart, S. Renninger, L. Waltersmann, R. Costa, A. Schulz, R.-U. Dietrich, L. Möltner, V. Meynen, A. Sauer, K. A. Friedrich, Can. J. Chem. Eng. 2022, 100, 2736.

[2] N. Stöckl, S. Lindner, N. Claasens, E. Klemm, D. Holtmann, Current Opinion in Biotechnology 2022, 74, 155.

[3] H. Liu, H. Wang, Q. Song, K. Küster, U. Starke, P. van Aken, E. Klemm, Angew. Chem. Int. Ed. 2022, 61, e202117058.

[4] M. Oßkopp, A. Löwe, C. Lobo, S. Baranyai, T. Khoza, M. Auinger, E. Klemm, J. CO2 Utilization 2022, 56, 101823.

[5] A. Löwe, M. Schmidt, F. Bienen, D. Kopljar, N. Wagner, E. Klemm, ACS Sustainable Chem. Eng. 2021, 9, 4213.

TECHNISCHE UNIVERSITÄT IN DER KULTURHAUPTSTADT EUROPAS CHEMNITZ

Prof. Dr. Michael Sommer
Telefon: 0371 / 531 32507
E-Mail: michael.sommer@chemie.tu-chemnitz.de