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Universiteit Leiden



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Title: Selective and efficient electrochemical CO₂ reduction on nanostructured catalysts

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Propositions

accompanying the thesis

Selective and efficient electrochemical CO₂ reduction on nanostructured electrodes

1. The design of future catalysts that can selectively reduce CO₂ to valuable products at low overpotentials rests on mechanistical insights of the reaction, obtained either by experiments or theory.

Chapter 2 of this thesis.

2. A lot of studies dealing with the electrochemical reduction of CO₂ have been using bicarbonate buffers as electrolytes. However, since bicarbonate can be reduced to formic acid by direct or indirect reduction, bicarbonate buffers should not be the electrolyte of choice for this reaction.

*Chapter 3 and 4 of this thesis; Sreekanth, N. et al. Chem. Commun. **2014**, 50, 11143.*

3. Reversible electrochemical CO₂ reduction to 2-electron products on heterogeneous electrocatalysts is possible.

Chapter 4 and 5 of this thesis.

4. A selective and efficient catalyst for the electrochemical CO₂ reduction toward formic acid is made by optimizing the composition of Pd_xPt_(100-x)/C nanoparticles.

Chapter 5 of this thesis.

5. The catalytic properties of an alloy catalyst for CO₂ reduction are not necessarily the same as the catalytic properties that the parent materials display.

*Chapter 5 and 6 of this thesis; Hahn et al. J. Mater. Chem. A **2015**, 3, 20185-20194.*

6. The catalytic properties of nanoparticulate catalysts for CO₂ reduction can be altered significantly by the catalyst support.

Chapter 7 of this thesis.

7. Both the pH and buffer strength of the electrolyte are important parameters determining the catalytic selectivity of CO₂ reduction on copper.

*Kas, R.; Kortlever, R. et al., Phys. Chem. Chem. Phys. **2014**, 16, 12194-12201; Kas, R.; Kortlever, R. et al. ChemElectroChem **2015**, 2, 354-358; Varela, A. S. et al. Catal. Today **2015**, 260, 8-13.*

8. It does not make sense to store CO₂ underground if there are ways to convert CO₂ into useful chemicals.

9. In this day and age it is not logical to rely on coal, the power source of the 19th century. Therefore, it is highly remarkable that energy companies in the Netherlands are still building new coal power plants.