Electrocatalytic CO2 reduction toward liquid fuels : on heterogeneous electrocatalysts and heterogenized molecular catalysts

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Propositions

accompanying the thesis

Electrocatalytic CO_2 Reduction toward Liquid Fuels

On heterogeneous electrocatalysts and heterogenized molecular catalysts

1. The presence of disproportionation reactions during electrocatalytic reduction of CO_2 may lead to product distributions, which should be distinguished from direct CO_2 reduction products.
   Chapter 3 of this thesis

2. Heterogenization of molecular catalysts is attractive, but often carried out without clear underlying, mechanistic rationale. More importantly, parameters related to the heterogenization of molecular catalysts, such as the nature of the substrate and its chemical functionality can significantly influence the selectivity, reactivity and stability of electrochemical CO_2 reduction.
   Chapter 6 of this thesis

3. Research on the electrocatalytic reduction of carbon dioxide has mainly been devoted to the improvement and understanding of intrinsic parameters of electrocatalysts. Other parameters, extrinsic to the electrocatalyst, are equally important. Especially when aiming at an industrially viable CO_2 reduction technology, all these parameters should be taken into account, from a fundamental ánd engineering perspective.
   Chapter 2 of this thesis

4. Polymers are often used as binder for immobilization of nanoparticles, and for encapsulation of molecular catalysts on surfaces. The nature of the polymer can significantly influence the performance of electrocatalytic reduction of carbon dioxide.
   Chapter 6 of this thesis

5. In contrast to the formation of hydrogen, methane, ethylene, and methanol, electrochemical conversion of carbon dioxide to carbon monoxide or formic acid has a high potential to become an economically competitive process.
   Durst et al., Chimia 69 (2015), 769 - 776

6. The impact of scientific work, and consequently the ease of getting the work published, depends not only on the quality of the work, but also on its field, and the (sub)topic of the research.

7. There should be certain rules (benchmark procedures) within the CO_2 electroreduction community, which are important especially when comparing activities between different electrocatalysts/systems. Examples of such procedures are ohmic drop correction, normalization to the electrochemical active surface area and to the amount of active species.

8. A healthy dose of skepticism or paranoia of a researcher during electrochemistry experiments, is beneficial for the quality of experiments and experimental procedures.

9. For the publication of scientific work, journals are too often chosen based on their impact factor instead of their aim and scope. Therefore, it would be better to have more specified, topical journals instead of journals which cover a broad range of subjects.

10. In some sense, a PhD candidate is analogous to an electrocatalyst. For both cases, one would like high activity, preferably at low overpotential, and a high stability, for at least 4 years in case of a PhD student. Moreover, not only activity, but also selectivity is important and not only intrinsic "catalyst" properties have influence on the performance of the process, but also extrinsic factors of the "catalyst" (e.g. environment, working conditions).

11. Performing research often results not in knowing more about a certain topic, but more in knowing what you do not know of that topic. Hence, the more you study, the more you realize how little you actually know.

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