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Role of near-surface environment in tuning electrochemical CO₂ reduction reaction and H₂ evolution reaction

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Propositions
accompanying the thesis:
**Role of Near-Surface Environment in Tuning
Electrochemical CO₂ Reduction Reaction and
H₂ Evolution Reaction**

1. The rotating ring disk electrode technique is a simple yet effective method to study mass transport effects on electrocatalytic reactions and to tune their activity and/or selectivity.
(chapter 2 of this thesis)
2. Mass transport conditions tune the Faradaic selectivity for CO formation during CO₂ reduction reaction (CO₂RR) mainly by tuning the rate of competing H₂ evolution reaction (HER).
(Chapter 2 and 5 of this thesis)
3. Electrolyte identity plays a crucial role in determining which branch of HER competes with CO₂RR.
(Chapter 2 and 5 of this thesis)
4. It is obvious and yet often overlooked that Ohmic drop effects along the length of the nanoporous channels can render nanoporous catalysts partially inaccessible for electrochemistry.
(chapter 5 of this thesis)
5. Near-surface cation concentration is a central parameter for tuning the HER activity in alkaline media.
(Chapter 3 and 4 of this thesis)
6. Electrolyte pH (bulk as well as local) and near-surface cation concentration are two interrelated parameters, such that it is not possible to change the former without changing the latter.
(Chapter 3 and 4 of this thesis)
7. Cations near the surface enhance HER activity on Au when the near-surface cation concentration is relatively low/moderate. However, if we keep increasing the near-surface cation concentration beyond a threshold, cations start to have an inhibitive effect on HER activity. In electrocatalysis, just like in life, it is possible to have “too much” of a good thing.
(Chapter 3 and 4 of this thesis)
8. Near-surface reaction environment is a dynamic entity that can be defined by varying the electrolyte composition and/or by tuning mass transport.
(Chapter 2, 3, 4 and 5 of this thesis)
9. Its unbecoming to always size up the importance of academic research based on its immediate applications. As Faraday aptly pointed out, “What is the use of a new-born baby?”
(Source: Gregory, R., *Discovery or The spirit and service of science*. New York, The Macmillan Company, **1923**)
10. There is always more to be discovered and to be understood.