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The electrode-electrolyte interface in CO2 reduction and H2 evolution: a multiscale approach

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PROPOSITIONS

accompanying the thesis

"The electrode-electrolyte interface in CO_2 reduction and H_2 evolution: a multiscale approach"

1. "Producing miniaturized pH probes *is quite possible, with practice*".
   Nims, L. F. Yale J. Biol. Med. 1938, 10 (3), 241–246 and Chapter 2
2. There has been intensive development of methods for measuring pH in electrochemistry lately. Knowing precisely the research questions that need answers is key for defining the most suitable technique to investigate a given system.
   Chapter 2
3. In contrast to commonly used metal oxides, the 4-HATP/4-NSTP pH sensor is robust, selective and has high sensitivity, which allows to measure the local pH with a resolution better than 0.1 pH unit.
   Chapters 3-6
4. Diamond suspension is a safer polishing medium than alumina, to completely avoid affecting the catalytic activity of electrodes.
   Chapter 7
5. The main role of metal cations is to stabilize the key CO_2^- intermediate, to the extent that in its absence, CO_2 reduction to CO does not take place on gold, copper and silver. This conclusion has important implications for CO_2 reduction modeling and catalyst design.
   Chapter 8
6. Three key parameters for CO_2 reduction performance are ruled by cation acidity: cation accumulation at the Outer Helmholtz Plane, water dissociation kinetics, and cation-CO_2 coordination.
   Chapter 9
7. The inhibition of hydrogen evolution by weakly hydrated cations on platinum is observed already at lower alkalinity and lower cation concentrations than on gold, suggesting that under hydrogen evolution conditions platinum interacts stronger with metal cations.
   Chapter 10
8. Large scale CO_2 electrolysis can be performed in acidic electrolyte and offers an improvement of the overall process energy efficiency in direct comparison with neutral media.
   Chapter 11
9. Shear-force based SECM opens up a path for probing the activity of GDEs locally, in a more controlled manner than using conventional product detection techniques.
   Chapter 12
10. Who you are as a researcher reflects a lot the experiences you had with former supervisors and co-workers. Therefore, PhDs and postdocs should be thought how to teach and supervise students, as this is not a skill that comes natural to everyone.
11. Chemists, Material Scientists, Chemical Engineers, and Physicists carrying out academic research should talk to each other more often.
12. Creativity, initiative, independence, and a pinch of stubbornness, are secret ingredients to a successful PhD.
13. The best pão de queijo (cheese bread) from Brazil comes from Minas Gerais. Do not believe if people tell you otherwise.