Propositions

accompanying the thesis

Catalysis of the electrochemical water oxidation to oxygen

1. The initial stages of the electrochemical water oxidation on gold electrodes in acid involves a decomposition/disproportionation reaction of gold oxide at the electrode surface which delivers oxygen gas consisting of two oxygen atoms from the surface oxide, following a Mars-Van Krevelen-type mechanism.

   Chapter 2 of this thesis.

2. The activity towards oxygen evolution catalyzed by iridium-N-dimethylimidazolin-2-ylidene molecular catalyst strongly depends on the nature of the working electrolyte (anions and pH). By suitably tuning pH and electrolyte, the catalytic activity of the iridium-based organometallic compound towards water oxidation can be enhanced by a factor of 20.

   Chapter 3 of this thesis.

3. The nature of the active sites in nickel hydroxide doped with 3d transition metals depend on the doping metal. However, their geometry does not depend on that, and it is always octahedral.

   Chapter 4 of this thesis.

4. Nickel oxyhydroxide gets deprotonated via a hydroxide-mediated mechanism that produces negatively charged surface oxide, and this charged species acts as precursor for the oxygen evolution reaction. Therefore, the stability of NiOOH in the pH range 7 – 11 is not the only limiting factor for its use as an OER catalyst, its lack of OER activity due to unfavorable deprotonation conditions for the oxyhydroxide surface is an equally important factor.

   Chapter 5 of this thesis.

5. The nature of the electrolyte and the pH play a crucial role in the catalysis of the electrochemical water oxidation, and they should be carefully addressed to benchmark the activity of new oxygen evolution catalysts.

   Chapter 3 and 5 of this thesis.

6. Iridium-based double perovskites show superior catalytic activity towards electrochemical water oxidation in acid media compared iridium oxide, the state-of-the art benchmarking catalyst. This family of catalysts contains three times less iridium, and exhibit a more than 3-fold higher catalytic activity for the oxygen evolution reaction in acid media, which makes them the most active catalysts for OER in acid media reported till now.

   Chapter 6 of this thesis.

7. Electrochemistry cares about reducing the tensions while being aware of the current events.