Operando Spectro-electrochemical investigations of Pt and Pt-alloys as fuel cell catalysts

Nagra, H.J.

Propositions

accompanying the thesis:

"Operando Spectro-Electrochemical Investigations of Pt and Pt-alloys as Fuel Cell Catalysts"

1. It is possible to fit raw XPS data rather well with both realistic and unrealistic components. Therefore, incorporating knowledge of what line shape, binding energies, and oxidation states are realistic for the studied system is crucial. (*Chapter 2*)

2. The use of nanoporous polycarbonate in graphene-membrane assemblies *for operando* XPS opens the technique up to the study of almost any aqueous electrocatalytic reaction, even the ones requiring dissolved gases. (*Chapter 2*).

3. Under fuel cell start-up conditions, the Pt cathode catalyst forms an oxide monolayer containing a mixture of all oxidation states (δ^+, 2^+ and 4^+), contrary to the series oxidation scheme proposed in the Pourbaix diagram of Pt (*Chapter 3*).

4. Atomic-level understanding of the electrode surface of fuel cell catalysts under reaction conditions is necessary for designing a durable and efficient fuel cell catalyst (*Chapter 3*).

5. Fuel cell operating potentials are not low enough to fully reduce the oxides formed at the cathode during startup and shutdown. This may lead to lower activity and degradation over time (*Chapter 3*).

6. The ability of Pt_3Ni catalysts to outperform Pt in terms of hydrogen evolution reaction activity can be turned on and off at will, depending on its electrochemical conditioning beforehand (*Chapter 4*).

7. Normalization of catalytic activity by geometric area never forms a fair basis of comparison for catalytic properties. (*Chapter 4*)

8. Perfecting one aspect of a catalyst is bound to produce imperfections somewhere else. An optimum catalyst is a compromise between perfection and practicality.

9. While a higher number of publications may benefit the PhD candidate, a single but well-scrutinized work will benefit science more.

10. One's clarity regarding their own work is proportional to the simplicity with which you can explain it.

11. The advancement of scientific knowledge is based on challenging the status quo; it is the moral duty of every PhD candidate to take the current volume of knowledge with a grain of salt.

12. Discipline beats motivation every day; A well-defined structure within the PhD to do experiments, analyze and report is the key to surviving the tough and overwhelming times.

Hassan Javed Nagra
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