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Oxidation catalysis on Pt and Au : complexity of simple chemistry

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Propositions

Accompanying the PhD thesis

“Oxidation catalysis on Pt and Au: Complexity of simple chemistry”

- I. It is not appropriate to classify the structures formed on Pt(111) under oxygen-rich reaction conditions as either chemisorption structures or oxides, as they are structurally, electronically, and most importantly, chemically different from both. Chapters 2 & 3 of this thesis
- II. The surface oxides discovered on Pt(111) and Pt(110) contain the most reactive oxygen atoms and, therefore, are most relevant for catalysis. Chapters 3 & 4 of this thesis
- III. Stepped surfaces are usually described by the facets forming the terraces and the steps. However, for the anisotropic (110) step, the direction of the step within this (110) facet could be more significant than the structure of the terrace, in binding of interacting adsorbates. Chapter 4 of this thesis
- IV. In the water-promoted oxidation of carbon monoxide over gold catalysts, hydroxides play a minor role. Chapter 5 of this thesis
- V. Seriani and Mittendorfer overestimate the significance of the (110) facet in their predictions of the shape of a platinum nanoparticle under oxygen-rich conditions, because they do not consider the proper surface oxides. N. Seriani and F. Mittendorfer: “Platinum-group and noble metals under oxidizing conditions”, J. Phys.: Condens. Matter. **20**, 184023 (2008)
- VI. The large difference in conditions between surface science experiments and catalytic reactions has been identified as the “pressure gap”. However, this is misleading as all its implications are more related to time than to pressure. P. Stoltze and J.K. Nørskov: “Bridging the “Pressure Gap” between Ultrahigh-Vacuum Surface Physics and High-Pressure Catalysis”, Phys. Rev. Lett. **55**, 2502–2505 (1985)
- VII. It is unclear how well the steps of a vicinal surface can serve as a model for the facet edges of a nanoparticle catalyst. B. Lang, R.W. Joyner, and G.A. Somorjai: “Low energy electron diffraction studies of chemisorbed gases on stepped surfaces of platinum”, Surf. Sci. **30**, 454–474 (1972)

- VIII. Recently developed in situ and operando instrumentation has led to highly specialized equipment, which, in turn, determines the frame of reference of the conclusions obtained with this equipment.
A. Ziegler, H. Graafsma, X.F. Zhang, and J.W.M. Frenken (Eds.): "In-situ Materials Characterization", Springer Series in Materials Science (2014)
- IX. X-ray photoelectron spectroscopy is like playing guitar; it is easy to start doing, but incredibly hard to master.
- X. The shift of focus in scientific publishing from communication of results and reasoning towards ranking scientists, has significantly degraded the quality of the published work.

Matthijs A. van Spronsen
Leiden, 28-06-2016