A structural view of Pd model catalysts : high-pressure surface X-Ray diffraction

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STELLINGEN

behorende bij het proefschrift

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High-Pressure Surface X-Ray Diffraction

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1. Problems related to mass-transfer limitations in studies of single crystal model catalysts can be mitigated effectively by studying increasingly small samples.
   Chapter 3 of this thesis.

2. The evolution of roughness is the driving force for the observed reaction oscillations in the CO oxidation rate on Pd(100) under near-ambient conditions.
   Chapter 4 of this thesis.

3. The transient reactivity of Pd(100) observed by Goodman and co-workers cannot be regarded as a proof for the existence of a hyperactive surface phase.
   Appendix A of this thesis.

4. The catalytic role played by defects in surface compounds may well explain differences between data obtained under ultrahigh vacuum conditions, where the defect density is usually relatively low, and data collected under (semi-)realistic conditions, where the defect density is often higher.
   This thesis.

5. Model catalysts of epitaxially aligned nanoparticles, such as Pd on MgO(100), are suitable for the detailed study of shape changes under mildly oxidizing conditions ($P_{O_2} < 10^{-5}$ mbar). This approach does not give the same detailed information about the particle shape when exposing these model catalysts to 'real' reaction conditions with CO and O_2 at pressures above 1 mbar, because the particles quickly lose their epitaxial nature under these conditions.
   *P. Nolte et al., Science **321**, 1654-1658 (2008)*
   *P. Nolte et al., Nano Letters **11**, 46974700 (2011).*

6. Given that the characterization of nanoparticles is challenging in ensemble measurements due to their structural heterogeneity, more effort should be spent on developing techniques that can probe the structure and reactivity of *single* nanoparticles.
   *W. Xu et al., Nature Materials **7**, 992-996 (2008).*
   X. Zhou et al., Nature Nanotechnology, doi:10.1038/nnano.2012.18 (2012).

7. The use of photons as an extra source of energy to activate catalytic reactions through the generation of surface plasmons potentially lowers the operating temperature of catalysts and thereby also increases their lifetime. Since the rate enhancement can vary for different reactions it also provides a way of changing the selectivity of the catalyst.
   *P. Christopher et al., Nature Chemistry **3**, 467-472 (2011).*

8. The reactivity of Pd/PdO towards methane oxidation depends strongly on the orientation of the facets of the PdO that are exposed to the gas phase.
   *A. Hellman, Journal of Physical Chemistry Letters **3**, 678682 (2012).*

9. The concept of chemical potential is poorly understood by many physicists, because it is introduced to them as $\mu = (\partial E/\partial n)_{S,V,\ldots}$. This is equivalent to attempting to familiarize a student with the concept of temperature by explaining that $T = (\partial E/\partial S)_{V,n,\ldots}$. The explanation does not help the student to acquire an intuition for the concept.
   *G. Job, and F. Herrmann, European Journal of Physics **27**, 353-371 (2006).*

10. The value of technical expertise and technical achievements is consistently underestimated in a research environment that tends to put its main focus on publication output and citation scores.

11. The success of a synchrotron experiment is for a large part determined by the improvisation skills of the experimentalist, because of the strict limitation on the duration of the experiment.

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