Interaction of oxygen and carbon monoxide with Pt(111) at intermediate pressure and temperature : revisiting the fruit fly of surface science

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Propositions
accompanying the thesis

Interaction of Oxygen and Carbon Monoxide with Pt (111) at Intermediate Pressure and Temperature: Revisiting the Fruit Fly of Surface Science

1. Platinum remains an attractive model catalyst for surface science due to its primary role in many oxidation reactions occurring, e.g. in fuel cells and automotive exhausts.
2. The Pt(111) surface, when exposed to molecular oxygen at elevated temperatures (400-600 K), can dissociatively adsorb more oxygen than the previously assumed (Derry & Ross Surf. Science 140 (1984) 165; Chapter 3 of this thesis).
3. No oxygen coverage above 0.25 ML was found on the Pt(111) surface after exposure to molecular oxygen. This leads to the conclusion that the excess oxygen is stored below the surface of platinum (Chapter 3 of this thesis).
4. Exchange between surface-bound and subsurface oxygen is a slow process. This enables experiments in which surface and subsurface oxygen can be distinguished with isotope labeling.
5. Unlike highly reactive α-PtO2 formed under high pressure conditions (Ackermann et. al Phys. Rev. Let. 95 (2005) 255505), subsurface oxygen shows a low reactivity toward the oxidation of coadsorbed CO. However, it does not influence oxidation properties of surface bound oxygen (Chapter 3 of this thesis).
6. A lower reaction barrier for CO oxidation was found for oxygen at the border of the O-p(2x2) islands on Pt(111) compared to oxygen inside the island (Volkening&Wintterlin, J. Chem. Phys. 114 (2001) 6382). Such islands form when the surface switches between reactive and unreactive states (Chapter 4 of this thesis).
7. An ordered CO islands do not coexist with oxygen p(2x2) islands on Pt(111) under steady state conditions (Chapter 4 of this thesis) in contrast to what was observed for titration experiments (Wintterling et. al, Science 278 (1997) 1931).
8. The fast Fourier transformation of the tunnel current signal can be used to monitor the noise intensity in the tip-to-sample tunnel barrier (Chapter 5 of this thesis)
9. Better control over the experimental conditions should improve the noise detection measurements (Chapter 5 of this thesis).
10. Any experiment is like an iceberg where the preparations are submerged and only results can be noticed.