

Thermo- and Photostimulated reactions of H₂O, O₂, and CO on Pt(111) and C(0001) surfaces

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ABSTRACT

Surfaces and molecules interacting on surfaces are of great importance both from a purely scientific perspective and for many applications like catalysis, hard metal coatings, and biomaterials. Surface science builds new knowledge inspired both by the fundamental aspects and the applications. The surface properties are studied both for the pure state in ultra-high vacuum, and when the surfaces interact with the environment, e.g., gases and liquids.

The topic of this thesis is the interaction between a few surfaces and water, sometimes with other co-adsorbates, and also how these systems are affected by incident light. The first study explored how photons might influence the function of exhaust gas cleaning in a so-called three way catalyst. We found that photons can enhance the catalytic CO oxidation reaction. The effect was discussed in terms of an irradiation-induced CO desorption from the CO poisoned surface. Then CO oxidation on Pt(111) was investigated with regard to how it is affected by the addition of H₂O. It was found that H₂O can strongly enhance the rate of reaction, most likely through the formation of OH. In an extension of this study it was found that O₂ is stabilized by water molecules until the latter desorb. A high density of OH was formed on the surface. In the next study the effect of pulsed, intense laser irradiation of surface films of Amorphous Solid Water (ASW) was investigated. The irradiation causes rapid ejection of loosely bound water molecules through excitations in the ice films. In yet another study, ASW films were used to trap reaction products, formed during photon irradiation of the K+H₂O co-adsorption system, predeposited at the ASW-graphite interface. H₂ was released directly upon irradiation, while the CO and CO₂ photoreaction products were released only when the ASW was thermally desorbed.

Keywords: Surface Science, Catalysis, Surface Photochemistry, Adsorbed Water, Platinum, Graphite, Carbon monoxide, Oxygen