Combining HESXRD and LED reflectance during a catalytic reaction

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CO oxidation has been studied for years as prototype catalytic reaction [1]. The reaction has in particular been used as a model catalytic reaction for the development of experimental techniques enabling in-situ studies of catalytic reactions at semi-realistic industrial conditions [2]

LED-reflectance has recently been introduced as a surface sensitive technique during catalytic reactions at semi-realistic conditions [3,4], and is an attractive experimental approach for surface studies under harsh conditions due to its simplicity. The change in the reflectance has been attributed to a combination of the change in surface roughness and a change of the optical properties due to the formation of a new compound at the surface, such as an oxide. In this contribution we experimentally confirm that the change in the LED-reflectance signal during CO oxidation over a Pd(100) single crystal is due to the formation of PdO on the surface and the resulting change in surface roughness.

By simultaneously measuring High Energy Surface X-Ray Diffraction (HESXRD) [5,6] and LED-reflectance during the CO oxidation reaction at a total pressure of 200 mbar and elevated temperatures in a modified in-situ catalysis chamber [7], we follow the roughening of the surface as the surface is oxidized. In this way, we calibrate the change in the LED-reflectance signal with the measured PdO thickness and roughness of the surface as obtained from HESXRD.

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