

Electrocatalysis with well-defined Pt/Co₃O₄(111) model interfaces

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Electrocatalytic processes are the key to our future transition to a renewable energy system. Yet, our fundamental understanding of electrocatalysis lags behind classical heterogeneous catalysis which has been dominating chemical technology for a long time. Here, we use complex model catalysts made by surface science methods to explore electrocatalytic processes in aqueous environments. The stability of Pt/Co₃O₄(111) electrocatalyst was characterized with respect to the oxidation state of the Pt particles and the degree of the reduction of Co₃O₄(111) support under ultrahigh vacuum (UHV) and electrochemical conditions by means of synchrotron radiation photoelectron spectroscopy (SRPES) and X-ray photoelectron spectroscopy (XPS). Well-defined model systems were prepared in situ and investigated without exposure to air. We employed a dedicated experimental setup that combines an electrochemical cell and XPS analysis to investigate the redox processes and their influence on the structure of Co₃O₄(111) and Pt/Co₃O₄(111) in electrochemical environments as a function of the electrode potential. Various processes such as charge transfer, oxygen spillover, and water dissociation, which are observed in UHV (Figure 1), were also found under electrochemical conditions. We found that the formation of OH groups at the surface of Co₃O₄(111) film is coupled to the charge transfer within the stability window. Under the same conditions, the oxidation state of the Pt/oxide and the Pt/electrolyte interface was found to change reversibly as a function of the electrode potential.

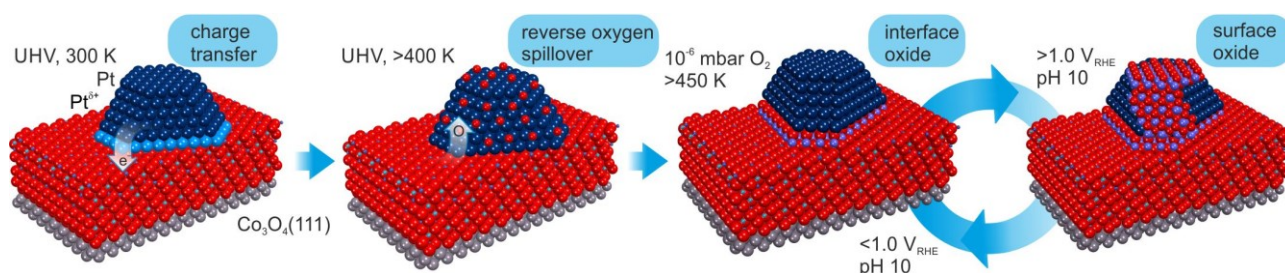


Figure 1. Redox processes in the model Pt/Co₃O₄(111) system.