Looking Live at Active Catalyst Surfaces

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Catalytic processes are very important in many parts of the modern industrialised world, from large chemical plants to car (exhaust) catalysts and fuel-cell technology. Although research in catalysis has been going on for almost a full century, some knowledge about the elemental steps in basic catalytic reactions is still lacking. A typical example of such a basic reaction is catalytic CO oxidation to form CO_2 on metal surfaces (e.g. Pt, Pd, Rh).
We present here the first *in-situ* measurements of single crystal surfaces of these materials, so-called model catalysts, with Surface X-ray Diffraction, in realistic pressure and temperature (1 atm, 650 K) conditions for CO oxidation. These measurements have given us a unique insight into the atomic processes that occur on the catalyst surface during CO oxidation. Our experiments show that pre- and post-reaction experiments in UHV do not, and can not show all the information necessary to understand what is happening on the catalyst surface. We have found new and catalytically highly active surface structures, that are not stable outside reaction conditions. By studying the dynamics of the reaction *simultaneously* with the changes in surface structure we can propose a new model for so-called self sustained oscillations in CO oxidation on Pt and Pd surfaces.