

SS-005

<Invited Talk>

The Role of Surface Oxide of Metal Nanoparticles on Catalytic Activity of CO Oxidation Unraveled with Ambient Pressure X-ray Photoelectron Spectroscopy

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Colloidal synthesis of nanoparticles with well-controlled size, shape, and composition, together with development of in situ surface science characterization tools, such as ambient pressure X-ray photoelectron spectroscopy (APXPS), has brought new opportunities to unravel the surface structure of working catalysts. Recent studies suggest that surface oxides on transition metal nanoparticles play an important role in determining the catalytic activity of CO oxidation. In this talk, I will outline the recent studies on the influence of surface oxides on Rh, Pt, Ru and Co nanoparticles on the catalytic activity of CO oxidation [1-3]. Transition metal nanoparticle model catalysts were synthesized in the presence of poly(vinyl pyrrolidone) polymer capping agent and deposited onto a flat Si support as two-dimensional arrays using the Langmuir-Blodgett deposition technique. APXPS studies exhibited the reversible formation of surface oxides during oxidizing, reducing, and CO oxidation reaction [4]. General trend is that the smaller nanoparticles exhibit the thicker surface oxides, while the bigger ones have the thin oxide layers. Combined with the nature of surface oxides, this trend leads to the different size dependences of catalytic activity. Such in situ observations of metal nanoparticles are useful in identifying the active state of the catalysts during use and, hence, may allow for rational catalyst designs for practical applications. I will also show that the surface oxide can be engineered by using the simple surface treatment such as UV-ozone techniques, which results in changing the catalytic activity [5]. The results suggest an intriguing way to tune catalytic activity via engineering of the nanoscale surface oxide.

References

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