In situ/operando Characterization of Noble Metal Clusters and Particles on Metal Oxides at Work

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The efficient use of scarce noble metals in emission control applications requires a thorough understanding of the structure-activity relationships. However, this task is very challenging as the structure of the noble metal and the support material is sensitive to the testing environment, thus requiring the characterisation under realistic operating conditions. This is achieved in our studies through a combination of several complementary *in situ/operando* characterisation techniques. In particular, X-ray absorption spectroscopy (XAS) and related X-ray methods have been used to determine the active noble metal site and to derive structure-activity correlations for CO oxidation.[1-3] These measurements were complemented by CO surface ligand infrared spectroscopy (CO-SLIRS) investigations in which the support structure can be tracked in real time.[4-6] The characterisation of such complex systems was furthermore substantiated by environmental transmission electron microscopy (ETEM) studies to visualise the fate of noble metal particles under different reaction atmospheres. By extending and applying our holistic spectroscopic approach towards further relevant oxidation reactions, we aiming at predicting and controlling the catalytically active sites within their lifecycle during emission control applications and use noble metals as efficiently as possible.

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