

Wet chemical preparation of CeO₂(111) supported Au catalyst

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Liquid phase deposition (LPD) is the most common way to produce heterogeneous catalysts in industry. For this purpose, a metal oxide powder is stirred in a solution containing a noble metal precursor. In an ideal case, uniformly distributed metal nanoparticles are supported on the metal oxide after rinsing, drying and calcination. Despite its broad application, the microscopic development of this process is poorly understood. Only few studies examined the LPD of gold on defect-free single crystal metal oxides [1, 2]. For the first time, this work characterises the Au/CeO₂(111) model catalyst after each step of the wet chemical catalyst preparation. Chemical composition, cluster size and distribution are determined *ex situ* by surface science methods.

We discuss the influence of LPD specific parameters such as solution pH, rinsing, and calcination on the oxidation state and cluster morphology of the gold nanoclusters. This has been determined in UHV by XPS, STM and TPD. We have found that Au¹⁺ and Au³⁺ species are the main compounds that adsorb to the partially hydroxylated CeO₂ surface indicating a grafting reaction as it was proposed on TiO₂, Fe₂O₃, and Al₂O₃ before [1,3]. After rinsing, chloride has been completely removed and gold species have been reduced. Former studies on Fe₃O₄ and other metal oxides have shown that gold has been completely reduced to Au⁰ after rinsing and annealing [2, 4]. In contrast, we have observed that a small part of the Au¹⁺ species remains on Ceria, even after annealing at 600 K. The amount of the Au¹⁺ species seems to depend on the pH of the precursor solution.

References:

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