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In-situ study of low-temperature CO oxidation on Au/CeO2 (111)

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Here we present results from a study of low-temperature CO oxidation performed on different model Au/CeO2 (111) catalysts. We prepared stoichiometric CeO2(111) surfaces decorated with gold nanoparticles and varying amounts of step edges. The prepared samples were investigated in UHV using synchrotron radiation photoelectron spectroscopy (SRPES) and scanning tunneling mi-croscopy (STM). This study helped to figure out how the one monolayer-high ceria step edges affect the metal–substrate interaction between Au and the CeO2(111) surface. It was found that the concentration of ionic Au+ species on the ceria surface increases with the increasing number of ceria step edges and does not correlate with the concentration of Ce3+ ions, which are supposed to form due to the interaction with gold nanoparticles, indicating an additional channel of Au+ formation on the surface of CeO2(111). The study of CO oxidation on the highly stepped Au/CeO2(111) model sample performed by combining near-ambient pressure X-ray photoelectron spectroscopy (NAP-XPS) and near-ambient pressure scanning tunneling microscopy (NAP-STM) demonstrated the high catalyst stability in CO. However, it underwent substantial chemical and morphological changes in CO oxidation operational conditions. Already at 300 K, almost all Au+ was reduced into metallic gold. In addition, gold nanoparticles begin to grow using a mechanism that involves the disintegration of small gold nanoparticles in favor of large ones. With increasing temperature, the catalyst quickly transformed into a system of primarily large Au particles that con-tained no ionic gold species.

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No

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