

Short communication: **Reactivity difference between Al and Zr: nanostructure drives the chemistry**

Abstract

Two hard to reduce oxides, Al_2O_3 and ZrO_2 , have been prepared as thin films with fractional coverage on an Pt111 single crystal by atomic layer deposition. Due to the novel nanostructure of the so prepared oxides, an extremely unusable, novel chemical redox behavior could be observed. We present ALD prepared Zr-nanoclusters that allow us to easily switch between the two Oxidation states Zr^{+IV} and Zr^0 whereas Zr^{+IV} can be either ZrO_2 or ZrOH . ALD prepared Al does not form nano-clusters but wide island as seen in STM and does therefore not show this strong variation from the bulk oxide. The novel Zr nano-state is suspected to be extremely relevant for several catalytic reactions such as fuel reforming processes because of the strong ability to efficiently active water at moderate temperatures and the full reversibility of the oxidation under catalytic conditions.

