Reactivity and coverage of active surface species in a Au-assisted Mars-van Krevelen mechanism – Active surface oxygen on a Au/TiO_2 catalyst

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Abstract

The influence of the composition of the reaction atmosphere ($CO:O_2$ ratio) on the amount of active oxygen and hence on the oxidation state of a Au/TiO_2 catalyst surface during CO oxidation was studied by quantitative temporal analysis of products (TAP) reactor techniques. The results demonstrate that i) there exists a distinct correlation between the O_2 content in the reaction atmosphere and the amount of active oxygen present on a Au/TiO_2 catalyst surface under working conditions and that ii) the oxidation state of the Au/TiO_2 catalyst surface adapts rapidly to the reaction gas composition, by reaction induced changes in the very initial stage of the reaction, until steady-state conditions are reached. This correlation shows up also in the activity for continuous CO oxidation at atmospheric pressure, demonstrating that the activity of supported Au/TiO_2 catalysts for the oxidation of CO is mainly affected by the amount of active oxygen present on the catalyst surface. Following our recent finding that this active oxygen species represents lattice oxygen at the perimeter of the interface between Au nanoparticles and TiO_2 (D. Widmann and R.J. Behm, Angew. Chem. Int. Ed., DOI 10.1002/anie.201102062), the results are discussed in terms of a Au-assisted Mars-van Krevelen mechanism.

Keywords: *Au/TiO_2, CO oxidation, Oxidation state, Active oxygen, Oxygen Storage Capacity (OSC), Temporal Analysis of Products (TAP)*

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