Influence of TiO$_2$ bulk defects on the CO adsorption and CO oxidation on Au/TiO$_2$ – Electronic metal-support interactions (EMSI) in supported Au catalysts

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Abstract

Electronic metal-support interactions (EMSI) are demonstrated to severely affect the CO oxidation activity and the CO adsorption properties of Au/TiO$_2$ catalysts. Bulk oxygen vacancies, generated by a strongly reductive pre-treatment of Au/TiO$_2$ at elevated temperature in 10% CO/N$_2$, significantly lower the catalytic activity for CO oxidation at 80°C. With time on stream, the activity slowly increases until reaching the same steady-state value as obtained for a previously calcined and, hence, defect poor Au/TiO$_2$ catalyst (activation period), where the time required for the activation period decreases with reaction temperature, but is independent from the oxygen partial pressure. Considering the similar Au particle size and Au loading, we conclude that the different activities originate from the presence of bulk oxygen vacancies generated during pre-treatment, which are slowly replenished during reaction. **In-situ** IR spectroscopy measurements reveal that the lower activity in the presence of bulk defects is coupled with and likely results from a strong modification of the CO adsorption strength on the reduced Au/TiO$_2$ catalysts due to electronic metal-support interactions (EMSI). A possible mechanism for this interaction is discussed.

Keywords: Au/TiO$_2$, CO oxidation, CO adsorption, Oxygen vacancies, Bulk defects, Electronic Metal-Support Interactions (EMSI), Reaction mechanism, Kinetic measurements

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