New Au/TiO_2 catalysts for the CO oxidation based on mesoporous TiO_2 supports

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Highly dispersed Au/TiO_2 catalysts have attracted increasing interest because of their high activity for various oxidation and reduction reactions, most prominent being the low-temperature CO oxidation. It is tempting to improve the stability and possibly also the activity of these catalysts by using mesoporous TiO_2 supports, where the Au nanoparticles are located in the mesopores and this way stabilized against sintering. The mesoporous TiO_2 was synthesized by cooperative self-assembly processes of amphiphiles (e.g. Brij56) in the presence of an ethylene glycol modified precursor (bis(2-hydroxyethyl)titanate; EGMT). This resulted in mesoporous TiO_2 (anatase or amorphous) with different specific surface areas, depending on the post-treatment (e.g., calcination or solvent extraction) to remove the surfactant. Au was introduced via a deposition-precipitation process. Finally, the resulting pre-catalysts were conditioned at different temperatures and in oxidative or reductive atmosphere.

Structural changes in the support material and in the Au nanoparticles induced by the conditioning procedure were characterized by XRD, XPS, TEM and N_2 porosimetry. The resulting Au particle sizes were evaluated. Measurements of the CO oxidation reaction kinetics in dilute $CO:O_2:N_2$ mixtures show an improved Au mass-normalized activity and stability (lower tendency for deactivation) of the mesoporous TiO_2 based catalysts compared to Au/TiO_2 catalysts based on commercial TiO_2 (P25, Degussa). Similar activation energies of these different catalysts indicate that the reaction mechanism is not affected by the different support materials. The effects of the different conditioning procedures on the catalytic properties are discussed.