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Ultrathin Titania Coating for High-temperature Stable SiO_2/Pt Nanocatalysts

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Recently, demand for thermally stable metal nanoparticles suitable for chemical reactions at high temperatures has increased to the point to require a solution to nanoparticle coalescence. Thermal stability of metal nanoparticles can be achieved by adopting core-shell models and encapsulating supported metal nanoparticles with mesoporous oxides [1,2]. However, to understand the role of metal-support interactions on catalytic activity and for surface analysis of complex structures, we developed a novel catalyst design by coating an ultra-thin layer of titania on Pt supported silica (SiO_2/Pt@TiO_2). This structure provides higher metal dispersion (~52% Pt/silica), high thermal stability (~600^oC) and maximization of the interaction between Pt and titania. The high thermal stability of SiO_2/Pt@TiO_2 enabled the investigation of CO oxidation studies at high temperatures, including ignition behavior, which is otherwise not possible on bare Pt nanoparticles due to sintering [3]. It was found that this hybrid catalyst exhibited a lower activation energy for CO oxidation because of the metal-support interaction. The concept of an ultra-thin active metal oxide coating on supported nanoparticles opens-up new avenues for synthesis of various hybrid nanocatalysts with combinations of different metals and oxides to investigate important model reactions at high-temperatures and in industrial reactions.

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