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Influence of TiO₂ Thin Film Thickness and Humidity on Toluene Adsorption and Desorption Behavior of Nanoporous TiO₂/SiO₂ Prepared by Atomic Layer Deposition (ALD)

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Adsorption and desorption of toluene from bare and TiO₂-coated silica with a mean pore size of 15 nm was studied using breakthrough curves and temperature programmed desorption. Thicknesses of TiO₂films prepared by atomic layer deposition on silica were < 2 nm, and ~ 5 nm, respectively. For toluene adsorption, both dry and humid conditions were used. TiO₂-thin film significantly improved toluene adsorption capacity of silica under dry condition, whereas desorption of toluene from the surface as a consequence of displacement by water vapor was more pronounced for TiO₂-coated samples with respect to the result of bare ones. In the TPD experiments, silica with a thinner TiO₂ film (thickness < 2 nm) showed the highest reactivity for toluene oxidation to CO₂ in the absence and presence of water. We show that the toluene adsorption and oxidation reactivity of silica can be controlled by varying thickness of TiO₂ thin films.

Keywords: Adsorption, Temperature programmed-desorption (TPD), Thin film, Atomic layer deposition (ALD), TiO₂/SiO₂