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Effect of the titania morphology on the Au/TiO_2-catalyzed aerobic epoxidation of stilbene

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ABSTRACT

We use a colloidal deposition method to prepare gold nanoparticles with similar size distributions centered at 3 nm over various anatase titania supports. All UV100, PC500 and AK350 titanias are loaded with similar amount of gold (1.0 ± 0.2 wt.%) which is in similar electronic and optical environments, as shown by X-ray photoelectron spectroscopy (XPS) and UV–vis. This allows us to assess the effect of the titania crystallization, morphology and chemical composition on the catalytic properties of gold in the aerobic epoxidation of *trans*-stilbene. We find that Au/UV100 is more active than Au/PC500 and Au/AK350 but that selectivities are similar on all materials. Epoxide yields on the other hand critically depend on the support functionalization and surface composition. TG–DTA characterization of the bare titania powders reveals indeed that AK350, which leads to the least active catalyst, is slightly less hydroxylated than PC500 and UV100. This indicates that surface titanol groups might be involved in the epoxidation of *trans*-stilbene. The presence of boron oxide on Au/UV100 (XPS), due to reaction of UV100 with the $NaBH_4$ reductant during the synthesis, is also thought to promote the epoxide-forming mechanism. This chemical promotion effect appears to compensate for the specific and beneficial gold–P25 interaction. As a result, Au/UV100 is more efficient than the reference Au/P25 catalyst for this reaction.