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The effect of gold particle size on the activity of Au/TiO₂ catalyst in the hydrogenation of CO₂

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Triggered by environmental protection concerns, CO₂ chemistry and the usage of CO₂ as an industrial feed-stock have become popular topics recently. It also turned out the nanosized gold particles show considerable catalytic activity.

The thermal activation of CO₂ on Au nanoparticles supported on TiO₂ and titanate nanotubes was studied. The catalysts were prepared by the incipient wetness method using HAuCl₄. The reduction step was carried out either by H₂ at 523 K or by NaBH₄ at 298 K. The catalysts were characterized by HRTEM, XPS and DRIFTS. TEM images showed that the size of the Au particles was around 9 nm on the H₂ reduced sample, and only 4 nm on the NaBH₄ reduced catalysts irrespective of the support. XP spectra revealed the existence of a metallic and a positively shifted gold state.

The hydrogenation of CO₂ was followed to test the catalytic activity of the samples. Partially reduced CO₂ formed on the gold particles in reverse water-gas shift reaction. IR spectra did not justify the presence of Au-CO complexes, but showed the presence of formate on the support. The samples reduced by NaBH₄ were more active, since the metal particle size was smaller, even when their total amount was less. The nature of the support can also modify the reaction routes of the reactants.

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