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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 feedstock 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.

Author: Dr OSZKÓ, Albert (University of Szeged, Dept. of Physical Chemistry and Materials Science)

Co-authors: BALÁZS, László (University of Szeged,); BAÁN, Kornélia (University of Szeged, Dept. of Applied and Environmental Chemistry); Prof. GALBÁCS, Gábor (University of Szeged, Dept. of Inorganic and Analytical Chemistry); Prof. KÓNYA , Zoltán (University of Szeged, Dept. of Applied and Environmental Chemistry & MTA Reaction Kinetics Research Group); Prof. ERDŐHELYI , András (University of Szeged, Dept. of Physical Chemistry and Materials Science); Prof. KISS, János (University of Szeged, Dept. of Applied and Environmental Chemistry & MTA Reaction Kinetics Research Group)

Presenter: Dr OSZKÓ, Albert (University of Szeged, Dept. of Physical Chemistry and Materials Science)

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