

Catalytic Activity of Bimetallic Gold Containing Nanoparticles on Different Supports Investigated by IR Spectroscopy

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Bimetallic catalysis has always been a subject of exciting investigations. Gold bimetallic catalysts have been prepared by several methods on different supports. Synergism in bimetallic AuPd catalyst was reported in hydrogenation reactions [1].

Some of the chlorinated organic compounds are widely used commercially, because of their advantageous chemical/physical properties or having toxicity for pestiferous living substances. However, most of them are environmental pollutants. Emitted into the atmosphere they are responsible for diminishing the ozone layer in the stratosphere. Therefore, a lot of effort is devoted in finding proper solutions to decompose these chemicals in environmentally friendly ways. Nobel metals on different carriers play very important role in catalytic hydrodechlorination of these compounds. No such own activity of Au was reported, but improved selectivity and activity could be reached by alloyed type and core/shell supported AuPd bimetallic particles in dichlorodifluoromethane and trichloroethene hydrodechlorination, respectively, compared to the monometallic Pd analogues [2, 3].

During the work leading to this contribution we have prepared SiO₂ and TiO₂ supported bimetallic Au-Pd [4] and Au-Pt samples and the monometallic Au, Pd and Pt analogues by adsorption of the preformed nanoparticles from the corresponding mono- or bimetallic hydrosols. The samples were characterized by X-ray fluorescence spectroscopy (metal content), transmission electron microscopy (metal particle size), X-ray diffraction (crystallinity) and CO chemisorption, oxidation. Catalytic activity of these noble metal nanoparticles was investigated in the hydrodechlorination of CCl₄ as model compound.

IR spectroscopic self-supporting wafer technique was employed for adsorption and catalytic measurements. The wafers were prepared from the solids and placed into the sample holder of an *in situ* IR cell. During the pretreatment process when the wafer was heated at 673 K for 1 h in 20% O₂ in nitrogen stream followed by evacuation at the same temperature the organic compound (remaining reducing and stabilizing agents) were removed. This oxidized sample was reduced in H₂ at 473 K. For hydrodechlorination experiments the pretreated catalyst wafers were loaded with the CCl₄ (carbon tetrachloride) reactant at room temperature. Both the surface species and the gas-phase products were analysed as the reaction proceeded under various experimental conditions by IR spectroscopy.

FT-IR measurements proved that the intermediate product is phosgene (COCl₂) and the final products are CO₂ and HCl. The hydrogen/reactant ratio exerts large influence on the rate of the hydrodechlorination reaction.

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