

## CO<sub>2</sub> hydrogenation at atmospheric pressure on ZnO supported Pd and Cu nanoparticles

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In this work two ZnO supported Pd and Cu nanoparticle catalysts were developed and characterized in view of chemical properties and structural information. Studies about the catalytic activity were carried out through kinetic measurements of the CO<sub>2</sub> hydrogenation reaction as a function of the reaction temperature at atmospheric pressure and in a variation of the reduction temperature. To gather chemical information H<sub>2</sub>-TPR and TPD analysis were performed. XRD, TEM and physisorption experiments were carried out to examine the structure of the developed catalysts.

EDX and XRD results show that the Pd/ZnO catalyst forms a PdZn surface alloy at a reduction temperature higher than 200 °C which effects in catalytic activity. [1] Interestingly, the Cu/ZnO catalyst does not present an alloy formation at any reduction temperature. The comparison of TEM/STEM-HAADF micrographs of the reduced catalysts and after a long-term reaction illustrates an increasing particle size during the reaction. Because of the high reaction temperatures sintering effects occurred which were the reason for alloy formation (Pd/ZnO catalyst) and a general particle size widening (Cu/ZnO catalyst).

As main hydrogenation product, the reversed water gas shift reaction takes place at atmospheric pressure performed with both catalysts. An increasing reaction temperature leads to higher conversion in general for both catalysts but the comparison at the same reaction temperature shows a higher catalytic activity with the Pd/ZnO catalyst.

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[1] K. Föttinger and G. Rupprechter, "In situ spectroscopy of complex surface reactions on supported Pd-Zn, Pd-Ga, and Pd(Pt)-Cu nanoparticles," *Acc. Chem. Res.*, vol. 47, no. 10, pp. 3071–3079, 2014.