Selective hydrogenolysis on bifunctional catalysts

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Different supports (zeolite Y, Al_2O_3, ZrO_2) with Pt and WO_X on it, were investigated as catalysts for a reaction of triol to mono alcohol. The dehydration occurs over acid sites and the hydrogenation over noble metals with hydrogen. The reaction was performed in liquid phase using a hydrogen pressure of 50 bar.

With the Al_2O_3 and the zeolite Y support the best conversion was achieved, however the Al_2O_3 catalyst produced more by-products. The ZrO_2 catalyst had a good selectivity for n-mono alcohol, but the conversion was the worst, so further studies were carried out only with the zeolite Y support. By-products were iso-mono alcohol, ketones and different gases.

At 220 °C and a WHSV of 0.07 h^{-1} the conversion was 99.3 % and the selectivity for the n-mono alcohol was 87.7 %. At a temperature higher than 220 °C the gas production increased strongly, therefore 220 °C was turned out to be the best temperature for the reaction. To determine the reaction pathway from the triol to the mono alcohols, we used different intermediates as reactants in the hydrogenation reaction. As a result, the reaction proceeds preferably via the 1,2-diol with a minor contribution of the pathway via the 1,3-diol. Furthermore, we found out that the dehydration requires a higher temperature than the hydrogenation step.

The BET surface area of the catalyst decreased from 510 m^2/g to only 154 m^2/g after the reaction, probably because of organic residues. The acid sites were characterized by temperature-programmed desorption of with NH_3 and IR spectroscopy of pyridine adsorption. The amount of acid sites was somewhat higher with higher WO_X loading (3.75 - 37.5 %) and did not change with Pt loading (0.5 - 5 %). A higher Pt amount increased the ratio of Lewis to Brønsted acid sites. The used catalyst exhibited overall less acid sites, and the organic residues mainly blocked the Brønsted acid sites. With UV-Vis spectroscopy no structural changes before and after the reaction were observed for the bands characteristic for WO_X and the zeolite Y.