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The role of rhenium in the selective hydrogenolysis of glycerol to 1,3-propanediol over supported Pt-Re/WO_3/ZrO_2 catalysts

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Biodiesel is an alternative biodegradable and renewable diesel fuel which can replace petroleum diesel in the future. However, about 1 kg of crude glycerol is formed as a byproduct for every 9 kg of biodiesel. So it will reduce the production cost of biodiesel and promote the use of clean and renewable energy if we convert the by-product glycerol to high-valued chemical materials like 1, 3-propanediol. Supported Pt-Re/WO_3/ZrO_2 catalysts were synthesized for the selective hydrogenolysis of glycerol to 1,3-propanediol. The effects of Re doping on the catalytic performance of Pt/WO_3/ZrO_2 catalysts were investigated. Experimental results suggest that appropriate amount of Re additives significantly increase the glycerol conversion to more than 99% and maintain similar 1, 3-propandiol yield with Pt/WO_3/ZrO_2 catalysts while reducing the content of Pt. NH3-TPD results show that NH3 desorption on the catalysts surface is observed over a wide temperature range, due to the different thermal stabilities of adsorbed NH3 species. The introduction of Re increases the adsorbing capacity of NH3 on the catalyst surface. NH3 DRIFT results suggest that Pt-Re/WO_3/ZrO_2 catalysts have more Brφnsted acid centers than Pt/WO_3/ZrO_2 catalysts, thus improves the dehydration activity of secondary hydroxyl group of glycerol. Temperature-programmed desorption of chemisorbed CO results indicate that Re greatly improve the dispersion of Pt, so the hydrogenation activity of dehydration-rearrangement product is enhanced after Re doping on.