

Production of 1, 2-propanediol and hydrogen by aqueous phase reforming of glycerol

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Hydrogen is being projected as the fuel of the future and there is considerable research effort worldwide to develop alternative sources for H₂ particularly from renewable sources. At the same time glycerol is the byproduct obtained during the manufacture of biodiesel by the transesterification of seed oil with methanol and there is an urgent requirement for value addition of glycerol. One of the reported options is to convert glycerol to 1-2 propanediol by hydrogenolysis. In the present work however we report a method for the production of 1-2 propanediol (1,2 PD) from glycerol **without adding external H₂** through aqueous phase reforming of glycerol. In addition, H₂ with high selectivity is also produced in the gaseous products.

3% Pt was loaded on different supports such as hydrotalcite (HT), SBA-15, KIT-6 and MCM-41 by wet impregnation method using Pt (NH₃)₄(NO₃)₂ as the metal precursor. It was observed that the HT supported catalyst was the most efficient, with a glycerol conversion of ~84% and the selectivity ~68% for 1,2 PD in the liquid phase and a selectivity of ~70% for H₂ in the gas phase. (reaction conditions : 2 g glycerol, 45 bar N₂, 250 °C, catalyst wt. 0.2 g, reaction time 3h. HT with Al₂O₃:MgO = 80:20 calcined at 260 °C and reduced at 260 °C). The other products obtained in the gas phase were CO₂, CH₄ and C₂H₆.

The XRD patterns of the HT supported samples showed that the HT structure was partially retained up to 250°C and there was complete structure collapse on further heating. On the other hand TPR studies showed two reduction peaks at 260°C and 450°C. Consequently the activity of the Pt/ HT catalysts calcined at 260°C and 450°C and reduced at 260°C and 480°C were evaluated and it was observed that the highest glycerol conversions and selectivities for 1,2 PD and H₂ were obtained for the catalysts calcined at 450°C and reduced at 480°C. Under these conditions, it was also observed that total glycerol conversion could be achieved when the reaction time increased to 5 hrs but the selectivity for 1-2, PD and H₂ reduced to 48.2% and 41.2% respectively. The optimum reaction time was found to be 3 hrs where a glycerol conversion of 85% was observed with the selectivity for 1,2 PD and H₂ being 61% and 87% respectively.

The present work demonstrates a method for the value addition of glycerol to 1,2-propanediol utilising the H₂ generated in-situ from H₂O, through aqueous phase reforming. Moreover, H₂ is additionally produced with high selectivity in the gaseous products