Selective Hydrogenolysis of Tetrahydrofurfuryl alcohol over Supported Pt Catalysts

Shixiang FENG1, Aiko NAGAO1, Hiroki MIURA1,2,3, Tetsuya SHISHIDO1,2,3

1Dept. of Applied Chemistry, Graduate School of Urban Environmental Sciences, Tokyo Metropolitan Univ., Tokyo, Japan
2ReHES, Tokyo Metropolitan Univ., Tokyo, Japan
3ESICB, Kyoto Univ., Kyoto, Japan

*E-mail: shishido-tetsuya@tmu.ac.jp

Tetrahydrofurfuryl alcohol (THFA) is one of the furfural derivatives, which has been produced through multistep reaction process (hydrolysis-dehydration-hydrogenation) in the conversion of hemicellulose in non-edible biomass. Among various processes for converting THFA to value-added chemicals, the selective C-O hydrogenolysis over heterogeneous catalysts provide a significant route to the production of 1,2-, and 1,5-pentanediol (PeD) (Scheme 1). In this study, we investigated the relationship between catalytic performances of Pt/WO3/ZrO2 catalysts with various loading amount of WO3 in the THFA hydrogenolysis and local structures around tungsten species.

Figure 1 shows the results of THFA hydrogenolysis over supported WO3, Nb2O5, and V2O5 catalysts. 1,5-PeD was mainly produced together with 1-pentanol (1-PeOH). The activity of supported WO3 catalysts was higher than those of supported Nb2O5 and V2O5 catalysts. Among the supported WO3 catalysts, Pt/WO3/ZrO2 gave the highest yield of 1,5-PeD.

The loading amount of WO3 significantly affected the products distribution in hydrogenolysis of THFA (Fig. 2). The yield of 1,5-PeD was increased with increase of WO3 loading, and reached the highest at 5 wt% loading (with 36.4% yield accounting for 64.8% selectivity). According to WO6 unit size (0.22 nm²) [1] and structural characterization, in the case of 5 wt% WO3 loading, the surface coverage of ZrO2 with WO3 was ca. 50%. When WO3 loading was further increased over 10 wt%, inert WO3 crystals as well as a decrease of Brønsted acidity would occur and subsequently resulted in reduction of catalytic activity. This result suggests that hydroxyl groups located at the boundary between WO3 species domain and ZrO2 (W-(OH))-Zr), work as active sites for the selective hydrogenolysis of THFA to 1,5-PeD.

REFERENCES