

Hydrodeoxygenation of Anisole over Mesoporous TiO₂-supported Ru and Ru-Fe Catalysts

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The fast pyrolysis of lignocellulosic biomass has attracted significant attention as a promising technique for producing bio-oil in order to achieve our dependence on fossil fuels [1]. However, bio-oil must be upgraded to make it suitable for better utilization because of its high oxygen concentration that results in several undesirable properties including high viscosity, low energy density, and high acidity [2, 3]. Hydrodeoxygenation (HDO) is considered to be the most feasible strategy to lower the oxygen content by direct removing the oxygen in the form of water [2]. In this contribution, the new type of catalyst for HDO of anisole (lignin model compound) was investigated. The anisole conversion and the selectivity toward aromatic product were increased by the synergy of the active sites (Ru and Fe) and mesoporous support (TiO₂).

Mesoporous TiO₂ support was synthesized based on the hydrothermal method reported elsewhere [4]. Supported-Ru-Fe catalysts were prepared by incipient wetness method with 3 wt. % Ru and 1–10 wt. % Fe. The surface area and total pore volume of support and catalysts were determined by nitrogen adsorption-desorption using Belsorp mini II (Bel, Japan). The HDO experiments were performed in a stainless steel batch reactor. The liquid-phase products were analyzed by a gas chromatography (GC, Agilent Technology 6890).

Figure 1 shows the nitrogen adsorption-desorption isotherms of TiO₂ support and Ru-Fe catalysts. All isotherms can be assigned as type IV, represent typical mesoporous materials. Incorporation of active metals into the support resulted in the decreased of surface area and total pore volume for all catalysts. These decreases mainly come from the

deposition of metal nanoparticles within the mesoporous channels of support.

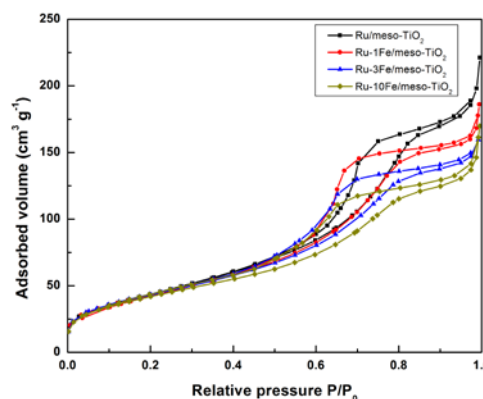


Fig.1 N₂ adsorption-desorption isotherms of support and catalysts.

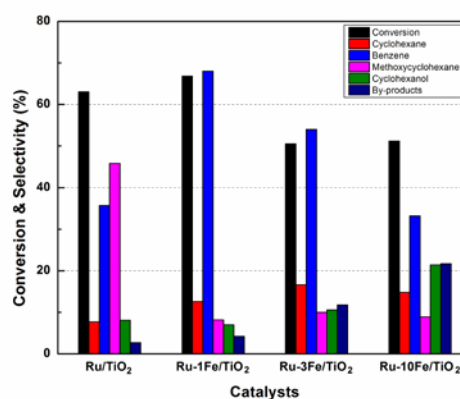


Fig. 2 Conversion and product distribution of the HDO of anisole. The reaction were performed at 200 °C and 10 bar H₂ for 3 h.

Figure 2 illustrates the conversion and the product distribution of the HDO of anisole. Ru-1Fe/meso-TiO₂ showed highest anisole conversion and produced largest amount of benzene among these catalysts. It indicates that adding small amount of Fe enhanced catalytic activity and directed the reaction pathway toward direct deoxygenation, which means decreasing the H₂ consumption as well.

REFERENCES

- [1] A.J.R. Hensley, Y. Hong, R. Zhang, H. Zhang, J. Sun, Y. Wang and J.S. McEwen, *ACS Catal.*, 4 (2014) 3381.
- [2] N. Arun, R.V. Sharma and A.K. Dalai, *Renew. Sustain. Energy Rev.*, 48 (2015) 240.
- [3] G. W. Huber, S. Iborra and A. Coma, *Chem. Rev.*, 106 (2006) 4044.
- [4] J. Yu, G. Wang, B. Cheng and M. Zhou, *Appl. Catal. B-Environ.*, 69 (2007) 171.