

# Selective Hydrogenation of DCPD on Pd@Al<sub>2</sub>O<sub>3</sub> Catalyst

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The aim of this study was to develop a method to prepare Pd@Al<sub>2</sub>O<sub>3</sub> with core shell-structure. The catalyst with core-shell structure usually has high product selectivity and long life time. If the reaction is fast and pore-diffusion is limited, the metal inside the particles becomes of no use. Only the metals in the shell can be used in reaction. Pd@Al<sub>2</sub>O<sub>3</sub> with core-shell structure was prepared by impregnation technique. 0.1068 g Pd(CH<sub>3</sub>COO)<sub>2</sub> was dissolved in 150 ml toluene.  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> obtained from Osaka Yogyo was calcined at 1000 °C for 6 h. The particle size of alumina bead was 2-4 mm in spherical shape. Alumina support was then dipped into the above toluene solution for 3 h. The catalyst was dried at 100 °C for 1 h, and then calcined at 350 °C for 6 h. The sample was analyzed by ICP-OES to measure the Pd metal loading. It showed that the Pd metal loading was 0.3 wt. %. The bulk density of this catalyst is 0.68 g/cm<sup>3</sup>, and the BET surface area is 60 m<sup>2</sup>/g. Selective hydrogenation of DCPD to endo-THDCPD over the catalyst was carried out in this study. Endo-THDCPD is isomerized to exo-THCPD, which is the fuel of JP-10. In this study, 30 g DCPD dissolved in 70 g n-hexane was loaded into a Parr reactor, catalyst was then loaded into the reactor. The hydrogen pressure was varied between 5 and 10 atm, the temperature was varied between 50 and 70 °C, and the catalyst loading was varied between 1.7 mg and 3.7 mg. Al<sub>2</sub>O<sub>3</sub> was converted to  $\delta$ -Al<sub>2</sub>O<sub>3</sub> after calcinations. In this study, Pd@ $\delta$ -Al<sub>2</sub>O<sub>3</sub> showed high activity and 100% selectivity to endo-THDCPD. The kinetics study showed the rate equation is  $-r_{\text{DCPD}} = 2.525 \times 10^2 \times \exp(-4380/T) P_{\text{H}_2}$  (mol/s. g). The activation energy is 6.42 kJ/mol and the reaction rate is first order with respect to the partial pressure of hydrogen.

Keywords: hydrogenation, RJ-10 fuel, selective hydrogenation, Palladium catalyst, core-shell structure.

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