Rational Design of Hydrocracking Catalysts for BTX Production from Polyaromatic Hydrocarbons

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It has been required to upgrade surplus polyaromatic hydrocarbons (PAHs) of diesel boiling range such as light cycle oil (LCO) from fluidized catalytic cracker due to emission control worldwide raised by environmental concerns [1-4]. One feasible option for upgrading LCO is to produce high value chemicals such as benzene, toluene and xylenes (BTX). For this purpose, LCO comprised mainly of 2- and 3-ring aromatics was first hydrotreated into products rich in 1-ring aromatics followed by selective hydrocracking of 1-ring aromatics into BTX [3-4].

Herein, we report rational design approaches of hydrocracking catalyst for the hydroconversion of PAHs into BTX in high selectivity and yield. For this purpose, various metals with different hydrogenation (HYD) activity were supported on zeolites. The hydrocracking (HYC) of tetralin was studied in a fixed-bed down-flow reactor under 4 MPa as a model reaction for PAHs conversion to BTX. In order to test the HYD activities of various metals and their effects on the HYC of tetralin, the metals were also supported on the low acidity γ-Al_2O_3, and were tested in the HYD of tetralin.

Figure 1 shows BTX yields obtained over various HYC catalysts as a function of HYD activity of metal in the HYC catalysts. For all the reaction temperatures, HYC catalysts containing metal with a moderate HYD activity showed the highest BTX yield. However, the BTX yield was much lower than the theoretical yield expected from the HYC of tetralin. To further increase the per-pass yield of BTX from tetralin HYC, zeolites with different dealkylation activity was employed in the design of HYC catalysts. In **Figure 2**, the yields of alkylbenzenes (Abs.) other than BTX and BTX obtained at different reaction temperature are compared as a function of dealkylation activity of zeolite. When the metallic function is fixed, HYC catalyst containing zeolite with a moderate dealkylation activity showed much enhanced per-pass yield of BTX.

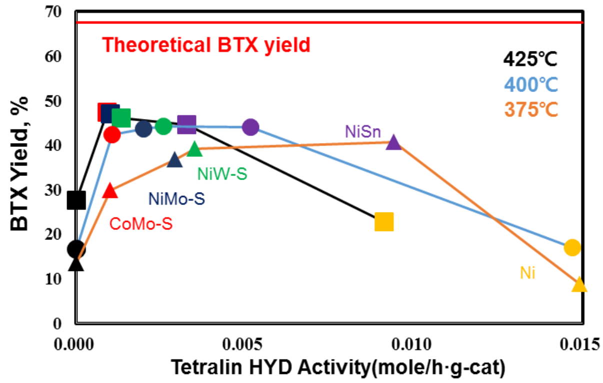

Figure 1. Effect of HYD activity of metallic function on the BTX yield in the tetralin HYC.

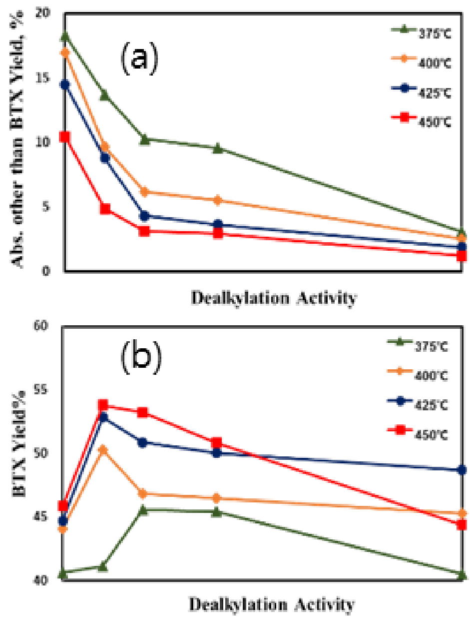

Figure 2. Effect of dealkylation activity of zeolite on the yields of (a) alkylbenzenes (Abs.) other than BTX and (b) BTX in the tetralin HYC.

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