Design of Solid Acid Catalysts for Cycloaddition of Dimethylfuran and Ethylene to Produce p-Xylene

Philip Wijaya, 하정명, 서동진, 제정호†
한국과학기술연구원

Diels-Alder cycloaddition between biomass-derived dimethylfuran (DMF) and ethylene and subsequent dehydrative aromatization have recently been proposed as a renewable route to produce p-xylene. Since p-xylene is a platform chemical in the production of polyethylene terephthalate (PET), the proposed process has received increasing attention. In this study, the Diels-Alder cycloaddition of dimethylfuran was investigated with different types of solid acid catalysts to develop the structure-activity relationships of this reaction. We have prepared and tested a series of well-characterized acid catalysts, including HZSM-5, HY, HBEA, Zr-P, sulfated zirconia, SiO2-Al2O3, SiO2-Al2O3 aerogels (SAA), WOX/ZrO2, sulfated graphene oxide, and AlCl3. Among the tested solid acid catalysts, the SAA with Si/Al=1 had the highest conversion and selectivity to p-xylene (67%). Acidity characterization of the catalysts with ammonia-TPD and solid state NMR revealed that the ratio of Bronsted to Lewis acid sites has a crucial role in the selective production of p-xylene.