UNIVERSITY OF MINNESOTA
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Ultra-High Yield Para-Xylene from Biomass-Derived 2,5-Dimethylfuran

P-Xylene from Biomass Feedstocks

A new series of phosphorous-containing solid catalysts produces ultra-high yields of p-xylene by suppressing competing side reactions. Among them, phosphorous-containing BEA zeolite (P-BEA) with 12 membered-ring (12 MR) structures and phosphorous-containing self-pillared pentasil (P-SPP) zeolite nanosheets with 10 MR exhibit exceptional activities up to 97% yield of p-xylene at 99% conversion of DMF. The Diels–Alder cycloaddition of 2,5-dimethylfuran (DMF) and ethylene and the subsequent dehydration of the cycloadduct intermediate is an attractive reaction pathway to produce renewable p-xylene from biomass feedstocks. Passing the Diels-Alder cycloaddition product of ethylene and DMF over this catalyst technology, a conversion rate of 97% can be achieved. The renewable p-xylene produced is an important precursor for production of PET and other related plastic materials.

Higher Yields at Potentially Lower Costs

Recent advances using Diels-Alder reactions for producing renewable aromatics (including p-xylene, toluene, benzene and other aromatic derivatives) could not exceed a 75% p-xylene yield. The phosphorous-containing solid catalysts in this technology produced p-xylene yields of up to 97%. Using ethylene (the most highly produced petrochemical) with DMF (which can be derived from fructose) may provide a more economical method of para-xylene production. Furthermore, P-containing zeolite Beta is an active, stable and selective catalyst for this reaction. It can catalyze the dehydration reaction selectively without producing alkylated and oligomerized products, unlike Al-containing zeolites and other solid phosphoric acid catalysts. This unique aspect establishes a commercially attractive process for renewable p-xylene production.

BENEFITS AND FEATURES:

- Cost effective phosphorous-containing solid catalysts
- Ultra-high yield production of p-xylene
- No competing side reactions
- Renewable p-xylene

APPLICATIONS:

- Precursor for terephthalic acid used in the production of PET and other related plastic materials
- Beverage bottles, automotive, fibers for clothing and carpeting

Phase of Development - Prototype

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Publications

Renewable p-Xylene from 2,5-Dimethylfuran and Ethylene Using Phosphorus-Containing Zeolite Catalysts

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