

Optimizing the Shape Selectivity of Zeolite Catalysts for Biomass Conversion: The Kinetic Diameter

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Abstract

We have studied the influence of catalyst pore size and morphology on the conversion of glucose to aromatics by catalytic fast pyrolysis using over 15 different zeolite catalysts having a variety of shapes and pore sizes. The estimated kinetic diameter for the catalytic pyrolysis products and reactants was used to determine the optimal pore size for zeolite catalysts for catalytic fast pyrolysis. Smaller oxygenate pyrolysis products including furans, hydroxyaldehydes, and organic acids are sufficiently small in diameter to diffuse easily into ZSM-5 (6.3 Å). Of the aromatic products only benzene, toluene, indane, indene, naphthalene, ethylbenzene and xylenes are of a sufficiently small size compared to the ZSM-5 pore. Zeolites type catalysts with a range of pore size 3.9-7.4Å were used for catalytic testing. From these an optimum pore size range of 5.7-6.6Å is identified to maximize aromatic yield. In addition to pore window size, zeolite pore structure and intersections are critical for the reaction mechanism. It is likely that this small pore size also limits the formation of larger aromatics including coke in the pores.

Key words: Zeolite, Catalytic Fast Pyrolysis, Kinetic Diameter, Aromatics.

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