

Abstract

Zeolites are microporous crystalline aluminosilicates. They are used as catalysts due to their acidity, shape selectivity, high surface area, high thermal, and chemical stability. New types of zeolitic materials are of interests as catalysts for various reactions. Isomerisation of m-xylene is sensitive to shape and dimensionality of pores, thus it is excellent model reaction for zeolites characterisation.

The aim of this thesis is to investigate shape selectivity effects of isorecticular zeolites on the catalytic performance in m-xylene isomerisation. Isorecticular zeolites have the same crystalline layers connected in various way resulting in different, tuneable pore systems. The catalytic behaviour of the studied zeolites was compared to commercial ZSM-5 zeolite catalysts.

Isorecticular zeolites were prepared *via* ADOR method. This new method is a top-down approach for zeolite synthesis providing materials with preserved crystalline layers, but different channel systems. Parent Al-UTL (14- and 12-ring channels) zeolite was prepared *via* hydrothermal synthesis. This material was utilised for the synthesis of daughter zeolites with various channel systems: Al-IPC-7 (14- and 12-ring, as well as 12- and 10-ring channels), Al-IPC-2 (12- and 10-ring channels), Al-IPC-6 (12- and 10-ring, as well as 10- and 8-ring channels), and Al-IPC-4 (8- and 10-ring channels). The properties of prepared catalysts were characterised by powder X-ray diffraction, argon sorption, scanning and scanning transmission electron microscopy, and analysis of acid sites by infrared spectroscopy.

Isomerisation of m-xylene took place in a fixed-bed reactor at 350 °C. The highest conversion was provided by Al-IPC-7 catalyst with interconnected 14- and 12-ring channels, along with 12- and 10-ring channels, and also having the highest concentration of acid sites. In general, zeolites with 10-ring pores favoured monomolecular isomerisation thus providing a high p-xylene selectivity. Bimolecular reaction mechanism was enabled in 12- and 14-ring channels. The 8-ring channels were inaccessible, therefore their influence is neglectable. This caused practical decrease in the channel dimensionality to 1D pore system. Pore system controls selectivity and the presence of acid sites defines conversion with the presumption that the acid centres are accessible.

Key words: ADOR zeolites, shape selectivity, aluminium, catalysis, isomerisation, m-xylene, p-xylene