Characterization of external acidity of MFI zeolite nanosheets by ^{31}P NMR and catalytic cracking of decalin

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2.5nm-thick MFI zeolite nanosheets were synthesized using a zeolite structure-directing surfactant. External acid sites of MFI zeolite nanosheets were characterized using solid state ^{31}P MAS NMR with adsorbed trimethylphosphine oxide and tributylphosphine oxide as probe molecules. The acid strength and concentration were assessed by chemical shifts and peak areas of NMR spectra. The NMR investigation identified three types of Brønsted acid sites with different strengths on external surfaces. Due to the large number of strongest external acid sites, the MFI zeolite nanosheet exhibited much higher catalytic activity in decalin cracking as compared to bulk MFI zeolite, and even than other nanocrystalline MFI zeolites. Therefore, it is expected that these nanosheets and perhaps, related nanomorphic zeolites that can be tailor-synthesized by dual (both micro and meso levels) structure-directing surfactants would be useful in a wide range of acid-catalyzed reactions involving several bulky species.