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Synthesis of nanosized ZSM-5 zeolites by different amounts of sodium hydroxide and their catalytic performance in methanol to propylene reaction

Marzieh Hamidzadeh,* Solmaz Shifte, Ali Abdolali and Fereydoon Yaripour

Catalysis research group, Petrochemical Research & Technology Company, National Iranian Petrochemical Company, P.O. Box: 1493, Tehran, Iran.

* *E-mail: hamidzadeh@nipc.ir*

Four nanosized ZSM-5 zeolites were successfully prepared from gels with different Si/Na ratios and the same preparation procedures that included the use of tetrapropylammonium bromide as a template and a seeding method. The effect of the amount of sodium in gel on the physicochemical properties of the prepared samples was investigated by XRD, XRF, N_2 physisorption, FESEM, EDX, and NH_3-TPD. The catalytic performance of the nanosized ZSM-5 zeolites in the methanol-to-propylene process was compared. The prepared samples were phase-pure and highly crystalline ZSM-5 zeolites in Na_2O/SiO_2 ratio between 0.04 to 0.169. The other components in the initial gel were similar. The XRF and EDX results illustrated different Si/Al ratios in bulk and surface of synthesized zeolites, respectively. In addition, the change in the amount of sodium hydroxide in the initial gel affected the acidic properties and morphology of zeolites. The study of the prepared catalysts in methanol to propylene reaction revealed that both the acid characteristics of the ZSM-5 and their textural properties such as surface area were responsible for their performance in the reaction. A difference in the lifetime of every catalyst was attributed to the ability of the catalyst to coke forming on acid sites located on the external surface of the zeolite crystals. The sample with Na_2O/SiO_2 ratio equal to 0.084 in gel showed moderate acid sites with minimum strength, and this catalyst illustrated maximum surface area. The presented results show that the amount of Na_2O used to synthesize ZSM-5 zeolites is an important factor that determines the physicochemical properties, catalytic performance, morphology, selectivity, and acidity of final crystals.

Keywords: ZSM-5, Methanol to propylene, Na_2O/SiO_2.

References

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