

Understanding Gadolinium Promoted Zeolite Catalyst: Anti-coking Properties and Catalytic Activity

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Methanol can be mass-produced from synthesis gas ($\text{CO} + \text{H}_2$), which is produced not only via coal, methane, and biomass based process but also during steel manufacture as by-product. Solid acid catalysts, such as ZSM-5 zeolite, enable direct conversion of methanol to hydrocarbons with high selectivity toward desired products due to their strong acidity and unique pore structure. However, despite the high activity and selectivity of zeolite catalysts, severe deactivation due to coking is a major problem for their application in commercial MTH plants. In order to overcome this problem, many attempts, for instance various synthetic approach including modification of ZSM-5 zeolites, have been investigated. Furthermore, introduction of a small amount of a metal to ZSM-5 zeolites has been reported as another option, and recently, a gadolinium (Gd)-promoted ZSM-5 catalyst exhibited good anti-coking characteristic during hydrocarbon cracking reaction. Motivated by this previous discovery, we report the first comprehensive investigation on the role of Gd as a coke inhibitor and suggest strategic design of the Gd-promoted ZSM-5 catalyst for the MTH reaction.