Selective Hierarchical Aluminosilicates for Acetalization Reaction with Propylene Glycol

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Abstract: *Hierarchical micro-mesoporous aluminosilicates nanoparticles were synthesized at different of Si/Al ratios and were directly used as a solid acid catalyst for acetalization reaction with propylene glycol. TEM and N_2 adsorption analysis of the resulting aluminosilicates revealed the formation of the hierarchical structure occurs on the Si/Al ratio increases the formation of mesoporous within the structure of aluminosilicate. The aluminosilicates exhibit high selectivity towards acetalization reaction in comparison with the homogeneous PTSA. The presence of mesoporous structures is crucial for increased conversion and selectivity of the reaction which presumably due to the improved diffusion of substrate to reach acid sites.*

Keywords: *hierarchical aluminosilicates; Si/Al; acetalization; propylene glycol*

■ INTRODUCTION

Circumventing from the use of the homogeneous acid catalyst in the production of the fine chemical has attracted research in the development of solid acid catalyst. Zeolite, with a variation of silica to alumina molar ratio, offers stability and flexible acidity as an ideal choice of catalyst. Acetalization reaction is the reaction between aldehyde/ketone and alcohol requires Brønsted or Lewis acid catalyst to produce acetal/ketal products [1]. The product from acetalization is often used in fragrance, cosmetics, pharmaceuticals, detergents, lacquer and as an additive in the food and beverages industries [2-4]. The homogeneous acid catalyst is currently employed to serve the purpose and is associated as a corrosive substance that is not only harmful but required careful handling, storage and disposal [5-6]. The use of a solid acid catalyst is beneficial as the catalyst is easily separated from the product and can be re-utilized to reduce the operational cost. For the benefit of health and safety aspect and to reduce the devastating environmental consequences arising from the use of a homogeneous catalyst, numerous studies have been conducted to increase the performance of heterogeneous catalysts in acetalization reactions [7]. MCM-22, Al-MCM-41, AlMSU-Y were among aluminosilicates that have been widely employed to catalyze acetalization reaction [8-13] which the results indicated the catalytic performance was strongly affected by porosity and acidity of the catalysts.

We have previously reported the use of aluminosilicates in acetalization of 3,4-dimethoxy benzaldehyde [14] and in acetalization of furfuraldehyde [15] with propylene glycol which the results showed that the pore diameter and acidity affected the catalytic activity. Here we carried out detail studies on the influence of aluminosilicates with a variation of acidity and hierarchical structure on its activity for acetalization of three aldehyde compounds with propylene glycol and