HYBRID ACID CATALYSTS PREPARED VIA TRIMETHYLSILYLATION OF ALUMINOSILICATES SYNTHESIZED BY NON-HYDROLYTIC SOL-GEL

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Hybrid materials based on aluminosilicates are extensively studied for their enhanced catalytic performance. Organic groups can change acidity, hydrothermal stability, and porosity. First, we have shown, that non-hydrolytic sol-gel (NHSG) provides highly homogeneous and porous aluminosilicate materials exhibiting superior activity and long-term stability in ethanol dehydration [1]. Second, the ethylene selectivity was improved by one-pot incorporation of organic groups [2]. Interestingly, this approach did not display the direct influence of hydrophobicity on alcohol dehydration in contrary to other reports [3].

In this study, the NHSG-prepared aluminosilicate catalysts (fully inorganic) were post-synthetically modified by grafting trimethylsilyl groups onto their surfaces. Trimethylsilyl groups were attached to the surface using trimethylchlorosilane or trimethyl(methoxy)silane. The number of reacted ≡Si−OH moieties and thus the trimethylsilyl groups loading was controlled via a temperature-vacuum pretreatment of aluminosilicate samples. Trimethylsilyl groups loading was evaluated by ^{29}Si MAS NMR measurements (Figure 1). Structure, porosity, acidity, and hydrophobicity of NHSG-prepared catalysts were closely followed by MAS NMR studies, N_2 physisorption, IR-pyridine analyses, and water adsorption. Moreover, aluminosilicates were tested in a gas-phase fixed-bed catalytic reactor in ethanol dehydration and in a batch reactor in aminolysis of styrene oxide (liquid phase). These tailored NHSG-prepared aluminosilicate catalysts exhibited varying catalytic activity and selectivity in both catalytic reactions depending on trimethylsilyl groups loading in the samples.

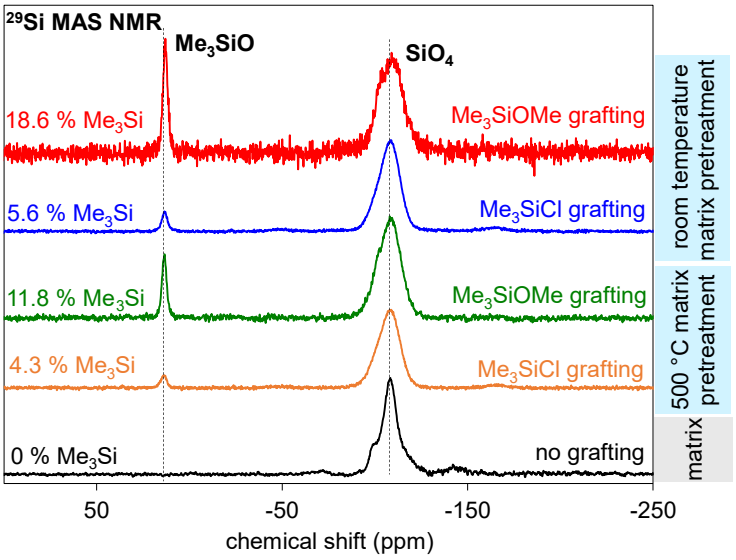

Figure 1: Comparison of pristine aluminosilicate with post-modified aluminosilicate samples in ^{29}Si MAS NMR

References

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