

Solid Base Catalysts: Opportunities for Renewable Fuels

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Abstract

A sustainable biomass economy requires the development of different integrated steps for the conversion of biomass-derived feedstocks into a range of fuels and chemicals. Many of these steps involve basic catalysts. One key step in biorefinery concept to produce diesel and jet fuel range alkanes involves C-C bond forming reactions by aldol condensation. In this research, we present two types of novel solid base catalysts for both the liquid and gas phase aldol condensation reactions: the nitrogen-substituted zeolites and silica supported CeZrO_x . Furaldehydes condensation with acetone or propanal was studied in liquid phase over the nitrogen-substituted NaY (Nit-NaY) and MgO-ZrO_2 , a mixed metal oxide. Nit-NaY showed comparable catalytic activity to MgO-ZrO_2 , but higher selectivity to furadehyde acetone monomer product, indicating the shape selective significance of Nit-NaY. In the gas phase aldol condensation reaction, butanal was selected as model compound to generate C8 to C12 hydrocarbon compounds. $\text{CeZrO}_x/\text{SiO}_2$ lowers the reaction temperature about 100°C and is very stable towards acid poisoning compared to MgO/SiO_2 . The nature of the basic sites, the reaction chemistries and reaction mechanisms were also investigated.

Keywords: Aldol condensation, solid base catalysts, biorefinery, nitrogen-substituted zeolites, silica supported CeZrO_x catalyst