Green diesel production from vegetable oils

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Inedible oils are a suitable substation of crude oil for production of transport fuels. They are renewable and carbon neutral. Thus, their use (unlike that of fossil resources) reduces greenhouse gas emissions and saves energy import bill. Transesterification and deoxygenation are two approaches for converting inedible oils into biofuels. The latter approach producing renewable diesel-range hydrocarbons (green diesel) is an attractive approach as it could be integrated with the existing refining processes. A few companies have commercialized this green diesel process using conventional hydrotreating catalysts that operates at harsh conditions. Pt and Pd based catalysts offer operation at milder conditions (moderate temperature and hydrogen pressure) but the catalyst stability is an issue. This presentation addresses factors controlling the catalytic deoxygenation activity and selectivity. We will present studies conducted on a series of Pt catalysts deposited on metal oxide modified supports (Pt-MO_x/Support, where M refers to W, Mo, Re and Sn and Support refers to Al_2O_3, $AlPO_4$-5, SiO_2-Al_2O_3 and ZrO_2).[1-3] Catalysts were characterized by a battery of physicochemical techniques and catalytic activity studies were evaluated in semi-batch reactors. In general, metal oxide promoted the deoxygenation activity of Pt. They altered the reaction path from decarboxylation/decarbonylation (DCO) to hydrodeoxygenation (HDO). Pt:M weight ratio of 1:2 was found ideal and Pt composition of 4 wt% enabled high activity and HDO selectivity. MO_x forms a polyoxide coverage on the support oxide and Pt is in contact with it. Platinum has a optimum dispersion value and below and above that value the conversion is lower. Higher the metallicity or higher the electron density of Pt higher is the deoxygenation activity. HDO selectivity followed a liner trend with the extent of metal oxide reducibility. 4Pt-8MoO_x/ZrO_2 was found to exhibit high conversion of fatty compounds into green diesel at a temperature as low as 200 °C and at 20 bar hydrogen pressure. The catalyst is reusable (Fig. 1). This catalyst has optimum metal dispersion, adequate amount of acid sites, high metallicity and high amount of reduced metal oxide species and thereby exhibited superior catalytic performance. Details of this work will be presented.

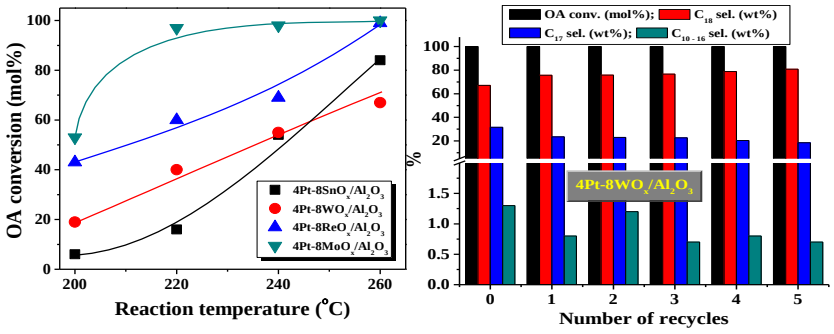

Fig. 1. Effect of metal oxides on deoxygenation of Pt-MO_x/Al_2O_3 (left) and catalyst recyclability study (right).

References

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