A sustainable catalytic route for the synthesis of five-membered dioxolane as a fuel additive using modified boehmite catalyst

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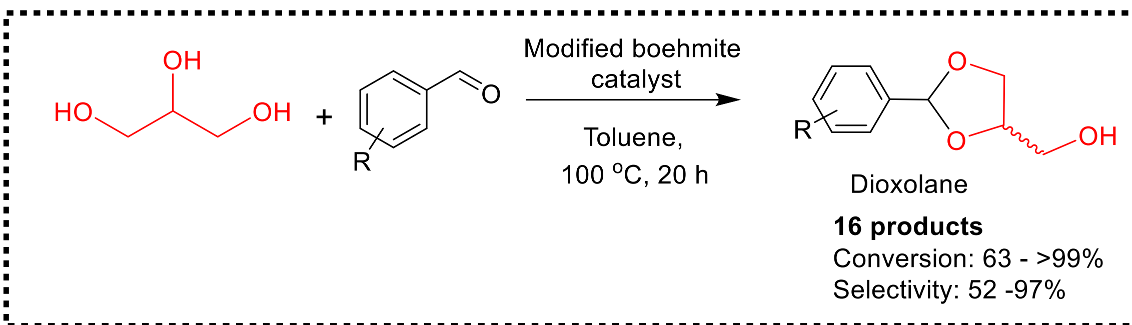
1. Introduction:

Every 100 Kg of biodiesel production generates 10 Kg of crude glycerol as a major by-product. Flooding of such additional glycerol in the already saturated market, downgrade its market. Hence significant efforts have been devoted to bridge the gap between sustainable production of biodiesel and valorisation of glycerol for its potential applications. Several investigations using homogeneous acids (H_2SO_4, HCl, H_3PO_4, p-toluenesulfonic acid, acidic ionic liquids) and heterogeneous solid acid catalysts (acidic resins, Montmorillonite, modified zeolite, silica and zirconia) have been reported for the acetalization of glycerol. we speculate that the development of cost-effective and industrially viable catalysts for the acetalization of glycerol is highly desirbale. This prompted us to study the unexplored boehmite as a support in combination with tungsten oxide for the preparation of renewable bio-additives via acetalization of glycerol. In this work, we report the synthesis and characterization of WO_3@boehmite with a focus on increasing the conversion of glycerol and selectivity towards the five-membered dioxolane product.



2. Material and Methods:

The catalyst studded in this work was initially prepared by a hydrothermal treatment of aluminium nitrate nonahydrate using urea as the precipitant at 150 °C for 24 h. The synthesized boehmite from treated with ammonium paratungstate in water at 30 °C for 16 h. The solid powder was subsequently calcined at 800 °C for 3 h to obtain tungsten oxide supported on alumina.

3. Significant Results and Discussion

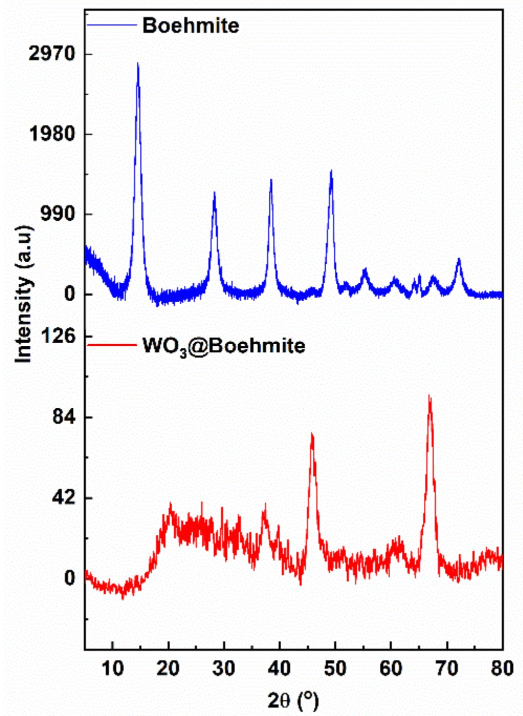


Figure 1. Powder XRD of pristine boehmite synthesised and the respective WO_3@boehmite

The XRD pattern showed different diffractions due to the thermal transition of boehmite which is in good agreement

Catalytic study:

Entry	Catalyst	Solvent	Temp. (°C)	Conv. (%)	Sel.[c] (%) (1b:1b')
1	Boehmite	Toluene	100	25	75:25
2	APT	Toluene	100	31	74:26
3	WO_3@Boehmite	Toluene	100	88	84:16
4	WO_3@Boehmite	H_2O	90	11	Trace
5	WO_3@Boehmite	DMF	100	NR	NR
6	WO_3@Boehmite	DMSO	100	95	63
7	WO_3@Acidic alumina	Toluene	100	59	74
8	WO_3@Neutral alumina	Toluene	100	61	70

4. Conclusions:

WO_3@Boehmite exhibited the highest catalytic performance toward acetalization using glycerol. The present catalyst system was amenable to the acetalization of wide spectrum of aldehydes and afford the corresponding dioxolane products in good conversions and selectivities.

References

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