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Sulphated KIT6-Zr as an efficient solid acid catalyst for the production of isosorbide from sorbitol

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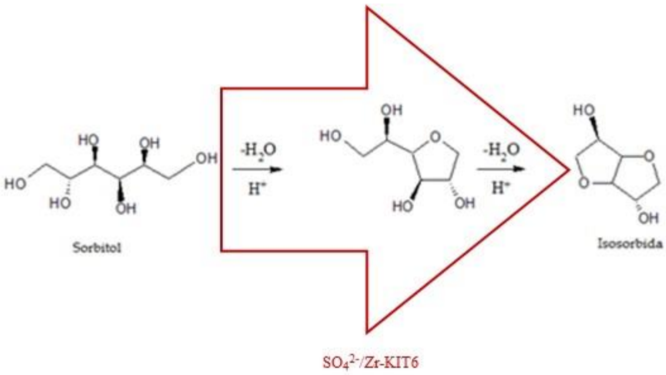
Introduction

In recent years, the development of new catalytic processes for the transformation of sugars is converting lignocellulosic biomass in a sustainable and renewable feedstock for the production of biofuels and high value-added chemicals. In this context, the hydrogenation of glucose to sorbitol, and its subsequent double dehydration and cyclization allows to obtain isosorbide, (Scheme 1). Much attention is being paid in the development of active and selective solid acid catalysts to transform sorbitol into isosorbide.[1]

Isosorbide has excellent physical and chemical properties applicable to various fields of industry, being an important pharmaceutical intermediate (for diuretic, and treatments of hydrocephalus and glaucoma), additive to improve the strength and rigidity of polymers such as polyethylene terephthalate (PET) and monomer for the production of biodegradable polymers.[2,3] Mesoporous sulfonic acid catalysts are widely used in acid-catalyzed reactions and have efficient catalytic properties for dehydration of sorbitol.[4]



Scheme 1. Pathway of sorbitol dehydrationl.

Results and Discussion

The present work deals with the optimization of different parameters, such as the Si/Zr molar ratio and aging time, in the hydrothermal synthesis of sulphated KIT6. The catalytic activity of the synthesized catalysts was evaluated in the production of isosorbide from molten sorbitol (Figure 1). An isosorbide yield of 58% has been reached at 175 °C after 3 hours of reaction with 10 wt% catalyst.

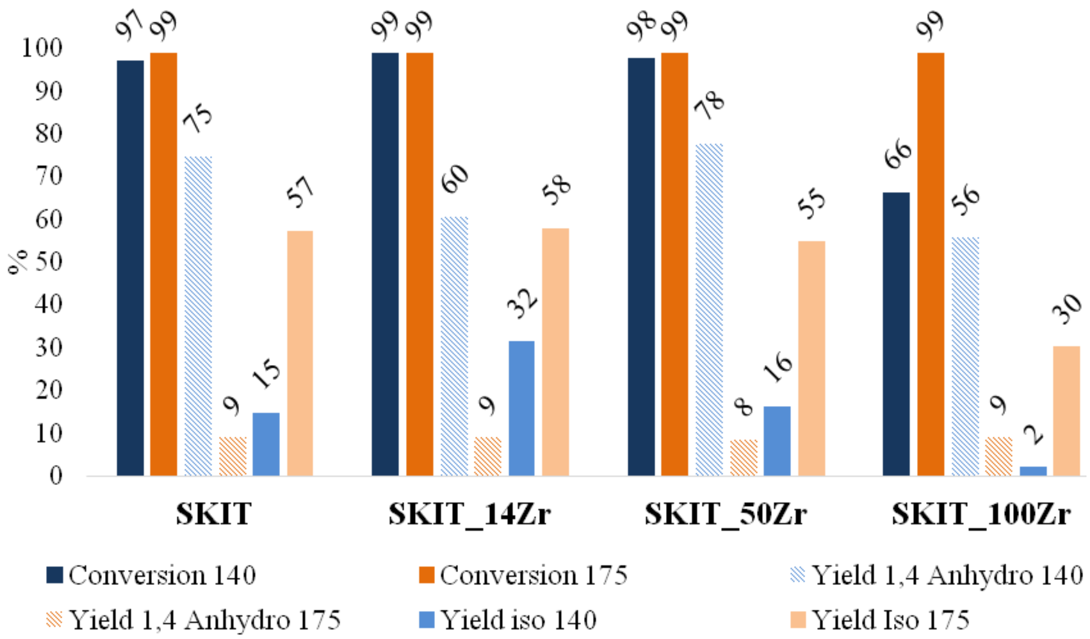


Figure 1. Dehydration of sorbitol by using sulphated KIT6 with different Si/Zr molar ratio as catalyst, at 140 y 175ºC.

All catalysts have been characterized by various techniques, including X-ray diffraction (XRD), Scanning Electron Microscopy (SEM-EDS) (Figures 2 and 3), N_2 adsorption at -196ºC, X-ray photoelectron spectroscopy (XPS) and the acidity has been measured by NH_3-TPD and FTIR of adsorbed pyridine, to elucidate structure-activity relationships.

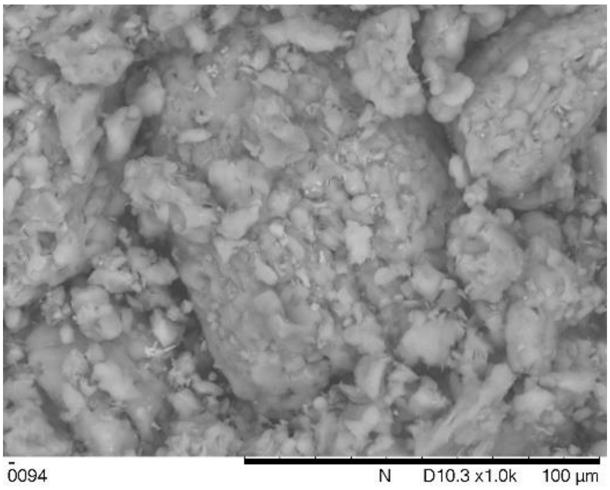


Figure 2. SEM image of SKIT-(24/48) 1000 Mag, 15 Kv, BSE.

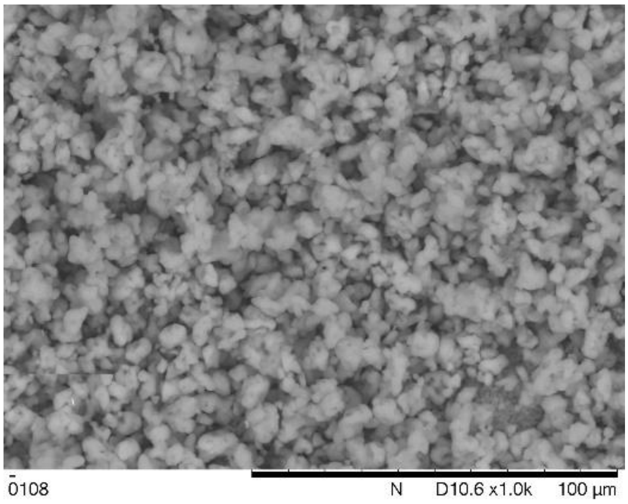


Figure 3. SEM image of SKIT_14Zr-(24/48) 1000 Mag, 15 Kv, BSE.

References

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