J Fundam Renewable Energy Appl 2017, 7:7 (Suppl)
DOI: 10.4172/2090-4541-C1-039

Catalytic conversion of biomass-derived polyols to alkenes

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The depletion of fossil fuel reserves and detrimental environmental impacts associated with the use of fossil fuels has mandated the search for alternative, inexpensive, and renewable resources. Biomass is a preferred candidate as an alternative source for both energy and chemicals due to its abundance and sustainability. Polyols are readily available in large quantities derived from biomass resources, such as mannitol extracted from sea weed, sorbitol from cellulose hydrolysis, and glycerol as the side-product from biodiesel production. The selective conversion of polyols to value-added chemicals is an area of great importance. Their conversion typically requires a reduction step to remove the undesired hydroxyl groups. In this paper, we showed that with a multifunctional catalyst system mannitol and sorbitol can be quantitatively converted to 2-iodohexane in a two-phase reaction media. At 100°C, a nearly 100% yield can be obtained in 5h. After the reaction, the product can be readily separated from the reaction mixture by removing the organic phase, which can be directly used in the next step. The direct heating of 2-iodohexane gives a mixture of hexenes including 1-hexene, 2-hexene, and 3-hexene with a ratio of around 1:42:10. 1-hexene is a key co-monomer for the synthesis of linear low density polyethylene (LLDPE) and high density polyethylene (HDPE). The annual demand for 1-hexene is around 30 MT with an annual increase of 8% to 10%. Thus, a method to convert mannitol and sorbitol to 1-hexene with high selectivity under mild conditions would be highly desirable. To selectively obtain 1-hexene, a metal catalyst such as CrO_2 can be used, which is still under investigation.

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