Efficient Conversion of L-Rhamnose into 5-Methylfurfural Combining Performance of Ionic Liquids and Zeolites

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Most carbon-based products that our society uses daily, derive from petroleum, and therefore require the exploitation of fossil fuels; this leads to a consequent increase in carbon dioxide emissions and global warming.[1] For this reason, interest in alternative and renewable energy sources has grown in recent years. Biomass resources including carbohydrates are an ideal petroleum alternative to produce fuels, chemicals, and materials. 5-Methylfurfural (5-MF) is an important intermediate widely used in pharmaceuticals, cosmetics, pesticides, and other applications. Thanks to the presence of several functional groups, 5-MF can be used to produce value-added product, such as 2,5-Dimethylfuran and 2,5-Furandicarboxilic acid. On the other hand, the industrial production of 5-MF involves 2-
Methylfuran, phosgene and *N,N*-dimethylformamide, resulting in high production cost. However, 5MF can be obtained from biomass-derived carbohydrates.[2] L-Rhamnose is a deoxyhexose carbohydrate, and it is the cheapest deoxy sugar. The conversion to 5-MF involves two steps, in particular the isomerization gives L-rhamnulose and the following dehydration form 5-MF.[3] In this study, we worked on the direct conversion of L-Rhamnose to 5-MF using Ionic Liquids (ILs) as solvents (Figure 1) and b zeolite as catalyst.

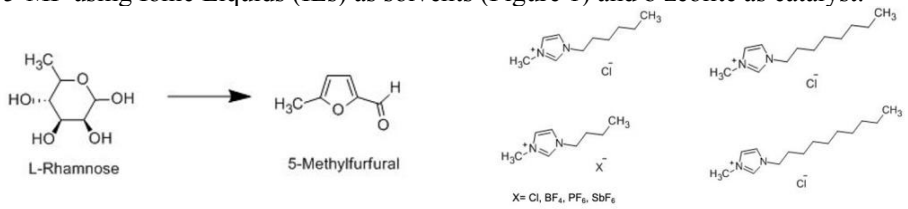

Figure 1. Synthesis of 5-MF from L-Rhamnose and structures of ILs tested.

Reaction conditions such as temperature, the amount of L-Rhamnose and catalyst loading were optimized. To illustrate the effect of solvent, ILs different for both anion and cation were tested, along with mixtures of ILs. Finally, using the best operating conditions, thanks to a biphasic system, we evaluated the possibility of extracting 5-MF and reusing the solvent-catalyst system.

References

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