22nd Iranian Chemistry Conference, 23-25 August, 2023
University of Kurdistan

Lanthanide Coordination Polymers as Heterogeneous Lewis Acid Catalysts for Glycerol Acetalization

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Coordination polymers containing lanthanide ions (LnCPs) have received relatively less attention compared to d-block metal coordination polymers, despite their potential for remarkable luminescence, catalytic activity, and magnetic properties.[1,2] LnCPs have shown promise as Lewis acid catalysts for various chemical transformations. Lewis acids are electron acceptors that can facilitate chemical reactions by accepting electron pairs from other molecules.[3] The use of lanthanide ions as Lewis acid catalysts is of particular interest, and researchers have been exploring their potential in this area.[4]

$[Er_2(bpndc)_3(DMF)_2]$ (**1**) and $[Yb_2(bpndc)_3(DMF)_2]$ (**2**) were synthesized by combining Benzophenone-4,4'- dicarboxylate ($bpndc^{2-}$) linker, Erbium nitrate hexahydrate, Ytterbium nitrate hexahydrate, respectively, using a facile solvothermal reaction and characterized using single crystal X-ray diffraction, Fourier transforms infrared spectroscopy, Thermogravimetric analysis, Powder X-ray diffraction, and Scanning electron microscopy. Both compounds exhibit good thermal and solvent stability.

These coordination polymers were used as heterogeneous Lewis acid catalysts for glycerol acetalization. The investigation has focused largely on the effect of reaction time and temperature, and catalyst to glycerol molar ratio. Optimal conditions for these two polymers included duration of 4 hours, a temperature of 50º C, molar ratio of 1 to 10 catalyst to glycerol, and conversion percentage was 77% for $[Er_2(bpndc)_3(DMF)_2]$ polymer and 72% for $[Yb_2(bpndc)_3(DMF)_2]$ polymer. The catalysts leaching, stability, and recyclability were investigated. This study shows the potential role of the $[Er_2(bpndc)_3(DMF)_2]$ and $[Yb_2(bpndc)_3(DMF)_2]$ as heterogeneous Lewis acid catalyst for the glycerol acetalization.

Keywords: Coordination polymers, Lanthanides, Lewis acid catalysts, Acetalization

References

[1] J.-C. G. Bu¨nzli, J. Coord. Chem., 2014, 67, 3706–3733.
[2] B. Li, H.-M. Wen, Y. Cui, G. Qian and B. Chen, Prog. Polym. Sci., 2015, 48, 40–84.
[3] S. Cotton, Lanthanide and Actinide Chemistry, John Wiley & Sons, Inc., Hoboken, 2013.
[4] T. Hajiashrafi, M. Karimi, A. Heydari and A. A. Tehrani, Catal. Lett., 2017, 147, 453–462.