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Novel nanoparticles of Ru and Pd supported on bacterial biomass for catalytic hydrogenation of 5-HMF to produce 2, 5-DMF

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This study presents the hydrogenation of 5-hydroxymethylfurfural (5-HMF) to 2,5-dimethylfuran (2,5-DMF) over ruthenium and palladium supported on bacterial biomass catalysts in molecular hydrogen. Bimetallic 5 wt% bio-RuPd catalyst had a significant activity for a selective hydrogenation of 5-HMF toward 2, 5-DMF comparing to monometallic bio-Ru and bio-Pd catalysts. To clarify the catalysts novelty, characterizations by using a transmission electron microscopy (TEM), scanning electron microscope (SEM) and other analytical techniques were studied. The monometallic 5wt% bio-Pd produced by D. *desulfuricans* was mostly found on the periplasmic surface of the bacterial support as Pd-nanoparticles and were generally larger. However, smaller Pd-nanoparticles were also seen within the intracellular matrix. The synthesis of monometallic bio-Ru by B. *benzeovorans* was mostly extracellular with no intracellular deposition of ruthenium nanoparticles which was different when bimetallic bio-Pd/Ru was synthesized by B. benzeovorans. There was both extracellular and intracellular deposition of bio-Pd/Ru using B. *benzeovorans* with occasional larger agglomerates within the intracellular compartment. A very high 5-HMF conversion (94.7%) and 55.5% 2, 5-DMF yield was achieved over the 5wt% bio-RuPd in a batch reactor. Accordingly, we concluded that the RuPd supported on bacterial biomass exhibited a good catalytic performance for the selective hydrogenation of 5-HMF to 2, 5-DMF in molecular hydrogen.

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