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Production of furans (2,5 dimethylfuran) from furfurals (hydromethoxyfurfural-HMF) as transport fuel molecules

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Due to recent concerns over future energy supplies and the environment, particularly global warming, attention has turned to biomass as an alternative renewable energy source. Biofuels derived from carbohydrates are an important option for reducing transportation emissions because they do not lead to additional CO_2 emissions. Of the main platform chemicals obtained from the dehydration of C_6 sugars (fructose) is 5-hydroxymethylfurfural (HMF). 2,5-Dimethylfuran (DMF) is particularly attractive because it is known to be a suitable compound for gasoline-range fuel. DMF is a furan derivative produced from the selective removal of five oxygen atoms from C_6 sugars. It can also be produced via the intermediate 5-hydroxymethylfurfural (HMF) by hydrogenation/hydrogenolysis reaction. It has a boiling point of 92–94°C and energy density of 31.5 MJ/L, which is 40% greater than that of ethanol 23 MJ/L. It is considered to be a liquid transportation fuel because it has the highest research octane number (RON=119) and lowest water solubility among all the mono-oxygenated C_6 compounds.

The use of formic acid-triethylamine mixture (FA/TEA) as hydrogen donor for the hydrogenation of 5-hydroxymethylfurfural (HMF) was investigated over a Ru/C catalyst. The reaction mixture was analysed by GC-FID, which provides both qualitative and quantitative information about the reaction products. It was possible to achieve a yield (92.1%) of DMF within the reaction time of 4 hours at 210°C. A significant effect of formic acid-triethylamine molar ratio was observed on the product distribution, where 5:2 molar ratio of FA/TEA gave the best yield of DMF. Optimization of the reaction parameters showed that temperature, time, FA/TEA molar ratio, Ru/C dosage, HMF concentration as well as agitation speed played important roles in the selectivity to the targeted DMF. It is interesting to note that a very high HMF conversion was achieved particularly as temperature increased. However, the intrinsic properties of the Ru/C catalyst determine the reaction pathway towards DMF or other products.

Biography

B Al-Duri won a Research Grant Award of £750k from the EPSRC in Supercritical Coal Fired Power Plants, in collaboration with Electrical Engineering at Warwick University, Tsinghua University and NCEPU in China. Industrial partners are E-On UK Ltd., Emerson UK Ltd. and Scottish Powers. She has recently returned from an EPSRC-supported UK-China Energy Conference in Beijing, where she represented the Project. Bushra completed 16 PhD programmes and has over 90 publications in Wastewater Treatment, Reactions & Biocatalysis, and Supercritical Fluids. She also has on-going collaborations with international institutions, including University of Tokyo. Her future plans include expanding of the research in Energy and Environment; focusing on combining existing processes with supercritical water technology as the next generation of processes for waste minimisation and energy production, which complies with the increasing concerns over carbon emission and hence global warming. Bushra was appointed as MEGS Deputy Director at the beginning of April 2011.

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