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Jet fuel-range hydrocarbons generation from the pyrolysis of saw dust over Fe and Mo-loaded HZSM-5(38) catalysts

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A R T I C L E I N F O

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A B S T R A C T

In this research, we studied the catalytic pyrolysis of sawdust over monometal (1 wt% Fe or 1 wt%Mo) and bimetal (1 wt% Fe-1 wt% Mo or 0.5 wt% Fe-0.5 wt% Mo)-loaded HZSM-5(38) catalysts, synthesized via wet impregnation method, for the generation of jet fuel-range hydrocarbons. In particular, we aimed to generate jet fuel-range aromatic hydrocarbons (C_8-C_{12}) and a high amount of organic-phase bio-oil at the same time from this pyrolysis. In addition, the bimetal-loaded HZSM-5(38) catalysts (1 wt% Fe-1 wt% Mo/HZSM-5(38) and 0.5 wt% Fe-0.5 wt% Mo/HZSM-5(38)) helped achieve a higher organic phase bio-oil yield (20.74 and 17.14 wt%) compared to those under the pristine HZSM-5 (9.57 wt%) and monometal-loaded HZSM-5(38) catalysts (1 wt% Fe/HZSM-5(38) and 1 wt% Mo/HZSM-5(38)) (13.04 and 11.45 wt%, respectively). The exchange of the strong Brønsted acidity in the HZSM-5(38) support with an added metal (Mo and Fe) ion of this catalyst might have prevented excessive cracking and dehydration of the bio-oil intermediates, thereby increasing the organic-phase bio-oil yield of the pyrolysis. The coke amount of bimetal-loaded HZSM-5(38) catalyst was lower than that of monometal-loaded HZSM-5(38). Overall, the bimetal-loaded HZSM-5(38) catalysts possessed a synergistic effect leading to their high activity, generating the higher amount of jet fuel-range hydrocarbons because of the enhanced deoxygenation such as hydrodeoxygenation and dehydrogenation reactions of the pyrolysis under this catalyst.

1. Introduction

The increasing consumption and prices of fossil fuels have raised concerns requiring to move toward sustainable energy sources in the recent past [1–3]. In addition, the detrimental environmental footprints left by the use of fossil fuels have also made it inevitable to look for green energy sources to save the environment for the future [4,5]. Hence, it is imperative to find an alternative, environment-friendly energy source and conversion [6,7] to meet future energy demands. Along these lines, the valorization of biomass via torrefaction [8], pyrolysis [9], or gasification [10] has been suggested as an alternative, environment-friendly way of converting energy from renewable biomass resources to overcome the current energy shortage and avoid the environmental damages caused by the excessive use of fossil fuels [11]. In particular, the transport industry uses a major portion of fossil fuels in the form of gasoline, diesel, and aviation or jet fuel. Moreover, the biomass valorization has a capacity to generate specific biofuels such as 2-methyl furan [12] and 2,5 dimethyl furan [13] having similar characteristics with gasoline and can be also converted to jet fuel range hydrocarbons via certain reactions such as decarboxylation and decarbonylation. Jet fuel

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