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Synthesis of Highly Efficient Bio-Octane Number Booster Using Nano Au-NiAlZr-Layered Double Hydroxides Catalyst

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Abstract : Furfural, a key biomass-derived platform compound, holds significant potential for biofuel production and the synthesis of high-value intermediates. This study investigates the hydrogenation-condensation reaction of furfural issued from lignocellulosique biomass with isopropyl alcohol to produce isopropylfurfuryl ether (iPFE), a next-generation synfuel with a high-octane number. iPFE's water stability and resistance to methanol absorption make it a sustainable alternative to conventional gasoline additives, offering comparable performance. The catalyst used in this reaction is based on NiAl layered double hydroxides (LDH), with zirconium incorporated to enhance the distribution and structure of active sites. Gold (Au) was deposited on the NiAlZr-LDH support to improve selectivity and yield. The addition of Zr improved the thermal and mechanical stability of the catalyst, while the Au modification further increased selectivity toward iPFE. Extensive catalytic experiments were conducted to optimize reaction conditions, including temperature, hydrogen pressure, and Au loading, to maximize iPFE yield. The results demonstrate a high conversion rate of furfural, exceeding 90% under optimal conditions, with enhanced selectivity toward iPFE. Moreover, iPFE was shown to have a higher-octane number compared to traditional furfuryl ethers, making it a highly promising candidate for advanced fuel applications.

Keywords : Au-NiAlZr-LDH, biofuels, furfural, green chemistry, hydrogenation, isopropylfurfuryl ether, octane number.
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