

Production of green diesel via hydrogen-free and solventless deoxygenation reaction of waste cooking oil

ABSTRACT

This work was successfully produced green diesel from domestic waste cooking oil via hydrogen-free and solventless deoxygenation over nickel-cobalt/organosilane-SBA-15 catalyst. Highly effective mesostructured catalyst has been synthesized by functionalizing with selected loadings of 3-Mercaptopropyl (trimethoxysilane) (MPTMS) onto SBA-15 by co-condensation method, followed by nickel and cobalt impregnation to produce 5Ni5Co/SBA-15-SH 0.1, 5Ni5Co/SBA-15-SH 0.3 and 5Ni5Co/SBA-15-SH 0.5. The 5Ni5Co/SBA-15-SH 0.1 catalyst exhibits high surface area and pore size (509 m²/g, 4.6 nm), which proved that the addition of MPTMS had increased the surface area and pore size due to the interaction between MPTMS and TEOS. The acidity of the synthesized catalyst also remarkably increased after MPTMS functionalization, suggesting the presence of the sulfonic acid group derived from the oxidation of MPTMS has enhanced the acidity of the catalyst. The amount of nickel and cobalt successfully impregnated onto the catalysts also show increment (5%–9%) following the amount of MPTMS added, which attributed to a strong interaction between metal species and support surface result in a homogeneous distribution of nickel and cobalt as observed in HRTEM. The MPTMS functionalization has successfully enlarged the surface area and increased the catalyst's acidic properties, enhancing the catalyst's deoxygenation activity. The catalytic activity study via deoxygenation was performed in a solventless and hydrogen-free reaction system to produce green diesel (350 °C within 2 h using 5%wt. Catalyst loading). Based on GC-FID analysis, it was proven that 5Ni5Co/SBA-15-SH 0.1 exhibits high hydrocarbon yield (77%) and diesel selectivity (70%) with the reusable catalyst for 4 catalytic cycles by maintaining the catalyst's selectivity. Hence, this work can produce green diesel from low-cost waste cooking oil via the synthesized organosilane-functionalized catalyst.