Synthesis and characterization of a LaNi/α-Al2O3 catalyst and its use in pyrolysis of glycerol to syngas

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Abstract:

The current paper reports on the kinetics of syngas production from glycerol catalytic pyrolysis over Ni/α-Al2O3 catalyst promoted by lanthanum. The 3 wt%La-20 wt%Ni/77 wt%α-Al2O3 catalyst was synthesized and its physiochemical properties were characterized. The BET specific surface area was 2.20 m2.g−1, which was 0.11 m2.g−1 larger than the unpromoted Ni/α-Al2O3 catalyst. Significantly, the BET results were supported by the FESEM image which showed that the promoted catalyst has smaller particle size compared to the unpromoted catalyst. The NH3 and CO2-TPD analyses indicates that the catalyst has net acidity with acid:base ratio of 1.12. Catalytic pyrolysis was performed in a 10 mm-ID stainless steel fixed bed reactor with reaction temperatures set at 973, 1023 and 1073 K, employing a weight-hourly-space-velocity (WHSV) of 4.5 × 104 ml g−1 h−1. From reaction studies, the highest glycerol conversion (XG) value was 36.96% at 1073 K. The resulting syngas has H2:CO ratios always lower than 2.0. Subsequently, mechanistic studies indicate that the catalytic glycerol pyrolysis occurred on single catalytic site via associative adsorption, with molecular surface reaction as the rate-determining step.