

Synthesis and characterization of a La—Ni/ 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 (X_G) 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.

KEYWORDS:

Glycerol; Pyrolysis; Nickel; Lanthanum; Syngas