Effect of La2O3 as a promoter on the Pt,Pd,Ni/MgO catalyst in dry reforming of methane reaction

ABSTRACT

Pt,Pd,Ni/MgO, Pt,Pd,Ni/Mg0.97La3+0.03O, Pt,Pd,Ni/Mg0.93La3+0.07O, and Pt,Pd,Ni/Mg0.85La3+0.15O (1% of each of the Ni, Pd, and Pt) catalysts were prepared by a surfactant-assisted co-precipitation method. Samples were characterized by the XRD, XPS, XRF, FT-IR, H2-TPR, TEM, the Brunauer–Emmett–Teller (BET) method, and TGA and were tested for the dry reforming of methane (DRM). TEM and thermal gravimetric analysis (TGA) methods were used to analyze the carbon deposition on spent catalysts after 200 h at 900 °C. At a temperature of 900 °C and a 1:1 CH4:CO2 ratio, the tri-metallic Pt,Pd,Ni/Mg0.85La3+0.15O catalyst with a lanthanum promoter showed a higher conversion of CH4 (85.01%) and CO2 (98.97%) compared to the Ni,Pd,Pt/MgO catalysts in the whole temperature range. The selectivity of H2/CO decreased in the following order: Pt,Pd,Ni/Mg0.85La3+0.15O > Pt,Pd,Ni/Mg0.93La3+0.07O > Pt,Pd,Ni/Mg0.97La3+0.03O > Ni,Pd,Pt/MgO. The results indicated that among the catalysts, the Pt,Pd,Ni/Mg0.85La23+0.15O catalyst exhibited the highest activity, making it the most suitable for the dry reforming of methane reaction.

Keyword: Biogas; Catalyst deactivation; Dry reforming; H2 production; Ni; Pd; Pt catalyst