

Methanation reaction over samarium oxide based catalysts

Abstract

Malaysia produces an acidic crude natural gas which contains 23% of CO₂ and <1% of H₂S. Their presence will corrode the carbon steel gas pipeline system, thus resulting in decreasing quality and price of natural gas as well as polluting the environment. Instead, using catalysts for the CO₂ methanation have been extensively studied and show high potentiality towards converting CO₂ gas to methane. The potential of samarium has been widely explored for its ability as a dopant catalyst for CO₂ methanation from researchers for metal oxide in CO₂ methanation. However, the potential of samarium as a based catalyst in CO₂ methanation have not been explored yet. Therefore, in this study the supported samarium oxide doped transition metals catalysts were prepared by wetness impregnation method for carbon dioxide methanation reaction by using trimetallic oxide catalyst because of the lower performance of conversion of CO₂ in monometallic oxide and bimetallic oxide catalysts. The catalytic activity of prepared catalysts was tested using inhouse built micro reactor coupled with Fourier Transform Infrared (FTIR) toward CO₂/H₂ methanation. Then, the catalysts were optimized by different calcination temperatures and different based oxide loadings. The potential catalysts of Ru/Mn/Sm (5:35:60)/Al₂O₃ calcined at 1000 °C and 1100 °C gave > 95 % of CO₂ conversion at 300 °C reaction temperature and yielded about 93.46 % of CH₄ at reaction temperature of 400 °C. XRD analysis showed the potential catalysts are an amorphous phase, while FESEM analysis illustrated the surface of the catalysts were covered with small and dispersed spherical particles. EDX analysis revealed that there were 0.3 % reduction of Ru in the Ru/Mn/Sm (5:35:60)/Al₂O₃ ofused catalysts compared to fresh catalysts. Meanwhile NA analysis showed that Ru/Mn/Sm (5:35:60)/Al₂O₃ catalyst attained surface area of 47.38 m²/g.