Physicochemical characteristic of neodymium oxide-based catalyst for in-situ CO_2/H_2 methanation reaction

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ABSTRACT

Carbon dioxide emission to the atmosphere is worsened as all the industries emit greenhouse gases (GHGs) to the atmosphere, particularly from refinery industries. The catalytic chemical conversion through methanation reaction is the most promising technology to convert this harmful CO_2 gas to wealth CH_4 gas for the combustion. Thus, supported neodymium oxide based catalyst doped with manganese and ruthenium was prepared via wet impregnation route. The screening was initiated with a series of Nd/Al_2O_3 catalysts calcined at 400 °C followed by optimization with respect to calcination temperatures, based ratios loading and various Ru loading. The $Ru/Mn/Nd\ (5:20:75)/Al_2O_3$ calcined at 1000 °C was the potential catalyst, attaining a complete CO_2 conversion and forming 40% of CH_4 at 400 °C reaction temperature. XRD results revealed an amorphous phase with the occurrence of active species of RuO_2, MnO_2, and Nd_2O_3, and the mass ratio of Mn was the highest among other active species as confirmed by EDX. The ESR resulted in the paramagnetic of Nd^{3+} at the g value of 2.348. Meanwhile nitrogen adsorption (NA) analysis showed the Type IV isotherm which exhibited the mesoporous structure with H3 hysteresis of slit shape pores.

KEYWORDS:

Neodymium oxide; Methanation;,Carbon dioxide; Natural gas; Greenhouse gases