Greenhouse Gases Mitigation by CO_2 Reforming of Methane to Hydrogen-Rich Syngas Using Praseodymium Oxide Supported Cobalt Catalyst

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ABSTRACT

This study focuses on the potential of hydrogen-rich syngas production by CO_2 reforming of methane over Co/Pr_2O_3 catalyst. The Co/Pr_2O_3 catalyst was synthesized via wet-impregnation method and characterized for physicochemical properties by TGA, XRD, BET, H_2-TPR, FESEM, EDX, and FTIR. The CO_2 reforming of methane over the as-synthesized catalyst was studied in a tubular stainless steel fixed-bed reactor at feed ratio ranged 0.1–1.0, temperature ranged 923–1023 K, and gas hourly space velocity (GHSV) of 30,000 h^{-1} under atmospheric pressure condition. The catalyst activity studies showed that the increase in the reaction temperature from 923 to 1023 K and feed ratio from 0.1 to 1.0 resulted in a corresponding increase in the reactant's conversion and the product's yields. At 1023 K and feed ratio of 1.0, the activity of the Co/Pr_2O_3 catalyst climaxed with CH_4 and CO_2 conversions of 41.49 and 42.36 %. Moreover, the catalyst activity at 1023 K and feed ratio of 1.0 resulted in the production of H_2 and CO yields of 40.7 and 40.90 %, respectively. The syngas produced was estimated to have H_2:CO ratio of 0.995, making it suitable as chemical building blocks for the production of oxygenated fuel and other value-added chemicals. The used Co/Pr_2O_3 catalyst which was characterized by TPO, XRD, and SEM-EDX show some evidence of carbon formation and deposition on its surface.

KEYWORDS: Cobalt; CO_2 reforming of methane; Hydrogen; Praseodymium oxide; Syngas

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