Syngas Production From Methane Dry Reforming Over Ni/Al_2O_3 Catalyst

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ABSTRACT

We evaluated dry reforming of methane in a tubular fixed-bed reactor at various reaction temperatures from 923 to 973 K using different reactant compositions over 10 % Ni/Al_2O_3 catalyst prepared by a wet impregnation method. Both NiO and $NiAl_2O_4$ phases were formed on the catalyst surface during calcination, and the 10 % Ni/Al_2O_3 catalyst possessed high surface area of 106.36 $m^2\ g^{-1}$ with fine metal dispersion. The low activation energy observed for formation of $NiAl_2O_4$ phase during calcination indicated strong interaction between the NiO form and the γ-Al_2O_3support. The NiO phase was completely reduced to metallic Ni^0 form via H_2 reduction. The conversions of CO_2 and CH_4 increased noticeably with increasing CO_2 partial pressure, and the H_2/CO ratio was always below unity, regardless of reaction conditions. The yield of H_2 was enhanced with growing CO_2 partial pressure, approaching a highest value of about 70 %. The heterogeneous nature of the deposited carbon was evident from the coexistence of carbon nanofibers and graphitic carbon. In addition, the amount of filamentous carbon appeared to be slightly less than that of graphitic carbon. However, these deposited carbons were completely removed by O_2 at below 900 K during temperature-programmed oxidation.

KEYWORDS: Dry reforming of methane; Ni-based catalysts; Syngas; H_2 production;CO_2 reforming of methane

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