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Catalytic Performance of Ceria-Supported Cobalt Catalyst for Co-Rich Hydrogen Production From Dry Reforming Of Methane

Bamidele V. Ayodele, Maksudur R. Khan, Chin Kui Cheng

Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang Kuantan, Pahang, Malaysia

ABSTRACT

Dry reforming of methane was studied over ceria-supported cobalt (20wt%) catalyst prepared via wet-impregnation method. The synthesized catalyst was characterized using thermogravimetric analysis (TGA), X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), energy dispersive X-ray spectroscopy (EDX), N_2 physisorption and Fourier transform infrared spectroscopy (FTIR). The catalytic methane dry reforming was carried out over the 20wt%Co/80wt%CeO_2 catalyst in a fixed-bed reactor. The experiment was performed at atmospheric condition with time-on-stream (TOS) of 4 h, reaction temperatures of 923–1023 K, and CH_4:CO_2 feed ratios of 0.1–1.0. The XRD pattern showed good dispersion of the cobalt metal on the support. This was corroborated by the FESEM-EDX and FTIR spectrum. The N_2 physisorption revealed that the BET specific surface area of the calcined catalyst was more than double the ceria support. The conversions of CH_4 and CO_2, respectively, as well as the H_2 and CO yield, were found to increase with reaction temperature and CH_4:CO_2 feed ratios. The highest conversions for both CO_2 and CH_4 were 87.6% and 79.5%, respectively, at 1023 K. Moreover, highest yield of 40% was obtained for CO while that of H_2 was 37.6%. Syngas ratio of 0.99 was obtained at a feed ratio of 0.9, which has further cemented the suitability of methane dry reforming over ceria-supported cobalt catalyst for production of syngas meant for Fischer–Tropsch synthesis.

KEYWORDS: Ceria; Cobalt; Dry reforming; Methane; Syngas

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