Promoting dry reforming of methaneviabifunctional NiO/dolomite catalysts for production of hydrogen-rich syngas

ABSTRACT

Extensive effort has been focused on the advancement of an efficient catalyst for CO_2 reforming of CH_4 to achieve optimum catalytic activity together with cost-effectiveness and high resistance to catalyst deactivation. In this study, for the first time, a new catalytic support/catalyst system of bifunctional NiO/dolomite has been synthesized by a wet impregnation method using low-cost materials, and it shows unique performance in terms of amphoteric sites and self-reduction properties. The catalysts were loaded into a continuous micro-reactor equipped with an online GC-TCD system. The reaction was carried out with a gas mixture consisting of CH_4 and CO_2 in the ratio of 1 : 1 flowing 30 ml min^{-1} at 800 °C for 10 h. The physicochemical properties of the synthesized catalysts were determined by various methods including X-ray diffraction (XRD), N_2 adsorption–desorption, H_2 temperature-programmed reduction (H_2-TPR), temperature-programmed desorption of CO_2 (TPD-CO_2), and temperature-programmed desorption of NH3 (TPD-NH_3). The highest catalytic performance of the DRM reaction was shown by the 10% NiO/dolomite catalyst (CH_4 & CO_2 conversion, χCH_4; χCO_2 ~ 98% and H2 selectivity, S_{H2} ¼ 75%; H_2/CO ~ 1 : 1 respectively). Bifunctional properties of amphoteric sites on the catalyst and self-reduction behaviour of the NiO/dolomite catalyst improved dry reforming of the CH_4 process by enhancing CH_4 and CO_2 conversion without involving a catalyst reduction step, and the catalyst was constantly active for more than 10 h.