

Effect of alkali and alkaline earth metal on Co/CeO₂ catalyst for high temperature water-gas shift reaction using waste derived synthesis gas

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We prepared a series of alkali (Na and K) and alkaline earth metal (Ca and Ba) promoted Co/CeO₂ catalysts to investigate the effect of the promoter on the stability of the catalyst in the high-temperature water-gas shift (WGS) reaction using waste derived synthesis gas. The activity results revealed the higher performance by the alkali metal-doped catalysts than alkaline earth metal-doped catalysts in the temperature range of 400-550 °C. However, a stability result showed that alkaline earth metal-doped catalysts exhibit the higher stability (XCO=~85%, 50 h) than alkali metal-doped catalysts. Transmission electron microscopy (TEM) and X-ray diffraction (XRD) results show that the higher stability of the Ba- and Ca- doped Co/CeO₂ catalyst was caused by the strong resistance to sintering of metallic cobalt nanoparticles showing a relatively small crystallite size of metallic cobalt compared to the alkali metal promoted catalysts after water-gas shift reaction. This result shows that alkaline earth metal-doped Co/CeO₂ are promising catalysts for use in the industrial high-temperature water-gas shift reaction.