Catalytic Performance of La-Ni/Al₂O₃ Catalyst for CO₂ Reforming of Ethanol

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ABSTRACT

Introduction

Bio-derived ethanol has been considered as an attractive and alternative feedstock for dry or steam reforming reactions to generate renewable hydrogen, which may be used for replacement of conventional fossil fuels. Ethanol dry reforming (EDR) is an environmentally-friendly process since it transforms greenhouse gas, CO₂ to value-added products and ethanol can be easily obtained from biomass which is free of catalyst poisons (i.e. sulphur-containing compounds). However, there are currently limited studies regarding syngas production from EDR [1, 2]. Ni-based catalysts are commonly used for reforming reactions due to its capability of C-C bond rupture, relatively low cost and high availability compared to precious metals [2]. Nevertheless, carbonaceous deposition may considerably deteriorate catalytic activity and stability of Ni-based catalysts. La promoter reportedly hindered carbon deposition and improved catalytic activity [3]. Hence, the objective of this research was to investigate the effect of La promotion on 10%Ni/Al₂O₃ catalyst for EDR.

Experimental

Gamma Al₂O₃ support was pretreated in air at 973 K to ensure thermal stability before it was co-impregnated with precise amounts of La(NO₃)₃ and Ni(NO₃)₂ precursor solutions to prepare 10%Ni/Al₂O₃ and 3%La-10%Ni/Al₂O₃ catalysts. The slurry mixture was stirred at ambient temperature for 3 h and subsequently dried in an oven for 24 h at 383 K followed by calcination in air at 873 K for 5 h with a heating rate of 5 K min⁻¹. EDR runs were carried out in a quartz fixed-bed reactor placed vertically in a split tubular furnace at temperature range of