Catalytic Performance of La-Ni/Al_2O_3 Catalyst for CO_2 Reforming of Ethanol

Mahadi B. Bahari[1], Nguyen Huu Huy Phuc[2], Nurul Ainirazali[1], Dai-Viet N. Vo[1,*]

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

[2]*Department of Electrical and Electronic Information Engineering, Toyohashi University of Technology, 1-1 Hibarigaoka, Tempaku, Toyohashi, Aichi 441-8580, Japan*

*E-mail: vietvo@ump.edu.my (D.-V. N. Vo)

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, CO_2 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/Al_2O_3 catalyst for EDR.

Experimental

Gamma Al_2O_3 support was pretreated in air at 973 K to ensure thermal stability before it was co-impregnated with precise amounts of $La(NO_3)_3$ and $Ni(NO_3)_2$ precursor solutions to prepare 10%Ni/Al_2O_3 and 3%La-10%Ni/Al_2O_3 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