Production of Syngas from Ethanol CO_2 Reforming on La-doped Cu/Al_2O_3: Impact of Promoter Loading

Mohd-Nasir Nor Shafiqah[1], Trinh Duy Nguyen[2], Lau N. Jun[1], Mahadi B. Bahari[1]
Pham T. T. Phuong[3], Bawadi Abdullah[4] and Dai-Viet N. Vo[1,5*]

[1]*Faculty of Chemical & Natural Resources Engineering, University Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang, Malaysia*
[2]*Center for Advanced Materials Research, Nguyen Tat Thanh University, Ho Chi Minh City, Viet Nam*
[3]*Institute of Chemical Technology, Vietnam Academy of Science and Technology, 1 Mac Dinh Chi Str., Dist.1, Ho Chi Minh City, Viet Nam*
[4]*Chemical Engineering Department, Universiti Teknologi PETRONAS, 31750, Tronoh, Perak, Malaysia*
[5]*Centre of Excellence for Advanced Research in Fluid Flow, Universiti Malaysia Pahang, 26300 Gambang, Kuantan, Pahang, Malaysia*

[*]Corresponding author: vietvo@ump.edu.my

Abstract. Incipient wetness impregnation (IWI) method was applied to prepared 10%Cu/Al_2O_3 whereas M%La-doped 10%Cu/Al_2O_3 (Mwt%= 1%, 2%, 3%, 4% and 5%) were synthesized by employing sequential IWI technique. The prepared catalysts were evaluated from ethanol CO_2 reforming (ECR) at 1023 K and stoichiometric feed ratio. Average crystallite size of CuO particle is reduced with La-promoter addition probably caused by lanthana dilution effect that prevent agglomeration from occur within CuO particles. H_2 reduction process produce complete CuO reduction and constant signal is appear beyond 525 K suggests that the catalysts were completely reduced beyond that temperature. 3%La catalyst identified as optimal promoter loading based on reactant conversions. C_2H_5OH and CO_2 conversions were achieved on 3%La loading is 87.6% and 55.1%, respectively. Carbon was identified on catalyst surface based on X-ray diffraction (XRD) and scanning electron microscopy (SEM).

Keywords: Ethanol dry reforming; La_2O_3; Syngas; Cu/Al_2O_3 catalyst; Hydrogen

INTRODUCTION

The diminution of fossil fuels for global energy necessities largely contribute to the environmental concerns such as air pollution as well as greenhouse emissions. Carbon dioxide (CO_2) discharged into the environment as one type of greenhouse gases lead to major environmental issues. In addition, fossil fuels known to be non-renewable resources that eventually can depleted in the future. Thus, extensive studies into renewables and environmentally friendly approach are on demand.

In addition, ethanol (C_2H_5OH) is gaining a lot of interests as a replacement of fossil fuels because of its low toxicity, low cost, high availability and renewability [1-3]. Additionally, C_2H_5OH is mostly produced from fermentation of biomass such as sugarcane, corn and wheat [4]. Furthermore, syngas (mixture of H_2 + CO) is rising as potential alternatives for sources of energy because of its renewable nature and nature-friendly [5]. Moreover, syngas can be employed for the downstream production of higher chain hydrocarbons through Fisher-Tropsch synthesis [6-7] and other petrochemical industries such as methanol, dimethyl ether (DME) and methyl tert-butyl ether (MTBE) [8-9].