Syngas production from glycerol dry reforming using Nd_2RuO_5 perovskite catalysts

Ahmad Faiz Malek[1], Siti Nor Amira Rosli[1], Nurul Asmawati Roslan[1], Mohd-Nasir Nor Shafiqah[1], William Mah Wey Lian[1], Nur Aqilah Mohd Razali[1], Osarieme Uyi Osazuwa[1,3], and Sumaiya Zainal Abidin[1,2,a)]

[1]Department of Chemical Engineering, College of Engineering, Universiti Malaysia Pahang, 26300 Gambang, Pahang, Malaysia

[2]Centre for Research in Advanced Fluid & Processes (FLUID CENTRE), Universiti Malaysia Pahang, 26300 Gambang, Kuantan, Pahang, Malaysia

[3]Department of Chemical Engineering, University of Benin, PMB 1154, Benin City, Edo State, Nigeria

[a)]Corresponding author: sumaiya@ump.edu.my

ABSTRACT

Currently, fossil fuels as the global energy sources have become a liability due to the emission of greenhouse gases that causes global temperature elevated and climate changes to happen more frequently. As a result, glycerol dry reforming (GDR) has been a research priority, owing to its reforming capabilities in turning greenhouse gases (CO_2) and biodiesel byproducts (glycerol) into syngas. The choice of catalysts is critical for increasing the efficiency of the syngas production process. Hence, this paper studies the application of Nd_2RuO_5 perovskite catalysts on the dry reforming of glycerol. Before characterization, the catalysts were prepared by using the Pechini Sol-Gel method. GDR reactions were conducted using a fixed-bed reactor at operating conditions; 873 – 1173 K and CO_2 to Glycerol ratio (CGR) at 1:1. Based on XRD finding, the dominant phase belongs to Nd_2RuO_5, a pseudo double perovskite. The reduction profile from TPR showed a lowered reduction temperature which belongs to Ru that reduced into Ru^0. The images of perovskite showed a well dispersed and smooth surface, and no agglomeration occurred on the pore sites. From the catalytic evaluation on the effect of temperature, the best temperature was observed at 1073 K, giving the highest glycerol conversion at 69%, whereas for H_2, CO yields 20.8% and 13.8%, respectively. Intense carbon formation has been detected at post XRD analysis which later confirmed to be a filamentous type, that oxidized at low oxidation temperature from 400 – 500 K.

KEYWORDS

Energy sources; Glycerol dry reforming (GDR); Syngas production process

ACKNOWLEDGEMENTS

The authors recognize the financial support from the Ministry of Higher Education, Malaysia, for FRGS research grant with vote number FRGS/1/2018/TK02/UMP/02/12 (RDU190197) and Universiti Malaysia Pahang through the internal research grant (RDU 1803118 and PGRS210382).