ARTICLE IN PRESS

Materials Today: Proceedings xxx (xxxx) xxx

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

Facile synthesis of fibrous Faujasite Y supported Ni (Ni/FFY) catalyst for hydrogen production via glycerol dry reforming

N. Abdullah [b], N. Ainirazali [a,b,*], H.D. Setiabudi [a,b], A. Ideris [b], A.R. Mohamed [c], A.A. Jalil [d,e]

[a] Centre of Excellence for Advanced Research in Fluid Flow (CARIFF), Universiti Malaysia Pahang, 26300 Gambang, Malaysia
[b] Faculty of Chemical and Process Engineering Technology, Universiti Malaysia Pahang, 26300 Gambang, Malaysia
[c] School of Chemical Engineering, Engineering Campus, Universiti Sains Malaysia, Seberang Perai Selatan, 14300 Nibong Tebal, Malaysia
[d] School of Chemical and Energy Engineering, Faculty of Engineering, Universiti Teknologi Malaysia (UTM), 81310 Johor Bahru, Malaysia
[e] Centre of Hydrogen Energy, Institute of Future Energy, Universiti Teknologi Malaysia (UTM), 81310 Johor Bahru, Malaysia

ARTICLE INFO

Article history:
Available online xxxx

Keywords:
Zeolite Y
Dendritic morphology
Interparticle porosity
Ni catalyst
Hydrogen
Dry reforming

ABSTRACT

In this study, the dendritic structure of Ni-supported Fibrous Faujasite Y (Ni/FFY) catalyst was successfully synthesized by employing a hydrothermal-assisted microemulsion system and subsequently tested in glycerol dry reforming to produce syngas. FFY possesses high porosity due to the formation of radial wrinkle fibre observed from TEM analysis. This provides a huge amount of interparticle pores that facilitate the absorption of the molecules within the material under a minimum hindrance, hence boosting the interior surface accessibility of Ni/FFY. This exclusive morphology contributed to the enhancement in the amount of accessible Ni active sites, resulting in the good activity of Ni/FFY ($C_3H_8O_3$ conversion = 56.28 %, CO yield = 70.14 %, and H_2 yield = 49.80 %). The extraordinary physicochemical properties of Ni/FFY and outstanding catalytic performance in glycerol dry reforming proved its capability as a sustainable catalyst in transforming waste byproduct (glycerol) and greenhouse gas (CO_2) to clean energy (H_2). This finding presents a pioneering fibrous zeolite catalyst for hydrogen generation in glycerol reforming.

1. Introduction

Fossil fuels, for instance coal, natural gas, and petroleum are currently utilized to fulfill the largest of the world's energy demands. They account for more than 80 % of all energy use [1]. However, the rising costs of processing fossil fuels, the socioeconomic effects of global warming because of CO_2 accumulation, and the environmental repercussions have spurred efforts toward research, development, and market use of energy technologies and renewable fuels. Biodiesel is becoming more popular among renewable fuels owing to its environmental advantages, for example fewer CO_2 emissions, easy processing from low-cost, readily available feedstocks, and the potential to increase the biodiesel's price [2]. The process of transesterification of agricultural oils, animal fats, and recycled cooking oil with ethanol or methanol produces biodiesel and glycerol. The fast development in the production of biodiesel technology has headed to huge amounts of glycerol by-products, which reached a peak at 1.05 lb per gallon of biodiesel produced [3]. Glycerol production was propelled by increasing biodiesel supply. This surplus has created an overstock problem, which has impeded the biodiesel industry's growth, especially in economic viability [4]. Utilizing glycerol as a syngas feedstock will help to lessen the price of refining in biodiesel production and can effectively address environmental problems.

In recent years, further methods for valorizing glycerol to produce syngas (H_2 and CO) via various reforming synthesis approaches, such as aqueous phase, autothermal, dry, and steam, have been documented [5–8]. Among all these options, the CO_2 reforming route or so-called glycerol dry reforming (GDR) has emerged as a viable option for glycerol valorization since it uses greenhouse gases (GHGs) (CO_2) and glycerol waste as reactants, thus minimizing major economic and environmental constraints. Nevertheless, the deposition of coke and the sintering of metal are the major concerns in reforming reactions as they can deactivate the active metal sites of the reforming catalysts. However,

* Corresponding author.
E-mail address: ainirazali@ump.edu.my (N. Ainirazali).

https://doi.org/10.1016/j.matpr.2023.06.314
2214-7853/