Available online at www.sciencedirect.com

ScienceDirect

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

Optimization of boron dispersion on fibrous-silica-nickel catalyst for enhanced CO_2 hydrogenation to methane

N.S. Hassan [a], A.A. Jalil [a,b,*], N.A.A. Fatah [b], I. Hussain [b], A.F.A. Rahman [a], S.A.M. Dolit [a], K. Kidam [a], R. Jusoh [c], M.A.A. Aziz [a], H.D. Setiabudi [c], C.K. Cheng [d]

[a] School of Chemical and Energy Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, JohC, Malaysia

[b] Centre of Hydrogen Energy, Institute of Future Energy, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia

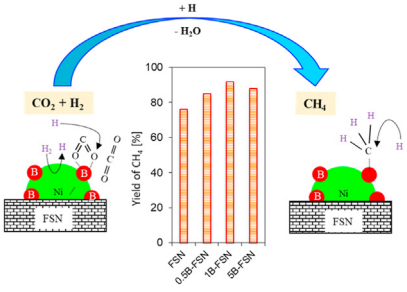
[c] Faculty of Chemical and Process Engineering Technology, College of Engineering Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300, Gambang, Kuantan, Pahang, Malaysia

[d] Center for Catalysis and Separation (CeCaS), Department of Chemical Engineering, College of Engineering, Khalifa University of Science and Technology, 127788, Abu Dhabi, United Arab Emirates

HIGHLIGHTS

- Apt boron dispersion surround nickel particles improved CO_2 adsorption.
- Boron accelerated the methanation and restricted the coke formation.
- Addition of boron onto FSN improved the nickel activity and stability.
- Optimization of methanation by FCCCD and RSM gave the highest 84.3% of methane.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 14 August 2021
Received in revised form
1 January 2022
Accepted 14 February 2022
Available online 5 March 2022

ABSTRACT

There are numerous reports regarding boron-containing catalysts for hydrogen-related reactions from CO_2 including dry reforming of methane and methanation. Besides enhancing the productivity, boron also improved nickel activity and stability. However, the detailed mechanistic study, particularly in explaining the starring role of boron in the enhanced reactions, is still lacking. Thus, herein we loaded boron on fibrous-silica-nickel and investigated their physicochemical properties and mechanistic route by means of in-situ FTIR for enhanced CO_2 methanation. It was found that the appropriate dispersion of

* *Coresponding author*. School of Chemical and Energy Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310, UTM Johor Bahru, Johor, Malaysia.
E-mail address: aishahaj@utm.my (A.A. Jalil).

https://doi.org/10.1016/j.ijhydene.2022.02.126