Robust Ni-Based Dendritic Rod-Like F-SBA-15 and Spherical DFSBA-15 For Methane Dry Reforming

H.D. Setiabudi [a,b]* , C.C. Chong [a] , S.N. Bukhari [a] , A.A. Jalil [c,d]

a Faculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang, 26300 Gambang, Kuantan, Pahang, Malaysia.

b Centre of Excellence for Advanced Research in Fluid Flow, Universiti Malaysia Pahang, 26300 Gambang, Kuantan, Pahang, Malaysia.

c School of Chemical and Energy Engineering, Faculty of Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.

d Centre of Hydrogen Energy, Institute of Future Energy, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia.
E-mail: herma@ump.edu.my

ABSTRACT

In the current study, the transformation of conventional SBA-15 into uniform rod-liked structure of fibrous SBA-15 (F-SBA-15) and spherical dendritic fibrous SBA-15 (DFSBA-15) were successfully synthesized by the microemulsion technique. The synthesized supports were loaded with 5 wt.% Ni using the impregnation method and catalytically applied in methane dry reforming of methane (MDR). Both Ni-based F-SBA-15 and DFSBA-15 catalysts exhibited excellent activity and stability over MDR, with no indication of deactivation up to 30 h timeon-stream. This phenomenon could be credited to their superb physiochemical attributes of dendrimeric morphology of F-SBA-15 and DFSBA-15, which resulted in homogenous and better Ni scattering onto the siliceous framework of the support, moderate Ni crystallites size, and thus strengthening the Si-O-Ni interaction, in parallel with the findings from XRD, BET, FTIR, TEM and FESEM-EDX analyses. These favorable properties facilitated high reactivity between two gaseous reactants (CH4 and CO2), thus resulted excellent catalytic performance. The post reaction characterizations (XRD and TPO), confirmed the insignificant coke deposition and metal sintering for both Ni/F-SBA-15 and Ni/DFSBA-15. This study acknowledged that the transformation of conventional mesoporous SBA-15 into the unique F-SBA-15 and DFSBA-15 were praiseworthy for the syngas production via MDR.

Keywords: Ni/F-SBA-15; Ni/DFSBA-15; Fibrous Morphology; Methane Dry Reforming; Coke Deposition.

Acknowledgment

This work was financially supported by Universiti Malaysia Pahang (UMP) through Research University Grant (RDU1803174).