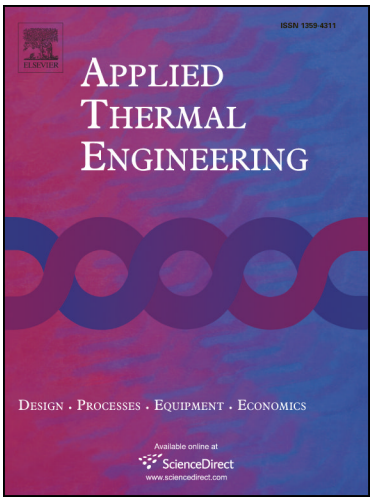

Promoting hydrogen-rich syngas production from catalytic reforming of biomass pyrolysis oil on nanosized nickel-ceramic catalysts

Ningbo Gao, Ying Han, Cui Quan, Chunfei Wu

PII: S1359-4311(17)30590-2
DOI: http://dx.doi.org/10.1016/j.applthermaleng.2017.07.028
Reference: ATE 10695

To appear in: *Applied Thermal Engineering*

Received Date: 26 January 2017
Revised Date: 3 July 2017
Accepted Date: 4 July 2017

Please cite this article as: N. Gao, Y. Han, C. Quan, C. Wu, Promoting hydrogen-rich syngas production from catalytic reforming of biomass pyrolysis oil on nanosized nickel-ceramic catalysts, *Applied Thermal Engineering* (2017), doi: http://dx.doi.org/10.1016/j.applthermaleng.2017.07.028

Promoting hydrogen-rich syngas production from catalytic reforming of biomass pyrolysis oil on nanosized nickel-ceramic catalysts

Ningbo Gao[a, b*], Ying Han[b], Cui Quan[a], Chunfei Wu[c,d*],

[a] School of Energy and Power Engineering, Xi'an Jiaotong University, Xi'an, China, 710049.

[b] School of Environmental Science and Technology, Dalian University of Technology, Dalian, China, 116024.

[c] School of Engineering and Computer Science, University of Hull, Hull, HU6 7RX, UK

[d] School of Energy and Environmental Engineering, Hebei University of Technology, Tianjin, China, 300401

Tel/Fax: +86-29-82668572; E-mail: nbogao@xjtu.edu.cn; c.wu@hull.ac.uk

ABSTRACT: Catalytic reforming of real biomass pyrolysis oil (BPO) was carried out with a nano-Ni/ceramic foam catalyst using a fixed bed reactor. XRD, TPR, SEM/EDX and BET were used to characterise the synthesized catalysts. The analysis results showed that nickel oxide was in-situ reduced to active nickel metal during the steam reforming process and the size of NiO particles loaded on the surface of ceramic foam was in the range of 30-40 nm. NiO nanoparticles showed a homogeneous multilayer deposition on the surface of the catalyst and the BET surface area of the fresh catalyst was increased with the increase of Ni loading. The effects of calcination temperature, reaction temperature and weight hourly space velocity (WHSV) on hydrogen production were studied. The results showed that the yields of hydrogen and gas were decreased with the calcination temperature increasing from 400 to 700 °C. The yield of H_2 were in the range of 44.41-89.17 g H_2 kg^{-1} BPO when the reaction temperatures varied from 500 to 800°C. The hydrogen yield was decreased with the increase of WHSV, and a low activation energy (25.34 kJ mol^{-1}) was obtained from kinetic studies, indicating the effectiveness of the nano-Ni/ceramic foam catalyst.

Keywords: Hydrogen production; Steam reforming; Biomass pyrolysis oil; Nano-NiO/ceramic foam catalyst.