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Research Article

Syngas Production from Catalytic CO_2 Reforming of CH_4 over $CaFe_2O_4$ Supported Ni and Co Catalysts: Full Factorial Design Screening

M. Anwar Hossain[1], Bamidele V. Ayodele[1], Chin Kui Cheng[1,2,3], Maksudur R. Khan[1,2*]

[1]Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang Kuantan, Pahang, Malaysia
[2]Rare Earth Research Centre, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang Kuantan, Pahang, Malaysia
[3]Center of Excellence for Advanced Research in Fluid Flow, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang Kuantan, Pahang, Malaysia

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Abstract

In this study, the potential of dry reforming reaction over $CaFe_2O_4$ supported Ni and Co catalysts were investigated. The $Co/CaFe_2O_4$ and $Ni/CaFe_2O_4$ catalysts were synthesized using wet impregnation method by varying the metal loading from 5-15 %. The synthesized catalysts were tested in methane dry reforming reaction at atmospheric pressure and reaction temperature ranged 700-800 ^oC. The catalytic performance of the catalysts based on the initial screening is ranked as $5\%Co/CaFe_2O_4 < 10\%Co/CaFe_2O_4 < 5\%Ni/CaFe_2O_4 < 10\%Ni/CaFe_2O_4$ according to their performance. The $Ni/CaFe_2O_4$ catalyst was selected for further investigation using full factorial design of experiment. The interaction effects of three factors namely metal loading (5-15 %), feed ratio (0.4-1.0), and reaction temperature (700-800 ^oC) were evaluated on the catalytic activity in terms of CH_4 and CO_2 conversion as well as H_2 and CO yield. The interaction between the factors showed significant effects on the catalyst performance at metal loading, feed ratio and reaction temperature of 15 %, 1.0, and 800 ^oC. respectively. The 15 wt% $Ni/CaFe_2O_4$ was subsequently characterized by Thermogravimetric (TGA), X-ray Diffraction (XRD), Field Emission Scanning Electron Microscopy (FESEM), Energy Dispersive X-ray Spectroscopy (EDX), X-ray Photoelectron Spectroscopy (XPS), N_2-physisorption, Temperature Programmed Desorption (TPD)-NH_3, TPD-CO_2, and Fourier Transform Infra Red (FTIR) to ascertain its physiochemical properties. This study demonstrated that the $CaFe_2O_4$ supported Ni catalyst has a good potential to be used for syngas production via methane dry reforming.

Keywords: Cobalt; Nickel; $CaFe_2O_4$; Methane dry reforming; Syngas

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* Corresponding Author.
E-mail: mrkhancep@yahoo.com (Khan, M.R.)
Telp.: +609 5492872, Fax.: +609 5492889