Artificial Neural Network Modeling Of Hydrogen-Rich Syngas Production From Methane Dry Reforming Over Novel Ni/$CaFe_2O_4$catalysts

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ABSTRACT

In this study, the application of artificial neural networks (ANN) for the modeling of hydrogen-rich syngas produced from methane dry reforming over Ni/$CaFe_2O_4$ catalysts was investigated. Multi-layer perceptron (MLP) and radial basis function (RBF) neural network architectures were employed for the modeling of the experimental data obtained from methane dry reforming over novel Ni/$CaFe_2O_3$ catalysts. The Ni/$CaFe_2O_3$ catalysts were synthesized and characterized by XRD, SEM, EDX and FTIR. The as-synthesized Ni/$CaFe_2O_3$ catalysts were tested in a continuous flow fixed bed stainless steel reactor for the production of hydrogen-rich syngas via methane dry reforming. The inputs to the ANN–MLP and ANN–RBF-based models were the catalyst metal loadings (5–15wt %), feed ratio (0.4–1.0) and the reaction temperature (700–800 °C). The two models were statistically discriminated in order to measure their predictive capability for the hydrogen-rich syngas production. Coefficient of determination (R^2) values of 0.9726, 0.8597, 0.9638 and 0.9394 obtained from the prediction of H_2 yield, CO yield, CH_4 conversion and CO_2 conversion respectively using ANN–MLP-based model were higher compared to R^2 values of 0.9218, 0.7759, 0.8307 and 0.7425 obtained for the prediction of H_2 yield, CO yield, CH_4 conversion and CO conversion respectively using ANN–RBF-based model. The statistical results showed that the ANN–MLP-based model performed better than ANN–RBF model for the prediction of hydrogen-rich syngas from methane dry reforming over the Ni/$CaFe_2O_4$ catalysts. Further t-test performed based on the target outputs from the ANN–MLP and ANN–RBF network shows that the models were statistically significant.

KEYWORDS: Artificial neural network; Calcium ferrite; Methane dry reforming; Multi-layer perceptron;Nickel; Radial basis function

DOI: 10.1016/j.ijhydene.2016.04.034