# Experimental and optimization studies of hydrogen production by steam methane reforming over lanthanum strontium cobalt ferrite supported Ni catalyst

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## ABSTRACT

Over the years, research focused has been on the development of active and stable catalysts for hydrogen ($H_2$) production by steam methane reforming (SMR). However, there is less attention on the individual and interaction effect of key process parameters that influence the catalytic performance of such catalysts and how to optimize them. The main objective of this study is to investigate the individual and interaction effects of key parameters such as methane partial pressure ((Formula presented.) (10-30 kPa), steam partial pressure ((Formula presented.) (10-30 kPa), and reaction temperature (T) (750-850°C) on $H_2$ yield and methane ($CH_4$) conversion during SMR using Box-Behnken experimental design (BBD) and response surface methodology. The $H_2$ production was catalyzed using Ni/LSCF prepared by wet impregnation method. The evaluation of the Ni/LSCF using different instrument techniques revealed that the catalyst exhibited excellent physicochemical properties suitable for SMR. Response surface models showing the individual and interaction effect of each of the parameters on the $H_2$ yield and $CH_4$ conversion were obtained using the set of data obtained from the BBD matrix. The three parameters were found to have significant effects on the $H_2$ yield and $CH_4$ conversion. At the highest desirability of 0.8994, maximum $H_2$ yield and $CH_4$ conversion of 89.77% and 89.01%, respectively, were obtained at optimum conditions of 30 kPa, 28.86 kPa, and 850°C for (Formula presented.), (Formula presented.), and temperature, respectively. The predicted values of the responses from the response surface models were found to be in good agreement with the experimental values. At optimum conditions, the catalyst was found to be stable up to 390 minutes with time on stream. The characterization of the used catalyst using thermogravimetric analysis, scanning electron microscopy, energy-dispersive X-ray spectroscopy, and transmission electron microscopy showed some evidence deposition of a small amount of carbon on the catalyst surface.

**KEYWORDS**
Box-Behnken design; Desirability function; Lanthanum strontium cobalt ferrite; Response surface methodology; Steam methane reforming

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