

Dry Reforming Combined With Steam Reforming Of Methane For Hydrogen Production Over Ni/CeO₂ Catalyst

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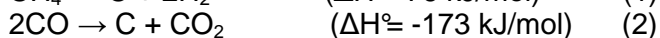
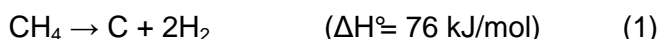
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Abstract:

Hydrogen offers a range of benefits as a clean energy carrier that can be produced from any available primary energy source, contributes to a diversification of automotive fuel sources and provides the long-term possibility of being solely produced from renewable energy sources [1]. Recently, the major research efforts have been concentrated on the CO₂ reforming (dry reforming) and steam reforming of methane (originated from biogas) for hydrogen production [2, 3]. The combination of these two reactions has substantial interest in alternative routes for the conversion of methane to hydrogen.

In this work, we present new results on the catalytic dry reforming combined with steam reforming of methane over Ni/CeO₂ catalyst. The main objective is to elucidate the reaction pathway and the influence of the process parameters (reaction temperature, CO₂/H₂O feed-ratio...) on the activity and selectivity. The Ni catalyst was prepared by impregnation method with a Ni loading of 15 wt%. The methane reforming was carried out at temperatures between 600-800°C under atmospheric pressure. In the simultaneous CO₂ and steam reforming, the conversion of methane and CO₂ as well as H₂/CO product ratio are strongly influenced by the CO₂/H₂O feed-ratio and by the reaction temperature. Ni-CeO₂ catalyst showed an excellent reactivity in CO₂ and steam reforming of methane at 650°C : 90% CH₄ conversion and about 68% CO₂ conversion and a H₂/CO molar ratio equal to 2.3 were obtained. No deactivation and loss of activity were observed during experimental test. These results were correlated with those of DTA/TG analysis, which confirmed the absence of coke formation on the catalyst.

It can be concluded that the dry reforming combined with steam reforming of methane can not only produce hydrogen with desired H₂/CO ratio, but also could inhibit carbon formation (originated from methane decomposition (Eq. (1)) and Boudouard reaction (Eq. (2)) which is usually a serious problem in the CO₂ reforming of methane.



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