World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:11, No:11, 2017

Dry Reforming of Methane Using Metal Supported and Core Shell Based Catalyst

Authors : Vinu Viswanath, Lawrence Dsouza, Ugo Ravon

Abstract : Syngas typically and intermediary gas product has a wide range of application of producing various chemical products, such as mixed alcohols, hydrogen, ammonia, Fischer-Tropsch products methanol, ethanol, aldehydes, alcohols, etc. There are several technologies available for the syngas production. An alternative to the conventional processes an attractive route of utilizing carbon dioxide and methane in equimolar ratio to generate syngas of ratio close to one has been developed which is also termed as Dry Reforming of Methane technology. It also gives the privilege to utilize the greenhouse gases like CO2 and CH4. The dry reforming process is highly endothermic, and indeed, ΔG becomes negative if the temperature is higher than 900K and practically, the reaction occurs at 1000-1100K. At this temperature, the sintering of the metal particle is happening that deactivate the catalyst. However, by using this strategy, the methane is just partially oxidized, and some cokes deposition occurs that causing the catalyst deactivation. The current research work was focused to mitigate the main challenges of dry reforming process such coke deposition, and metal sintering at high temperature.To achieve these objectives, we employed three different strategies of catalyst development. 1) Use of bulk catalysts such as olivine and pyrochlore type materials. 2) Use of metal doped support materials, like spinel and clay type material. 3) Use of core-shell model catalyst. In this approach, a thin layer (shell) of redox metal oxide is deposited over the MgAl2O4 /Al2O3 based support material (core). For the core-shell approach, an active metal is been deposited on the surface of the shell. The shell structure formed is a doped metal oxide that can undergo reduction and oxidation reactions (redox), and the core is an alkaline earth aluminate having a high affinity towards carbon dioxide. In the case of metal-doped support catalyst, the enhanced redox properties of doped CeO2 oxide and CO2 affinity property of alkaline earth aluminates collectively helps to overcome coke formation. For all of the mentioned three strategies, a systematic screening of the metals is carried out to optimize the efficiency of the catalyst. To evaluate the performance of them, the activity and stability test were carried out under reaction conditions of temperature ranging from 650 to 850°C and an operating pressure ranging from 1 to 20 bar. The result generated infers that the core-shell model catalyst showed high activity and better stable DR catalysts under atmospheric as well as high-pressure conditions. In this presentation, we will show the results related to the strategy.

Keywords : carbon dioxide, dry reforming, supports, core shell catalyst
Conference Title : ICCD 2017 : International Conference on Carbon Dioxide
Conference Location : Venice, Italy
Conference Dates : November 13-14, 2017