Optimizing of Yttria Modifier for Hydrogen Production over Zirconia-Supported Nickel Catalyst via Dry Reforming of Methane

Abdulrahman N. Kurdi, Anis H. Fakeeha, Ahmed S. Al-fatesh, Ahmed A. Ibrahim, Ahmed E. Abasaeed,
King Saud Universtiy, Saudi Arabia

The worldwide high concern with the environment has urged to search for harmless fuel instead of fossil-based fuels to fulfill the energy demands. The process of dry reforming methane has been established as a method for utilizing carbon dioxide and methane and generating synthesis gas, composed of H2 and CO in a 1:1 molar ratio. The eventually produced H2, after its separation from CO, can be utilized in various petrochemical industries or as a source of energy source. However, DRM suffers from coke deposition and sintering of the nickel active catalyst, which suppresses the catalytic performance and reduces the catalyst's life. Modified mesoporous support on nickel was tested as a viable solution. Thus, the catalytic performance of zirconia supported Ni-based catalyst with the addition of various amounts of yttria modifier was investigated. The Ni was loaded over a mixture of ZrO2 and Y2O3 via the wet impregnation method. Catalysts having 0.0, 5.0, 10.0, 15.0, and 20.0 wt/wt% loadings were prepared.The catalysts were then dried at 120°C and finally were calcined at 700°C for three hours. The crystalline phases of the catalysts were identified by X-ray powder diffraction. The specific surface area and porosity of the catalysts were assessed by nitrogen physisorption. Textural properties of the catalysts were also explored by H2-TPR for investigating the reducibility and the interaction between Ni, Zr, and Y oxides. The surface basicity was studied using CO2-TPD. It was found that 15% Y2O3 enhanced the catalytic conversions of both CO2 and CH4 to 71.8% and 63.5% respectively. The catalytic improvement could be linked to the increase of catalyst surface basicity by Y2O3 modifier, which enhanced subsequently the adsorption of CO2.

Keywords: Dry reforming of methane, Nickel-based catalyst, zirconia support, yttria modifier

Biography:

Mr. Abdulrahman N. Kurdi obtained his B.Sc. degree in chemistry from Taibah University in 2015. Immediately, he worked for "Chem Club" at his university. He expanded his experience by working in the water analysis laboratory of Saudi Binladin Group for three months. He joined Bournemouth University for English classes for a year. Afterwards, he joined the reneawable Energy Master program at King Saud University, where he is doing his research in dry reforming of methane as a tool for hydrogen production.