The role of ceria supported copper-based nanoparticle catalysts on Reverse Water-Gas Shift Reaction

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Abstract

The reverse water gas shift (RWGS) reaction is a potential method for converting CO_2 into CO, which can subsequently be employed as a syngas component to make useful chemicals and liquid fuels. The reaction is mildly endothermic and at low temperatures, it competes with an extremely exothermic CO_2 methanation reaction. As a result, designing highly selective catalysts for the RWGS reaction, leading to cost-effective CO_2 hydrogenation, remains an important and difficult challenge. In this study, Cu-based materials were investigated for their ability to convert carbon dioxide into syngas utilizing ceria as a support. Ceria is known to be a good catalyst as well as an excellent support for oxygen and hydrogen transfer reactions (hydrogenation and dehydrogenation). Our experimental results showed that increasing the temperature enhances CO_2 conversion, with the highest conversion of 70% at 600°C that remained stable for over 1000 minutes time on stream (TOS) runs. The other point to note is that the catalyst was CO-selective, with no CH_4 detected in the effluent gas. Furthermore, both fresh and post-reaction samples were analyzed using different techniques such as XRD, TEM, SEM/EDX, and Raman to explore the crystallographic and morphological features of the support and catalyst as well as the influence of reaction on the catalyst surface. The findings may provide an effective platform for minimizing precious metals application as catalysts for CO_2 conversion reactions.

Keywords: CO_2 conversion, Cu-based catalysts, CeO_2 support, Reverse Water Gas Shift reaction