289k Ceria Supported Catalysts for the Low Temperature Water Gas Shift Reaction

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In recent years, there has been a renewed interest in the low temperature water-gas shift (LTWGS) reaction because of its potential use in conjunction with fuel cell power generation. Proton exchange membrane fuel cells require hydrogen of sufficiently high purity, as parts per million of CO poison the noble metal catalysts used in the fuel cell. The LTWGS reaction can be used as one of the steps to achieve this purity. Studies have shown that ceria and ceria-zirconia supported catalysts are promising catalysts for the LTWGS reaction [1,2]. Two mechanisms have been proposed for the reaction over ceria-supported catalysts. The first mechanism is a ceria-mediated redox process, where CO adsorbed on the metal is oxidized by ceria [2]. The second mechanism involves the formation of a surface formate intermediates which decomposes to H_2 and unidentate carbonate prior to liberation of CO_2 [3]. Significant debate still exists as to which mechanism, or combination of mechanisms [4], occurs during the reaction. What is known is that the reducibility of the support is important.

The addition of zirconia to ceria has been shown to improve the reducibility of the support [5]. Studies of the high temperature methane reforming reactions have shown that the formation of Ce^{3+} under reaction conditions exhibits a maximum, with the highest reducibility being observed on a $Ce_{0.5}Zr_{0.5}O_2$ support. The results of this work show that the LTWGS activity correlates well with the reducibility of the oxide support with a maximum being observed at a 50% Ce composition. Specifics of the proposed mechanism of reaction and the effect of the support composition, feed composition, and support surface area are discussed.

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