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Influence of Interaction between Copper and Iron on Catalytic Performance over Supported Catalysts for CO_2 Hydrogenation

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Anthropogenic CO_2 emissions increased from approximately 31.9 to 35.5 Gt per year in 2010-2014.[1] The continued growth in CO_2 emissions caused the climate change, which attracted considerable attention of researchers.[2, 3] Researchers are focusing on reduction of CO_2 into fuels and chemicals. C_{2+} hydrocarbons have a wider market (fuels) or a higher added value (chemicals), though the CO_2 molecule is stable and the C-C coupling is difficult.[4, 5]

The selectivity of desired products, such as C_2-$C_4^=$ and C_{5+}, is low over un-promoted iron catalysts for CO_2 hydrogenation. Promoters are often used to tailor and optimize product distribution. The effects of copper on product distribution over iron supported catalysts are different from other usual promoters. The selectivity of C_2-$C_4^=$ decreased while the C_{5+} selectivity increased obviously (**Figure 1**). The increase of CO_2 conversion and C_{5+} selectivity was attributed to the strong interaction of copper and iron, which facilitated the reduction of iron and enhanced the CO_2 adsorption of catalysts. C_3H_6-TPD demonstrated that the adsorption of primarily formed olefins increased on Cu-promoted catalysts. Hydrogenation of olefins increased the selectivity of paraffins, and the oligomerization of olefins increased the selectivity of C_{5+} (**Figure 2**). The interaction of iron and copper was controlled by changing the distribution of the two metals. The interaction strength of Cu and Fe had an influence on catalytic performance.

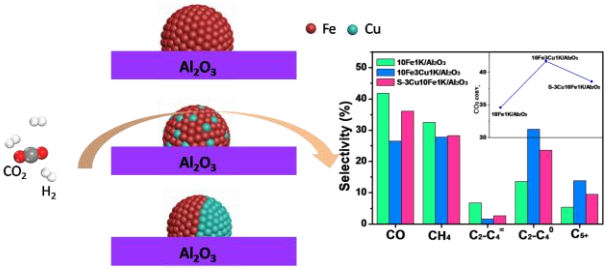

Figure 1. CO_2 hydrogenation over supported catalysts.

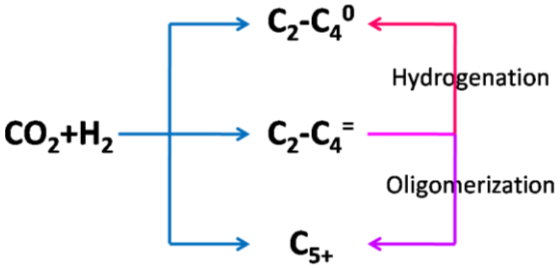

Figure 2. Pathways of CO_2 conversion into reaction products on Cu-promoted catalysts.

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