

## Reduction of Nitrogen Monoxide with Carbon Monoxide from Gas Streams by 10% wt. Cu-Ce-Fe-Co/Activated Carbon

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**Abstract :** Nitrogen oxides ( $\text{NO}_x$ ) is regarded as one of the most important air pollutants. It not only causes adverse environmental effects but also harms human lungs and respiratory system. As a post-combustion treatment, selective catalytic reduction (SCR) possess the highest NO removal efficiency ( $\geq 85\%$ ), which is considered as the most effective technique for removing NO from gas streams. However, injection of reducing agent such as  $\text{NH}_3$  is requested, and it is costly and may cause secondary pollution. Reduction of NO with carbon monoxide (CO) as reducing agent has been previously investigated. In this process, the key step involves the NO adsorption and dissociation. Also, the high performance mainly relies on the amounts of oxygen vacancy on catalyst surface and redox ability of catalyst, because oxygen vacancy can activate the N-O bond to promote its dissociation. Additionally, perfect redox ability can promote the adsorption of NO and oxidation of CO. Typically, noble metals such as iridium (Ir), platinum (Pt), and palladium (Pd) are used as catalyst for the reduction of NO with CO; however, high cost has limited their applications. Recently, transition metal oxides have been investigated for the reduction of NO with CO, especially  $\text{Cu}_x\text{O}_y$ ,  $\text{Co}_x\text{O}_y$ ,  $\text{Fe}_2\text{O}_3$ , and  $\text{MnO}_x$  are considered as effective catalysts. However, deactivation is inevitable as oxygen ( $\text{O}_2$ ) exists in the gas streams because active sites (oxygen vacancies) of catalyst are occupied by  $\text{O}_2$ . In this study, Cu-Ce-Fe-Co is prepared and supported on activated carbon by impregnation method to form 10% wt. Cu-Ce-Fe-Co/activated carbon catalyst. Generally, addition of activated carbon on catalyst can bring several advantages: (1) NO can be effectively adsorbed by interaction between catalyst and activated carbon, resulting in the improvement of NO removal, (2) direct NO decomposition may be achieved over carbon associated with catalyst, and (3) reduction of NO could be enhanced by a reducing agent over carbon-supported catalyst. Therefore, 10% wt. Cu-Ce-Fe-Co/activated carbon may have better performance for reduction of NO with CO. Experimental results indicate that NO conversion achieved with 10% wt. Cu-Ce-Fe-Co/activated carbon reaches 83% at  $150^\circ\text{C}$  with 300 ppm NO and 10,000 ppm CO. As temperature is further increased to  $200^\circ\text{C}$ , 100% NO conversion could be achieved, implying that 10% wt. Cu-Ce-Fe-Co/activated carbon prepared has good activity for the reduction of NO with CO. In order to investigate the effect of  $\text{O}_2$  on reduction of NO with CO, 1-5%  $\text{O}_2$  are introduced into the system. The results indicate that NO conversions still maintain at  $\geq 90\%$  with 1-5%  $\text{O}_2$  conditions at  $200^\circ\text{C}$ . It is worth noting that effect of  $\text{O}_2$  on reduction of NO with CO could be significantly improved as carbon is used as support. It is inferred that carbon support can react with  $\text{O}_2$  to produce  $\text{CO}_2$  as  $\text{O}_2$  exists in the gas streams. Overall, 10% wt. Cu-Ce-Fe-Co/activated carbon is demonstrated with good potential for reduction of NO with CO, and possible mechanisms will be elucidated in this paper.

**Keywords :** nitrogen oxides ( $\text{NO}_x$ ), carbon monoxide (CO), reduction of NO with CO, carbon material, catalysis

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