Selective catalytic reduction nitrogen oxides with methane over nanosized CuO supported on Al_2O_3. Part 1. Materials structural characterization

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Nitrogen oxides (NO_x) are one of the most toxic components, and are increasingly attracting the attention of stringent environmental emission regulations in Taiwan. The primary sources of NO_x ($NO+NO_2+N_2O$), including several stationary industrial fossil fuel high temperature combustion processes and automobile exhaust sources, are of concern because these pollutants are significant precursors to acidic precipitation, which may acidification of the aquatic and terrestrial systems, and because the pollutants react in the atmosphere to generate ozone and photochemical smog. Therefore, in an environmental point of view, the removal and control of NO_x emission from industrial waste streams are important. The selective catalytic reduction (SCR) of NO in a stream to molecular nitrogen and water is one method for solving problems of nitrogen oxides pollution. Moreover, copper-containing catalysts are active in a wider range of reactions of transformation of NO with respect to other catalytic systems. Hence, this work considers the SCR of NO by hydrocarbons (HC-SCR) using methane as a reducing agent over CuO supported on Al_2O_3 in a tubular fixed-bed reactor (TFBR) at temperatures from 623-1023 K in the presence of oxygen was studied. A nanosized CuO/γ-Al_2O_3 catalyst was prepared by incipient wetness impregnation approach of copper nitrate and γ-alumina support. The catalysts were characterized using TEM and FTIR. Figure 1 presents the textural characteristics of the nanosized Cu/γ-Al_2O_3 catalyst. These crystal phases may be responsible for the high activity of the catalysts. Figure 2 compares the FTIR spectra on the nanosized Cu/γ-Al_2O_3 catalysts, and also confirms the presence of the CuO-like phase on the surface of the nanoscale Cu/γ-Al_2O_3 catalyst. It reveals that the peaks associated with the CuO-like phase on the framework are associated with a peak at around 1400 cm^{-1}. Therefore, the highly catalytic activity of the nanosized Cu/γ-Al_2O_3 catalyst system in reduction NO with CH_4 may be explained by the reversible redox behavior of CuO-Al_2O_3 couples in promoting the functional mechanism.

Figure 1. TEM photograph of the fresh nanosized Cu/γ-Al_2O_3 catalyst.

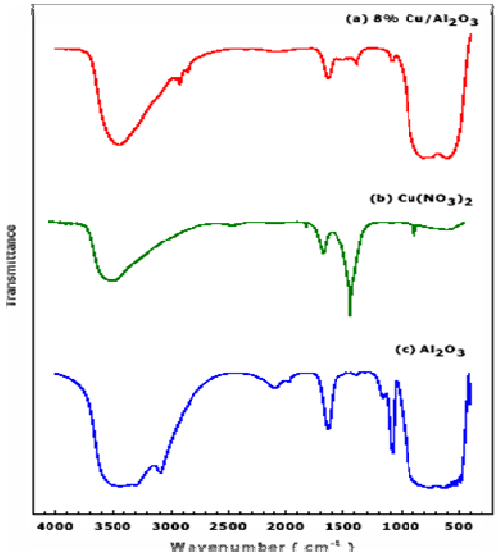

Figure 2. FTIR pattern of fresh nanosized Cu/γ-Al_2O_3 catalyst.