NO Oxidation Over Supported Cobalt Oxides Catalysts

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Nitrogen oxides such as NO, NO_2, and N_2O have been considered to be most notorious air pollutants to cause acid rain, photochemical smog, ozone depletion, and the greenhouse effects. Therefore, various technologies have been examined to control them. Among them, the selective catalytic reduction (SCR) with reductants such as NH_3 and hydrocarbons has been successfully applied to mobile and stationary sources. As the demand for the complete removal of nitrogen oxides increases, the advanced catalyst system is required to be operative at low temperatures. The insertion of unit where some of NO can be transformed into NO_2 before a SCR system have been considered to be a promising way to cope with new demands. The presence of equimolar amounts of NO and NO_2 have been reported to enhance NH_3-SCR activity noticeably especially at low temperatures. Until now, supported Pt catalysts and some transition metal oxides have been reported to be active for NO oxidation. It is needless to say that the novel transition metal oxides catalysts can be better candidates over supported Pt catalysts. In this work, cobalt oxides catalysts supported on various supports such as Al_2O_3, SiO_2, TiO_2, ZrO_2, CeO_2, SiO_2-Al_2O_3 and yttria-stabilized zirconia (YSZ) have been examined for this reaction.

All the catalysts were prepared with a wet-impregnation method from two kinds of cobalt precursors such as cobalt nitrate and acetate. The impregnated samples were dried overnight at 393 K and calcined in air at 573 K before a reaction. The activity of each catalyst was examined using a fixed-bed reactor at the reaction pressure of 1 atm. The steady-state NO conversion was obtained from 473 to 673 K. The reactant gas typically consisted of 500 ppm NO, 5 vol% O_2 and N_2. The gas hourly space velocity (GHSV) was $80{,}000h^{-1}$. The effluent gas composition was analyzed with NO/NO_2 combustion gas analyzer (Eurotron).

The catalytic activity was noticeably affected by the kinds of support. Cobalt oxides supported on reducible oxides showed the much higher activity compared with those supported on irreducible oxides. The effect of kinds of the cobalt precursor on the catalytic activity was depending on the support. This catalytic activity appeared to be closely related to the reducibility of cobalt oxides on supports.

Keywords: NO oxidation, NH_3-SCR, Cobalt, NO to NO_2