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Comparison of Effect of Promoter and K Addition of Co_3O_4 for N_2O Decomposition Reaction

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Abstract : Nitrous oxide (N2O) is now distinguished as an environmental pollutant. N2O is one of the representative greenhouse gases and N2O is produced by both natural and anthropogenic sources. So, it is very important to reduce N2O. N2O abatement processes are various processes such as HC-SCR, NH3-SCR and decomposition process. Among them, decomposition process is advantageous because it does not use a reducing agent. N2O decomposition is a reaction in which N2O is decomposed into N2 and O2. There are noble metals, transition metal ion-exchanged zeolites, pure and mixed oxides for N2O decomposition catalyst. Among the various catalysts, cobalt-based catalysts derived from hydrotalcites gathered much attention because spinel catalysts having large surface areas and high thermal stabilities. In this study, the effect of promoter and K addition on the activity was compared and analyzed. Co3O4 catalysts for N2O decomposition were prepared by co-precipitation method. Ce and Zr were added during the preparation of the catalyst as promoter with the molar ratio (Ce or Zr) / Co = 0.05. In addition, 1 wt% K2CO3 was doped to the prepared catalyst with impregnation method to investigate the effect of K on the catalyst performance. Characterizations of catalysts were carried out with SEM, BET, XRD, XPS and H2-TPR. The catalytic activity tests were carried out at a GHSV of 45,000 h-1 and a temperature range of 250 ~ 375 ℃. The Co3O4 catalysts showed a spinel crystal phase, and the addition of the promoter increased the specific surface area and reduced the particle and crystal size. It was exhibited that the doping of K improves the catalytic activity by increasing the concentration of Co2+ in the catalyst which is an active site for catalytic reaction. As a result, the K-doped catalyst showed higher activity than the promoter added. Also, it was found through experiments that Co2+ concentration and reduction temperature greatly affect the reactivity.

Keywords : Co_3O4, K-doped, N_2O decomposition, promoter
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