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Review

Catalytic decomposition of N_2O over cobalt based spinel oxides: The role of additives

Min-Jae Kim[a,b], Seung-Jae Lee[a], In-Soo Ryu[a], Min-Wook Jeon[a,c], Seung-Hyun Moon[a], Hyun-Seog Roh[b], Sang Goo Jeon[a,*]

[a] Climate Change Research Division, Korea Institute of Energy Research, 152 Gajeong-ro, Yuseong-gu, Daejeon 34129, Republic of Korea
[b] Department of Environmental Engineering, Yonsei University, 1 Yonseidae-gil, Wonju, Gangwon 220-710, Republic of Korea
[c] Department of Chemical Engineering, Chungnam National University, 99 Daehakro, Yuseong-gu, Daejeon, 305-764, Republic of Korea

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ABSTRACT

Catalytic activity at temperature below 400 °C for N_2O decomposition was investigated over catalysts based on cobalt oxide synthesized by a co-precipitation and impregnation method. The characteristics of the catalysts were assessed by XRD, BET, H_2-TPR, O_2-TPD, and XPS techniques, and the catalytic activity for N_2O decomposition was examined in the presence of O_2 and H_2O. In general, it was observed that the catalytic activity was enhanced by the increase of surface area and redox ability of the catalyst. In particular, the N_2O conversion of K/Co_3O_4 was notably higher than that of pure Co_3O_4, while the Co-CeO_2 catalyst slightly improved the activity. The K/Co-CeO_2 catalyst decomposed 100% of N_2O at 375 °C reaction temperature without O_2 and H_2O in the reaction gas stream, and this value was lowered to 95.7% with the presence of O_2 and H_2O.

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1. Introduction

Nitrous oxide (N_2O) causes environmental problems such as global warming and the ozone layer destruction. Although annual emissions of N_2O are much smaller than those of CO_2, the Global Warming Potential (GWP) of N_2O is 310 times higher than that of CO_2 [1,2]. The concentration of N_2O in the earth's atmosphere has been consistently increasing due to natural and anthropogenic activity (0.2% per year) [2,3]. One of the promising technologies for abatement of N_2O is catalytic decomposition, and various types of catalysts including noble metals [4–7], pure and mixed oxides [8–11], and ion-exchanged zeolites [12,13] accordingly have been studied. Recently, cobalt catalysts have been recognized as promising candidates for the decomposition of N_2O due to their comparatively high redox ability [14]. The adsorption of N_2O on the active site (Co^{2+}) causes a weakening of the N—O bond, releasing N_2 [8]. The unsaturated Co^{2+} ions are oxidized to Co^{3+} by oxygen species adsorbed on the surface of the catalyst. Due to

* Corresponding author.
E-mail address: sgjeon@kier.re.kr (S.G. Jeon).

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