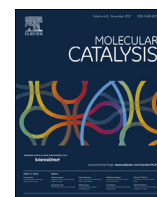




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Review

Catalytic decomposition of N₂O over cobalt based spinel oxides: The role of additivesMin-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 N₂O 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, H₂-TPR, O₂-TPD, and XPS techniques, and the catalytic activity for N₂O decomposition was examined in the presence of O₂ and H₂O. 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 N₂O conversion of K/Co₃O₄ was notably higher than that of pure Co₃O₄, while the Co-CeO₂ catalyst slightly improved the activity. The K/Co-CeO₂ catalyst decomposed 100% of N₂O at 375 °C reaction temperature without O₂ and H₂O in the reaction gas stream, and this value was lowered to 95.7% with the presence of O₂ and H₂O.

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1. Introduction

Nitrous oxide (N₂O) causes environmental problems such as global warming and the ozone layer destruction. Although annual emissions of N₂O are much smaller than those of CO₂, the Global Warming Potential (GWP) of N₂O is 310 times higher than that of CO₂ [1,2]. The concentration of N₂O 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 N₂O 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 N₂O due to their comparatively high redox ability [14]. The adsorption of N₂O on the active site (Co²⁺) causes a weakening of the N–O bond, releasing N₂ [8]. The unsaturated Co²⁺ ions are oxidized to Co³⁺ by oxygen species adsorbed on the surface of the catalyst. Due to

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