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SCR of NO with C_3H_6 in the presence of excess O_2 over $Cu/Ag/CeO_2$-ZrO_2 catalyst

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Abstract

The catalytic activity of a series of CeO_2-ZrO_2 mixed oxides in the selective catalytic reduction (SCR) of NO by C_3H_6 at 400 °C has been investigated. The NO reduction activity of pure CeO_2 is enhanced in the presence of Zr, reaching a maximum NO conversion with $CeO_2(75)$-$ZrO_2(25)$ catalyst. Then, the catalytic performances of $Cu(4)/Ag(1)/CeO_2$ and $Cu(4)/Ag(1)/CeO_2(75)$-$ZrO_2(25)$ catalysts were compared and the latter showed better activity especially in the low temperature region (250–350 °C). The stronger metal-support interaction and higher reducibility shown by the $Cu(4)/Ag(1)/CeO_2(75)$-$ZrO_2(25)$ catalyst were believed to enhance its performance compared to $Cu(4)/Ag(1)/CeO_2$ catalyst by activating more C_3H_6 to selectively reduce NO within this temperature region. Central composite response surface design methodology was employed to study the effect of operating variables such as temperature, NO and C_3H_6 concentrations on the SCR of NO by C_3H_6 over $Cu(4)/Ag(1)/CeO_2(75)$-$ZrO_2(25)$ catalyst and to determine the optimum value of operating variables for maximum NO conversion. Numerical results indicated that the optimum NO conversion of 82.89% is attained at reaction temperature = 415.38 °C, NO concentration = 1827.16 ppm and C_3H_6 concentration = 1908.13 ppm. The addition of water vapor to the reactant significantly decreased the NO conversion over $Cu(4)/Ag(1)/CeO_2$ and $Cu(4)/Ag(1)/CeO_2(75)$-$ZrO_2(25)$, but the inhibition was more pronounced over $Cu(4)/Ag(1)/CeO_2$ catalyst.

Keywords: SCR; C_3H_6; $Cu/Ag/CeO_2$-ZrO_2; Central composite design; Water vapor

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