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Catalytic decomposition of HCN on copper manganese oxide at low temperatures: performance and mechanism

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ABSTRACT: The Development of innovative treatment technology for HCN at low temperatures is vital for the control of HCN pollution. Here, a copper manganese oxide (Cu-Mn-O) catalyst was prepared for the decomposition of HCN at temperatures from 80 to 200 ˚C. The results showed that the Cu-Mn-O catalyst exhibited excellent catalytic performance for HCN conversion. X-ray photoelectron spectroscopy analysis revealed that Mn^{3+} manifested highly catalytic activity and was largely responsible for HCN decomposition. The N-contained products of HCN contained NH_3, NO/NO_2, N_2O, and N_2, thereby suggesting the concurrent catalytic oxidation and hydrolysis during HCN decomposition on the catalyst. The catalytic oxidation mechanism characterized by *in situ* diffuse reflectance infrared Fourier transform manifested that four N-contained intermediates (i.e., -CN, $-NH_2$, =NH and -NCO) were produced; subsequent the oxidation of these intermediates resulted in the formation of final product and/or oxidative species NO^+. The reaction of NO^+ with the N-contained intermediates also generated the final conversion products. Catalytic intermediate formamide plays a critical role in the hydrolysis of HCN, and its hydrolysis leads to the formation of NH_3. Multiple cycle experiments demonstrate the long-term stability of the Cu-Mn-O catalyst. These results indicate that catalytic decomposition of HCN based on the Cu-Mn-O catalyst at low temperatures may be an efficient approach for the treatment of tail gases containing HCN.

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