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The formation and migration of sulfur trioxide over V_2O_5/TiO_2 catalyst in SCR of NOx with NH_3

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The oxidation of sulfur dioxide (SO_2) to sulfur trioxide (SO_3) is undesirable during the selective catalytic reduction (SCR) of nitrogen oxides (NOx) found in the flue gas of power plants. Sulfur trioxide has toxicity over 10 times than that of SO_2 and is highly corrosive, resulting in corrosion of equipment and pollution of the environment. The objectives of this research are to establish the fundamental kinetics and mechanism of SO_2 oxidation over supported V_2O_5/TiO_2 catalyst and establish sulfur balance, then, use these insights to propose a basic theory for collaboratively controlling SO_3 emissions. A series of supported V_2O_5/TiO_2 catalysts were prepared with various V_2O_5 contents: 0.5%, 1%, 1.5%, 3%, 4% and 5%. Raman spectroscopy is used to determine the coordination of surface species. Isolated vanadia species were dispersed on the TiO_2 surface as Ti-O-V bonds at VOx coverage below the monolayer. Sulfur dioxide temperature-programmed desorption and *in situ* diffuse reflectance infrared Fourier transform spectroscopy were conducted to study the interaction between SO_2 and V_2O_5/TiO_2. It was found that Ti-O-V was demonstrated to play a critical role in the SO_2 adsorption and oxidation. A possible reaction mechanism of SO_2 oxidation over V_2O_5/TiO_2 catalyst was established in this study. The turnover frequency for SO_2 oxidation was very low, approximately 10^{-5} s^{-1} at 320 oC. Over the range of conditions studied, the rate of SO_2 oxidation is zero-order in oxygen and first-order in SO_2 and the apparent activation energies for SO_2 oxidation was obtained. The decrease of SO_2, the gaseous SO_3 and the sulfate deposited on catalyst surface were to be quantified by Fourier transform infrared spectrometer (FTIR), PENTOL SO_3 analyzer and ion chromatography (IC), respectively. Then, the sulfur balance was established.

Biography

Jin Xiong is currently pursuing his PhD in Environmental Engineering from University of Chinese Academy of Sciences, Beijing, China. He has completed his Bachelor's degree in Chemical Engineering and Technology from the Central South University, Changsha, China. His research interest is on SO_3 formation mechanism and migration route during SCR DeNOx process and SO_3 emissions collaboratively controlling.

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