Ozone Decomposition and Acetone Oxidation on Manganese Oxide Catalysts

by

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(Abstract)

This thesis describes the preparation and characterization of manganese oxide catalysts and their application in the oxidation of acetone, a typical volatile organic compound (VOC), and ozone decomposition. This topic is of great value because of environmental concerns of the elimination of the harmful VOCs and ozone. Manganese oxide was chosen because it is a well-known complete oxidation catalyst for VOCs and also an active catalyst for ozone decomposition. Two cases of studies were carried out in this work.

The first study involved the oxidation of acetone using ozone on silica- and alumina-supported manganese oxide catalysts deposited on aluminum oxide foam substrates. The characteristics of the catalysts were determined through various techniques, including x-ray diffraction (XRD), x-ray absorption spectroscopy (XAS), Brunauer-Emmett-Teller (BET) surface area analysis, temperature-programmed reduction (TPR), and oxygen chemisorption. The use of these techniques allowed better understanding of the nature of the catalysts. Activity tests were carried out in the acetone oxidation reaction and it was found that the usage of ozone substantially reduced the oxidation temperature. Steady-state *in situ* Raman spectroscopy was

also carried out to better understand the mechanism of the acetone oxidation reaction using ozone.

The second study involved an investigation of structural and electronic properties of manganese centers of the MnO_x/SiO_2 and MnO_x/Al_2O_3 catalysts during the ozone decomposition reaction using *in situ* x-ray absorption spectroscopy (XAS). The number of surface active sites was again determined through TPR and oxygen chemisorption measurements. The performance of the catalysts with different loadings and supports were also compared.