Compréhension des mécanismes réactionels pour la décomposition catalytique du protoxyde d'azote (N20) appliquée aux unités de production d'acide nitrique

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Abstract

The catalytic decomposition of nitrous oxide (N_2O) is a key process in reducing greenhouse gas emissions from nitric acid production plants. Despite extensive research, a detailed understanding of the reaction mechanisms involved remains essential to optimize catalyst performance and develop more efficient processes. This thesis investigates the fundamental reaction pathways and catalytic mechanisms for the decomposition of N_2O over Fe-zeolites based catalysts. Using a combination of in situ Fourier Transform Infrared (FTIR) spectroscopy, and operando FTIR spectroscopy, the surface species, intermediate reactions, and active sites responsible for N_2O decomposition were systematically explored. The study provides insights into the activation, and dissociation of N_2O on Fe-zeolites based catalysts, identifying the key factors that influence catalytic efficiency, such as Fe oxidation states, textural properties and structure properties. These findings contribute to a more comprehensive understanding of the catalytic behavior in industrial conditions and offer strategies for improving catalyst design, aiming at reducing N_2O emissions in nitric acid production processes.