Karlsruhe Institute of Technology

Institute for Chemical Technology and Polymer Chemistry (ITCP)
Chair Chemical Technology
KIT, Campus South, 11.23

Prof. Dr. Olaf Deutschmann

Bachelor's or Master's Thesis

Influence of Catalyst Composition and Operating Conditions on the Activity and Selectivity of Monolithic NH_3-SCO Catalysts

Background & Motivation

Ammonia (NH_3) is gaining increasing importance as a renewable energy carrier and as a convenient medium for hydrogen storage. However, the effective control of NH_3 emissions remains a significant challenge in the practical deployment of ammonia-based combustion and decomposition technologies. Selective catalytic oxidation of ammonia (NH_3-SCO) represents a promising strategy to address this issue, as it enables the targeted conversion of NH_3 into nitrogen and water.

For industrial application, catalyst systems must not only achieve high activity but also suppress the formation of undesired nitrogen oxides across a wide range of operating conditions. Developing such systems requires experimental studies that emphasize resource-efficient catalyst design, particularly by reducing precious-metal usage. Investigating monolithic catalysts under realistic conditions therefore constitutes an important step toward creating high-performance and economically viable solutions for exhaust gas aftertreatment.

Problem Statement

The goal of this thesis is to experimentally study and compare several monolithic NH_3-SCO catalyst systems with respect to their catalytic behavior. Key aspects include examining how catalyst composition, active-phase loading, exhaust gas composition, and space velocity influence both activity and selectivity under practical operating conditions.

For this purpose, monolithic catalysts will be synthesized and tested on a laboratory-scale setup under systematically varied conditions. The gas-phase products will be quantified using Fourier-transform infrared (FTIR) spectroscopy. Additionally, spatially resolved concentration profiles will be recorded to gain deeper insight into the reactions occurring within the monolith channels.

The overarching aim is to identify catalyst systems and operating windows that enable efficient and selective NH_3 removal from exhaust gases. The thesis thus contributes to experimental research in catalysis, reaction engineering, and analytical methods for sustainable exhaust gas aftertreatment, with particular emphasis on application-oriented catalyst development and the evaluation of performance under relevant operating conditions. The thesis may be written in either German or English.

Contact & Supervision

Iadh Ben Othman, M. Sc.
iadh.othman@kit.edu

Dr. Thomas Häber
thomas.haeber@kit.edu