

Experimental evaluation of effective diffusivity in monolith reactors using a modified Wicke-Kallenbach Cell

Student preference: MPISC, MPSES, MPMCEN, MPAUT

You are a master's student at the end of your education. You are interested in experimental work and have preferably a background in chemical engineering or similar. Program experience in Labview and design of experiments (DoE) is highly crediting.

Start date: X, **End date:** X, **Credits:** 30 credits, **Number of students:** 2

Examiner: Jonas Sjöblom, **Supervisors:** Magnus Walander, Jonas Sjöblom

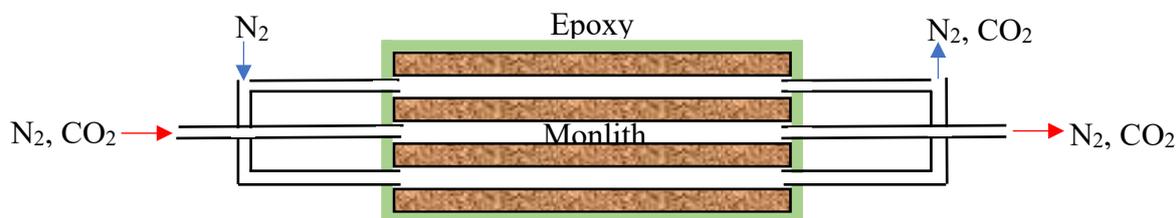
Background

In modelling of monolithic reactors used in exhaust aftertreatment, inter- and intraphase diffusion resistances are significant (1) and need to be included for predictive catalyst models. The washcoat, within which the intraphase diffusion occurs, is a highly complex material and thus its effective diffusivity depends on temperature, pressure, aging state of the catalyst etc. Furthermore, during long-term operation of e.g. the diesel oxidation catalyst, the reactive sites also change in number – further increasing the complexity between mass transfer and kinetic effects (2).

This master's thesis aims at improving the understanding of how thermal aging affects the washcoat, through experimental studies of effective diffusivities for various catalysts.

Project proposal

You are to build an experimental rig of the modified Wicke-Kallenbach cell (3), see figure 1. You will then utilize DoE to vary temperature, space velocity, washcoat loading, methods for thermal aging (engine test bench, oven aging) etc. There are no specific project deliverables so any suggestion for experimental design is encouraged!



PhD project

You will be working in close cooperation with the PhD project “Emission control by validated catalytic reactor modelling” (FFI-project 42814-1), which aims at developing better catalyst models through separating kinetics and mass transfer. A successful master's thesis will likely lead to a joint journal publication.

References

1. Walander M, Sjöblom J, Creaser D, Lundberg B, Tamm S, Edvardsson J. Efficient Experimental Approach to Evaluate Mass Transfer Limitations for Monolithic DOCs. *Topics in Catalysis*. 2019;62(1):391-6.
2. Fathali A, Olsson L, Ekström F, Laurell M, Andersson B. Hydrothermal Aging-Induced Changes in Washcoats of Commercial Three-Way Catalysts. *Topics in Catalysis*. 2013;56(1):323-8.
3. Hayes RE, Kolaczowski ST, Li PKC, Awdry S. Evaluating the effective diffusivity of methane in the washcoat of a honeycomb monolith. *Applied Catalysis B: Environmental*. 2000;25(2):93-104.