Possible Bachelor-/Master-/"Vertiefer-" thesis on environmental catalysis in the Grunwaldt group:

# Synthesis, characterization and catalytic testing of noble metal based oxidation catalysts supported on doped rare earth oxides


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Start: Any time possible (at least 2 months before the planned start of the thesis)

## Introduction/Motivation

Avoiding emissions of toxic pollutants like CO and unburnt hydrocarbons (HC) during the cold start of the engine is a major challenge in automotive exhaust gas catalysis (Fig. 1). It demands an improvement of the low temperature activity of exhaust abatement systems, e.g. of the diesel oxidation catalyst (DOC) [1]. In this regard, exploiting the interaction between reducible supports and the noble metal component represents a promising approach (Fig. 2). Our recent *operando* X-ray absorption spectroscopy (XAS) results demonstrated that in $Pt/CeO_2$ catalysts the size of noble metal nanoparticles [2] and consequently the platinum-ceria interface [3] is strongly dynamic and can be tuned precisely by short reducing pulses enhancing the low temperature CO- and HC-oxidation performance [2]. This catalyst activation and its stability will now be investigated in a consecutive step regarding the support properties (e.g. defect concentration, influence of dopants or morphology).

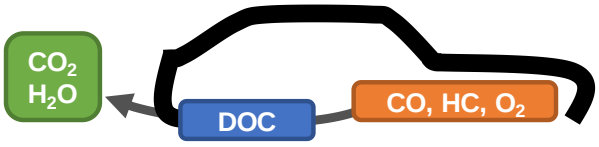


Figure 2: Scheme of the tasks of a diesel oxidation catalyst in a automotive exhaust gas aftertreatment system.

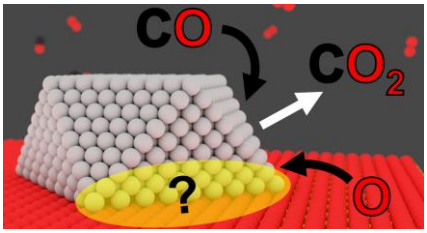


Figure 1: Illustration of the critical interface sites between reduced noble metal nanoparticles and reducible supports.

## Scope

A thesis on this topic will include the synthesis of the catalysts using hydrothermal synthesis or flame spray pyrolysis, catalytic testing and *in situ* characterization (e.g. DRIFTS or XAS). Depending on the preferences of the student the focus of the work can be shifted towards any of those three aspects.

## References


[1] O. Deutschmann, J.-D. Grunwaldt, Chem. Ing. Tech., 85, 595-617 (**2013**).

[2] A. M. Gänzler, M. Casapu, Philippe Vernoux, Stéphane Loridant, F. J. Cadete Santos Aires, T. Epicier, B. Betz, R. Hoyer, J.-D. Grunwaldt, Angew. Chem. Int. Ed., 56, 13078-13082 (**2017**).

[3] A. M. Gänzler, M. Casapu, F. Maurer, H. Störmer, D. Gerthsen, G. Ferrre, P. Vernoux, B. Bornmann, R. Frahm, V. Murzin, M. Nachtegaal, M. Votsmeier, J.-D.Grunwaldt, ACS Catal., 8, 4800-4811 (**2018**).