



SINCHEM PhD subject

Metal-based structured catalysts for partial oxidation processes

HOME INSTITUTION: Università di Bologna, Bologna, Italy. Supervisors of the PhD student in Bologna Prof. A. Vaccari, Prof. G. Fornasari, Dott. P. Benito

HOST INSTITUTION 1: RWTH Aachen Prof. Regina Palkovits

HOST INSTITUTION 2: Politecnico di Milano (Prof. A. Beretta, Prof. E. Tronconi)

PROJECT DETAILS

Structured catalysts based on catalysts coating 3D ceramic and metallic supports play an important role in process intensification of gas/solid processes. In particular open-pore foams made of metallic materials are suitable for exothermic partial oxidation reactions taking place at short contact times to control the temperature inside the catalytic bed and decrease pressure drop.

The PhD project will be focused on the preparation of structured catalysts consisting of metallic foam supports (FeCrAlloy, Al, Cu) coated with catalysts active in exothermic partial oxidation reactions of CH₄ and others oxidation reactions. The coating will be performed by the “in situ” synthesis of the catalyst or a catalyst precursor on the surface of the support. For comparison purposes some catalysts will be prepared by washcoating of ready-made catalysts. The synthesis conditions will be tailored to control the homogeneity and adherence of the catalytic film. The catalysts will be characterized and tested at **Unibo and Aachen University**. At Aachen University the materials can be additionally investigated in methane partial oxidation, dry reforming and N₂O decomposition with special emphasis on their long-term stability and deactivation behaviour. Additionally, a tailored design of experiment will be carried out to supply appropriate data for a subsequent investigation and mathematical description of mass and heat transfer effects (HOST 2).

HOST 2 – A characterization of the overall performance of the final structured catalyst will be addressed at Polimi; the study will include the characterization of heat and mass transfer, the measure of pressure drop and the testing in an adiabatic reactor for CPO tests with hydrocarbon fuels, equipped with sampling probes for the axially resolved measurements of temperature and concentration profiles under working conditions. Modelling of the reactor will allow to analyze the interplay of surface chemistry and transfer phenomena. (Reference persons will be Prof. A. Beretta, Prof. E. Tronconi)

Relevant Recent References:

1. *Combined use of synchrotron-radiation-based imaging techniques for the characterization of structured catalysts*. F. Basile, P. Benito, S. Bugani, W. De Nolf, G. Fornasari, K. Janssens, L. Morselli, E. Scavetta, D. Tonelli, A. Vaccari, *Advanced Functional Materials* 20 (2010) 4117–4126.



2. *Coating of FeCrAlloy foam with Rh catalysts: Optimization of electrosynthesis parameters and catalyst composition.* P. Benito, M. Monti, I. Bersani, F. Basile, G. Fornasari, E. Scavetta, D. Tonelli, A. Vaccari, *Catalysis Today* 197 (2012) 162–169.

3. *Electrosynthesis of Ni/Al and Mg/Al Layered Double Hydroxides on Pt and FeCrAlloy supports: Study and control of the pH near the electrode surface.* M. Monti, P. Benito, F. Basile, G. Fornasari, M. Gazzano, E. Scavetta, D. Tonelli, A. Vaccari, *Electrochimica Acta* 108 (2013) 596–604.