



SINCHEM PhD subject

“Perovskite catalysts from alternative synthesis routes” (*acronym: PERCATAR*)

HOME INSTITUTION: Ecole Nationale Supérieure de Chimie de Montpellier, Institut Charles Gerhardt Montpellier (ICGM), Montpellier, France; team “Advanced Materials for Catalysis and Healthcare” (Matériaux avancés pour la catalyse et la santé, MACS). Supervisors of the PhD student in Montpellier: Dr. Francesco DI RENZO (direnzo@enscm.fr, www.macs.icgm.fr) and Prof. Werner PAULUS (werner.paulus@um2.fr, ICGM team "Chemistry and Crystallochemistry of Materials", C2M).

HOST INSTITUTION 1: Politecnico di Torino, Department of Applied Science and Technology (Prof. Barbara BONELLI, barbara.bonelli@polito.it).

HOST INSTITUTION 2: Delft University of Technology, ChemE (Dr. Patricia KOOYMAN, P.J.Kooyman@tudelft.nl).

PROJECT DETAILS: Multicomponent oxides with perovskite structure are effective catalysts for several industrial reactions relevant to the valorisation of renewable resources as, *e. g.*, reforming and partial oxydation of biogas, conversion of glycerol, and electrochemical storage of electric energy. The optimisation of the composition of the oxide and the proper multi-scale shaping of the catalyst are key parameters for a successful implementation of the catalyst in a given process.

The objective of the work is to test the activity in heterogeneous catalysis of custom-tailored multicomponent oxide nanoparticles organized in structured porous systems. The PhD work will deal with a combination of innovative methods of elaboration of catalytic materials, characterisation of catalyst surface and reaction systems, and evaluation of the catalyst in appropriate laboratory-scale test reactions.

The ICGM has a significant expertise in the synthesis of mixed oxides by several methods (controlled precipitation, thermal treatment, decomposition of precursor mixed hydroxides or ionotropic polysaccharide gels). Several of these methods present a specificity for the exploration of original compositional domains and allow the control of the size of the oxide nanoparticles and their aggregation in porous self-supported systems. The control of composition and accessibility of the active surface are at the basis of the optimisation of the reaction rate and diffusivity ratios of the catalytic systems.

The elaboration of the mixed oxides will be oriented by a continuous flow of information from the characterisation of the properties of the materials (composition, texture, solid-state behaviour) and from the measurement of the activity as catalysts. The catalytic performances of the materials will be tested on specific reactions and compared to those of reference materials. The research work will imply regular communications between the partner laboratories, to insure a full exploitation of the synergy of their complementary expertises. The ICGM will bring its expertise in the

synthesis of oxides and in the laboratory-scale evaluation of the activity of catalysts. The Politecnico of Torino will bring its expertise in the physico-chemical characterization of the surface of catalyst and of the reaction media, by means of several techniques including FT-IR, Raman and XPS spectroscopies. Delft University will bring its expertise in the advanced characterization of the catalytic materials (*e.g.* by transmission electron microscopy, TEM) to establish structure-activity relationships.

The PhD student will be able to improve his/her expertise in elaboration of dispersed materials, bulk and surface characterization techniques, and catalysis engineering of heterogeneous processes. He/she is expected to spend 21 months in Montpellier, 12 months in Torino and 3 months in Delft.