



SINCHEM 2016 doctoral research subject

Green chemistry on perovskite oxide catalysts (GREENPEROX)

HOME INSTITUTION: Ecole Nationale Supérieure de Chimie de Montpellier (ENSCM), Institut Charles Gerhardt Montpellier (ICGM), Montpellier, France; Supervisors of the PhD student in Montpellier: Dr. Francesco DI RENZO (direnzo@enscm.fr, team "Advanced Materials for Catalysis and Healthcare", MACS) 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 (DISAT) (Prof. Barbara BONELLI, barbara.bonelli@polito.it).

HOST INSTITUTION 2: industrial partner.

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 oxydative depolymerization of biopolymers. 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 ICGM has a significant expertise in the synthesis of mixed oxides by several methods (controlled precipitation, sol-gel, spray-drying pyrolysis, 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 and morphology 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 PhD work will deal with a combination of innovative methods of elaboration of catalytic materials, in-situ characterisation of catalyst surface by several spectroscopic techniques, and evaluation of the catalyst in appropriate laboratory-scale test reactions. The objective of the work is to elaborate custom-tailored multicomponent oxide nanoparticles optimized for the activity in heterogeneous catalysis. 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, oxygen mobility, solid-state behaviour) and from the measurement of their surface reactivity by several spectroscopic methods. 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 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 by the industrial partner.