SINCHEM PhD subject

TITLE: "On the use of polymers and supercritical carbon dioxide for the elaboration of catalytic materials" ***(acronym: SUPERCAT)***

HOME INSTITUTION: **Ecole Nationale Supérieure de Chimie de Montpellier**, Charles Gerhardt Institute (Institut Charles Gerhardt, ICG), Montpellier, France ; team "Macromolecular Engineering & Architectures" (Ingénierie et Architectures Macromoléculaires, IAM). Supervisor of the PhD student in Montpellier: Patrick LACROIX-DESMAZES (polymers & clean processes in supercritical CO_2).

HOST INSTITUTION 1: **University of Nottingham**, United Kingdom. Supervisors of the PhD student in Nottingham: Steven M. HOWDLE (polymers and supercritical CO_2), Martyn POLIAKOFF (catalysis in supercritical CO_2), Michael W. GEORGE (metal complexes and kinetics).

HOST INSTITUTION 2: **Commissariat à l'énergie atomique et aux énergies alternatives** (Alternative Energies and Atomic Energy Commission) (CEA), CEA Marcoule, Bagnols sur Cèze, France. Supervisors of the PhD student at CEA Marcoule: Frédéric CHARTON (Head of the laboratory of supercritical processes and decontamination, LPSD), Audrey HERTZ (MATCOS platform for the synthesis of hybrid materials in supercritical CO_2).

PROJECT DETAILS: The PhD work will deal with the elaboration of composite materials for catalysis. The benefits of using supercritical carbon dioxide as unconventional reaction medium will be explored as a sustainable route to provide well-defined innovative catalytic materials. The topic will thus integrate the research line "Synthesis, materials processing and catalysis in unconventional reaction media" of SINCHEM. It will also be related to macromolecular chemistry, organometallic catalysis, nanoparticle catalysis, noble metals, hybrid materials, supported catalysis, and clean processes. The main objective of the work will be typically to elaborate a supported catalyst composed of a (meso)porous matrix (*e.g.* silica) containing dispersed and confined (organo)metallic catalytic species (*e.g.* palladium nanoparticles). To this aim, smart functional CO_2-soluble amphiphilic and complexing copolymers will be synthesized. The formation of macromolecular organic complexes with metal cations will then be studied in supercritical carbon dioxide. They will then be used as vectors and/or structuring agents into supercritical carbon dioxide to produce (meso)porous materials with metallic precursors. Then, these supported catalysts will be tested in various reactions (including cascade reactions) in supercritical fluids. The main part of the work will be performed in Montpellier (home institution). Nottingham (host institution 1) will bring its complementary expertise on polymers as well as its special expertise on catalysis in supercritical CO_2. CEA Marcoule (host institution 2) will bring its expertise in the development of processes in supercritical fluids at larger scale.