



SINCHEM PhD subject

Industrial application of supercritical carbon dioxide (scCO₂) soluble polymers”

Summary: This project addresses a critical need to make better use of carbon dioxide as an alternative and clean solvent. Carbon capture is now a major global process, and our aim is to make positive use of the captured CO₂ so that it is not just treated as waste. In this project you will achieve this by developing new CO₂-soluble polymers. Until very recently, only fluorocarbon and silicone based polymers showed any significant solubility in scCO₂, but these are expensive and not environmentally acceptable. In this project you will use controlled radical techniques (RAFT) to synthesize new highly soluble hydrocarbon based polymers and then turn these into surfactants and detergents that will work in real chemical processes in scCO₂. At **Nottingham** you will make new polymers, modify their functionality and test their solubility in our unique high pressure reactors. At **Lyon** you will use a wide range of advanced polymerization and end group modification strategies to target new scCO₂ soluble polymers and new applications. Possible target applications in scCO₂ include aqueous emulsions and the development of stabilizers for dispersion polymerisation. The project is strongly linked to industry and will provide you with a unique training opportunity in the vitally important area of Sustainable Industrial Chemistry.

Relevant Recent References:

1. “Synthesis and application of new CO₂ soluble vinyl pivalate hydrocarbon stabilisers via RAFT polymerisation.” Birkin, N. A.; Arrowsmith, N. J.; Park, E. J.; Richez, A. P.; Howdle, S. M., *Polymer Chemistry* **2011**, 2 (6), 1293-1299.
2. “One-Pot Synthesis of Block Copolymers in Supercritical Carbon Dioxide: A Simple Versatile Route to Nanostructured Microparticles” Jennings, J.; Beija, M.; Richez, A. P.; Cooper, S. D.; Mignot, P. E.; Thurecht, K. J.; Jack, K.; Howdle, S. M. *J. Am. Chem. Soc.* **2012**, 4772 – 4781

Supervisor of Thesis: Professor SM Howdle

Location: **The University of Nottingham (UK)**; the School of Chemistry was rated No. 2 in the UK for research quality in the most recent Research Assessment Exercise. Our research group is one of the leading groups for supercritical research in the world; www.nottingham.ac.uk/supercritical.

Partners:

Lyon (France). Full partner. Proposed Co-Supervisors of Thesis: **Dr. Muriel Lansalot and Dr. Franck D'Agosto** – the Lyon group have world leading expertise in RAFT polymerization, both in homogeneous and in dispersed media (*in-situ* synthesis of amphiphilic block copolymers that self-assemble into particles). The work at Lyon will focus on the synthesis of scCO₂ compatible polymers incorporating hydrophilic monomer units to create improved stabilizers for particle synthesis in scCO₂. The incorporation of these hydrophilic units might also lead to polymer particles that can be dispersed in water; a key target for commercial applications.

Synthomer (UK and Germany)- Associate partner candidate. Synthomer is one of the world's major suppliers of latices and speciality emulsion polymers in many markets including coatings, construction, textiles, paper and synthetic latex gloves. Synthomer is committed to developing new chemical processes that will enhance the sustainability of their products; <http://www.synthomer.com>