

Proposed PhD subject in the frame of SINCEM (a proposal to the EU Erasmus Mundus Joint Doctorates EMJD program to create an International joint Doctoral School in Sustainable Industrial Chemistry):

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 polymerizations and end group modification strategies to target new scCO₂ soluble polymers including those formed from CO₂. Possible target applications in scCO₂ include aqueous emulsions and the development of new chelating agents for extraction. 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 and Dr DJ Irvine

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 and has very important and close links with experts in Chemical Engineering.

Partners:

Lyon (France). Full partner. Proposed Co-Supervisors of Thesis: **Dr. Elsje Alessandra Quadrelli** with expertise in CO₂ utilisation and **Prof Bernadette Charleux** – bringing expertise in RAFT polymerization and (mini)emulsions.

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>