



SINCHEM doctoral research subject

Industrial application of CO₂-philic macroRAFT for polymerisation in supercritical carbon dioxide (scCO₂)

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 help us to achieve this by developing new RAFT-synthesized CO₂-soluble polymers. In the presence of added monomer these will initiate a dispersion polymerisation to grow novel block copolymers. A key target will be to add further monomers to create multiblock materials. You will choose carefully the additional monomers and will create a totally new approach to nanostructured block copolymer (micro)particles that will have very interesting potential industrial application. At **Nottingham** you will make new polymers in scCO₂ in our unique high pressure reactors and you will develop the scCO₂ reaction conditions to modify the structures that can be achieved. At **Lyon** you will use a wide range of advanced polymerization and end group modification strategies to synthesise new scCO₂ soluble macroRAFT agents starting with silicones but also developing other approaches. The project is strongly linked to industry and will provide you with the opportunity to carry out applications testing at **Kaneka**. All of this provides a unique training opportunity in the vitally important area of Sustainable Industrial Chemistry.

Relevant Recent References:

1. 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
2. McAllister, T. D., Farrand, L. D., & Howdle, S. M. *Macromolecular Chemistry and Physics*, **2016**. doi: 10.1002/macp.201600131
3. Lesage de la Haye, J.; Zhang, X.; Chaduc, I.; Brunel, F.; Lansalot, M.; D'Agosto, F. *Angew. Chem. Int. Ed.* **2016**, 55, 3739 –3743
4. Velasquez, E.; Rieger, J.; Steofflebach, F.; D'Agosto, F.; Lansalot, M.; Dufils, P-E.; Vinas, J. *Polymer* **2016**, dx.doi.org/10.1016/j.polymer.2016.08.083

Supervisor of Thesis: **Professor SM Howdle**

Location: **The University of Nottingham (UK)**; the School of Chemistry is an internationally acclaimed centre of expertise in sustainable chemistry and our research group is one of the world leaders in exploiting supercritical fluids <http://www.nottingham.ac.uk/research/groups/polymers-and-supercritical-fluids/index.aspx>

Partners:

Lyon (France). Full partner. Co-Supervisors of Thesis: **Drs. Muriel Lansalot and 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). Your work at Lyon will focus on the synthesis and characterization of scCO₂ compatible macroRAFT that will be used in the high pressure experiments. <http://www.c2p2-cpe.com/index.php>

Kaneka (Belgium). Associate partner candidate. An innovative company focused upon high performance polymers and sustainable products for a wide range of industrial sectors and applications. <http://www.kaneka.be/>