

SINCHEM 2016 doctoral research subject

Novel Renewable Polymers from Natural Terpenes

PROJECT DETAILS: This project will focus on solving a major issue for our society. Most of the polymers we consume are derived from oil, but society increasingly requires that more and more of our consumable items are derived from natural resources or are carbon neutral. But new monomers and polymers we create must also provide matching or improved properties and performance, and all without any significant increase in costs. Up till now, renewable polymers have generally shown poor performance. So, where will these new monomers and polymers come from?

One potential source of renewable monomers is the terpenes, the most common of which are derived from citrus (eg. d-limonene) and wood waste (eg. the α - and β -pinenes) and are already available on the multi-tonne scale. Recently we have created a range of new terpene derived acrylate and methacrylate monomers and shown that they can easily be converted into simple polymers. These materials are 100% sourced from renewable materials and are very attractive to industry. The challenge in this project will be for you to make and exploit these new monomers with more complex polymer chemistry to create a range of copolymers, telechelic and multifunctional materials and to understand their potential for applications that are industrially relevant.

The Green credentials of our project are further strengthened by our use of supercritical carbon dioxide as a unique and clean solvent medium that can eliminate toxic residues and provides opportunities to create new and unique polymeric materials. The project will be hosted in Nottingham with important input from Bologna to explore the new monomers, polymers and cross-linkers that we can make and to characterize materials properties. Moreover we will work closely with Synthomer who have extensive interests in the development of new sustainable monomers and polymers and their commercialisation.

Supervisor of Thesis: **Professor SM Howdle**

The University of Nottingham (UK); the School of Chemistry is one of the leading UK research centres. Our research group has significant expertise in both polymer synthesis and polymer processing and the use of supercritical fluids. We will give you a wide range of valuable skills and experience in polymers including synthesis, characterization and applications as well as the opportunity to learn high pressure supercritical fluid technologies.

www.nottingham.ac.uk/supercritical.

Partners:

Bologna (Italy). Full partner. Proposed Co-Supervisor of Thesis: **Prof. Mariastella Scandola** The Bologna group has significant experience in the use of polymers for fine control of materials properties with applications from medical materials and biocatalysis through to composites. In addition, Bologna has access to all the equipment needed for the detailed characterization of our new materials. The work at Bologna will focus on the exploration of new polymers with new materials properties and in particular will emphasize the renewable nature of the monomers and polymers that you will make. <http://www.ciam.unibo.it/polymers>

Synthomer (UK) - Associate partner candidate. Synthomer is an important industrial partner and one of the world's major suppliers of latices and speciality emulsion polymers for many market segments including coatings, construction, textiles, paper and synthetic latex gloves. Synthomer has



Two of the terpene polymers we have created so far - very different glass transition temperatures are observed for the acrylates (left) and methacrylates (right) of α -pinene



strong interests in the development of new green monomers and polymers and can provide real industrial application test expertise for our new candidate molecules. <http://www.synthomer.com/>