Centre for Sustainable Chemical Technologies

UNIVERSITY OF BATH

Centre for Sustainable Chemical Technologies; University of Bath

Project Title:	Sequence Control via Selective Polymerization Catalysis to Tune the Degradation Properties of Poly(lactic acid), PLA
Lead Supervisor and co-supervisors:	Professor Matthew Davidson (Lead Supervisor), Professor Antoine Buchard (Co-supervisor) and Dr Gerrit Gobius du Sart (Industrial Supervisor)
Industrial Partner:	Total Corbion PLA bv

Project Summary

Background: Poly(lactic acid) (PLA) is the most promising commercially viable bio-based polymer and it is produced at a significant scale via the ring-opening polymerization (ROP) of lactide (LA), for example at Total Corbion's new 75 ktpa facility in Thailand. In addition to commodity applications in packaging, fibres, consumer goods, etc., LA can be copolymerized with other cyclic esters.

We have recently shown that zirconium amine(trisphenolate) catalysts are competitive with commercial catalysts for production of PLLA but, in addition, offer the possibility of sequence control through both stereoselective monomer enchainment of LA monomers and chemoselective monomer enchainment of mixed cyclic esters. For example, polymerization of rac-LA yields highly hetrotactically enriched PLA.

Project Outline: In this project we propose to exploit the selectivity of these Zr-based catalysts to control monomer sequence in predominantly L-LA copolymers in order to tune the physical and mechanical properties of commercial bio-based plastics to enhance end-of-life options through recycling and/or degradation. For example, controlled introduction of non PLA blocks in PLLA should allow control over degradation and barrier properties.

Throughout, we will focus on copolymerisation kinetics in solution and in the melt phase (NMR, FTIR), copolymer structure (NMR, mass spec, GPC, XRPD, SAXS), and physical and mechanical properties (DSC, DMA, TGA). For promising materials we will also investigate important properties such as degradation rates and gas permeability.

Sustainability issues addressed

This project aims to improve the physical and mechanical properties of commercial bio-based plastics to enhance end-of-life options through recycling and/or degradation.