Centre for **Sustainable** Chemical Technologies

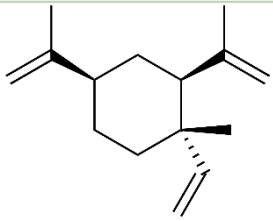
MONASH University

UNIVERSITY OF BATH

Bath Monash Global PhD Programme in Sustainable Chemical Technologies

Project Title:	β-elemene as facile building block in sustainable polymer synthesis
Supervisor at Bath: Supervisor at Monash:	Professor Matthew Davidson Professor Tanja Junkers
Home Institution:	Monash University
Indicative period at Host Institution:	12 months with exact dates to be confirmed

Project Summary



A switch from oil-based to bio-based monomers for polymer synthesis is a necessity to reach more sustainable solutions in materials development. Within this realm, especially esters and amides have found large interest due to their comparatively simple mode of polymerizations, and due to the abundance of the required functional groups in biological feedstocks. Compounds that feature unsaturations are, however, also of high interest, since they open avenues towards radical (polymerization) reactions. A basis for research can here be found in β-elemene (see structure), which features three vinyl groups with distinct chemical reactivity. While not directly polymerizable, ββelemene can be used in a variety of ways. On one hand it can serve as a crosslinker in thiol-ene reactions, and hence has the potential to replace pentaerithritol-based compounds that are classically used for this purpose. In the Monash research group, the reactivity of β-elemene with multifunctional polymer thiols will be evaluated for their use in polymer microbead synthesis. This pathway is highly attractive as it does not require any chemical modification of the natural compound before crosslinking. Also, the distinct difference between the two different vinyl groups can potentially be used to employ β-elemene as an asymmetric core for miktoarm -star polymer synthesis.

Further, the group in Bath has demonstrated that the vinyl groups can be selectively epoxidized. This opens further pathways towards functional polymers. Here, the epoxides will be ring-opened to increase the functionality of the monomer. The resulting (multi)ols can then be converted into (meth)acrylates via continuous flow processes used at Monash. (Co)Polymerization of the resulting monomers will allow to form either complex crosslinked materials, i.e. hydrogels and hyperbranched polymers, or linear polymers with pendant vinyl groups that can be used for on-demand post-polymerization modification.

The above described variety of polymer materials will be targeted, and materials made thereof be thoroughly investigated towards their thermal and mechanical properties. The most promising materials will be scaled in continuous flow reactors to cover as well sustainable resources, as well as green processing strategies. The PhD student will develop skills in monomer and polymers synthesis and characterisation, in flow chemistry and materials characterisation. Initial work to develop polymerization routes for β-elemene will be carried out at Monash (Year 1). Materials will then be further tested and new monomers prepared in Bath (Year 2). Further design, synthesis, characterisation and testing of appropriate materials (Year 3) will be carried out in Monash with input from and trips to Bath as appropriate.