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Lipase Catalysed Synthesis of Functional Renewable Polyesters in Supercritical CO_2

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Supercritical CO_2 ($scCO_2$) has been the focus of much research as potential replacement for conventional solvents in polymerisation reactions. The attention has been mainly focused on free radical polymerisation [1], but more recently enzyme catalysed polymerisations have also been reported [2].
At the same time, the use of renewable natural monomers is one of the most important topics in modern polymer science. Different sources ranging from trees, plants and algae could be exploited to extract from them the monomer materials required to prepare novel renewable polymers [3].
In this study we have investigated the synthesis in $scCO_2$ of renewable polyesters, starting from monomers extracted from the outer birch bark.
About 40% of dry birch bark is composed of *suberin*: a macromolecular network consisting of cross-linked aliphatic and aromatic molecules, which can be deconstructed to obtain long carbon chain monomers with varying structures [4].
The most abundant monomer is the *cis-9,10-epoxy-18-hydroxyoctadecanoic acid* (EFA), which can be polymerised giving a polyester with epoxy functionalities.
The two reactive end groups give us the possibility of preparing polyesters by polycondensations, but side reactions do occur when working in bulk. While using solvents, high molecular weights are difficult to achieve even after 48 hours [5].
In this paper we probe the use of $scCO_2$ to investigate whether it is possible to prepare higher molecular weights, use shorter reaction times and also to preserve the epoxy groups that can be subsequently exploited for further functionalisation or cross-linking.

References

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