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Enzymatic polymerization of bio-based monomers for applications in hydrogels and coatings

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Enzymatic polymerization has been gradually building up during the last 30 years as an alternative to classical polyesterificaiton processes, which permits preparation of polyesters under more benign conditions with high selectivity[1]. In particular, the high selectivity is an interesting property of the enzymatic catalysts that can provide control over polymer structure in functional polymers.
Lipase catalyzed polymerizations (specifically CALB) has been applied to prepare functional polyesters and to evaluate the possibilities of using less stable bio-based monomers such as itaconic acid or its derivatives. Through variation of starting materials, several different functional polyesters have been prepared with the purpose of exploiting the selectivity of the enzymes to prepare polyesters with a controlled degree of branching. Branched polyesters find application in coatings and some of the prepared systems will be discussed in relation to alkyd coatings.
By combination with longer chain water soluble polymers such as PEGs it is also possible to prepare water soluble polyesters with some control over the endgroup structure. In combination with different carboxylic acids, functional polyesters based on PEG have been prepared and functionalized through aza-michael additions as well as through thiol-ene chemistry[2]. Thereby the enzymatically prepared polymer backbone can be considered a scaffold for functional water soluble materials. Finally, these polymers have been applied for preparation of hydrogels, aiming at the potential use of these materials in drug delivery.

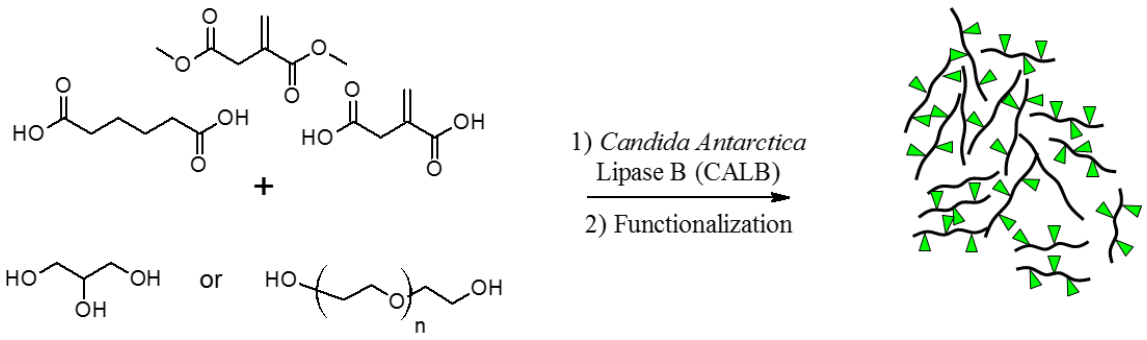

Figure 1: Investigation of the possibilities of enzymatic polymerization of functional monomers in different combinations with respect to both functionality of polymers and selectivity during the polymerization.

References

(1) Gross, R. A.; Kumar, A.; Kalra, B. *Chem. Rev.* **2001**, *101*, 2097.
(2) Hoffmann, C.; Stuparu, M. C.; Daugaard, A.; Khan, A. *J. Polym. Sci. Part A Polym. Chem.* **2015**, *53*, 745.