Bio-based polyester resins with stimuli-responsive reversible crosslinks for improved circularity

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This project aims at developing bio-based unsaturated polyester resins displaying improved circularity. The last decade has seen the emergence of various strategies to improve or facilitate the end-of-life management of thermoset polyesters. Among these strategies, the introduction of stimuli-responsive components into the polymer chain backbone or network is particularly interesting for obtaining materials with switchable properties and, in particular, the ability to be crosslinked and de-crosslinked at will. This approach will be followed by combining the use of selective enzymatic catalysis and reversible UV-induced [2+2] cycloaddition to develop new biosourced unsaturated polyester resins with reversible and stimuli-responsive crosslinks (cyclobutane rings) allowing the material to be reshaped or recycled [1-5].

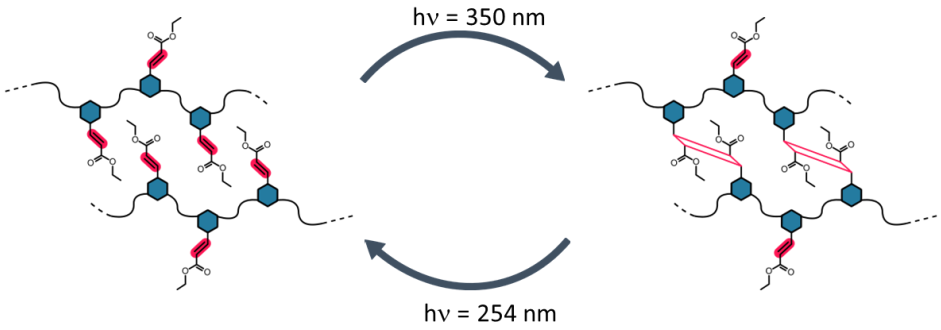

Figure 1: Schematic representation of the main strategy to obtain biobased unsaturated polyester resins containing reversible crosslinks for improved recyclability.

The objective of the thesis will consist in developping enzyme-catalyzed synthesis of polyesters from hydroxycinnamic acids derivatives that can further undergo a photo-induced [2+2] cycloaddition resulting in the material crosslinking known to be reversible thanks to the breakage of the cyclobutane rings induced by an external stimulus (temperature, light or mechanical stress). The expertise of our group in the field of enzymatical and chemical synthesis of bio-based polyesters will allow us to develop efficient synthetic pathways to obtain such innovative macromolecular architectures paving the way for enhanced circularity and recyclability of unsaturated thermosetting polyester resins.

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