MacroLemon

Design and Scale Up of Biobased Functionalized Polycarbonates for Adhesive and Coating Applications

Timeline | 12/2021 to 11/2023

Budget | 120,750 €

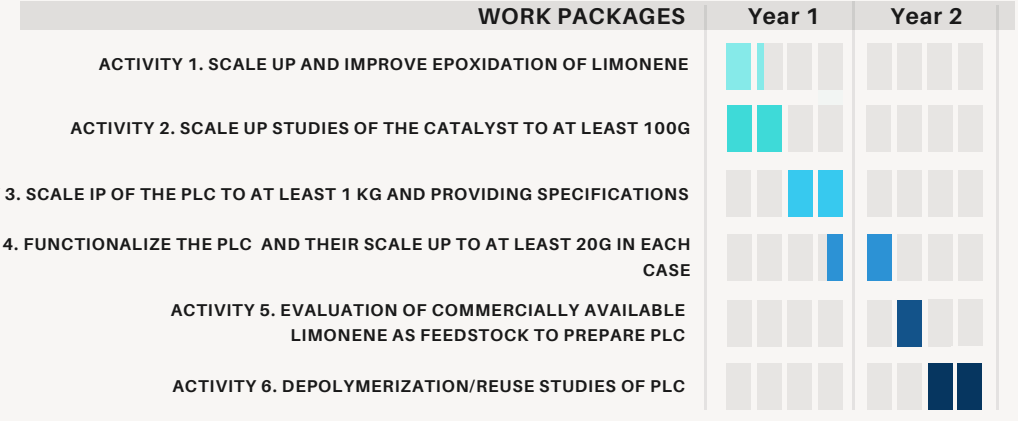
ICIQ People | A. Kleij Research Group

Call | Pruebas de Concepto 2021

SUMMARY

In this project the use of a bio-polycarbonate (poly(limonene)carbonate, PLC) is investigated in the synthesis of new biobased materials with a focus on resins and adhesives and their implementation in an industrial environment to advance the production of more sustainable functional materials and products. Various aspects of this process that produces PLC require optimization, and among them is the development of a reproducible scale up of the epoxide monomer (limonene oxide), the metal catalyst that was previously developed by the Kleij group at ICIQ (Tarragona), and the PLC itself to quantities of at least 1 kilogram. In addition to these scale-up activities, the project foresees to offer two samples of functionalized PLC: one type that incorporates alkyl thiol groups that have value in curing processes when combined with epoxies or compounds that contain double bonds, the other type will be equipped with epoxy groups that are also useful for curing and/or polymer post-modifications. The two functional PLC polymers will be examined in industry to reveal their potential as bioalternatives for existing resins and adhesives made from petroleum based resources. Another critical point is the valorization of commercial limonene sold by various companies at ton scale. This technical grade limonene typically contains around 90% of limonene. Once the PLC upscale is completed and optimized, we will scrutinize the use of technical grade limonene in the synthesis of PLC with physical properties similar to the material obtained from pure limonene. Finally, efforts to recycle polymers are gaining importance and its relevance increases continuously to repurpose the massive plastic waste stream on a global level. This project will thus investigate the reuse of PLC by a controlled and selective depolymerization process using organocatalysis as primary technology thereby regenerating the monomers limonene oxide and carbon dioxide. In addition, the preliminary observation of the intermediacy of a trans cyclic carbonate is motivation to study a controlled depolymerization towards this product as it can allow to recycle all atoms present in PLC through successive cycles of copolymerization (ROCOP), and depolymerization followed by ROP. The overarching objective is to advance the current TRL status from 4 to 6, meaning a demonstration of our PLC technology in a relevant industrial setting.

WORK PLAN



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