Renewable and Repairable Coating Design with Debonding on Demand

HyBRIt research group - Biopolymer and Recycling Innovation

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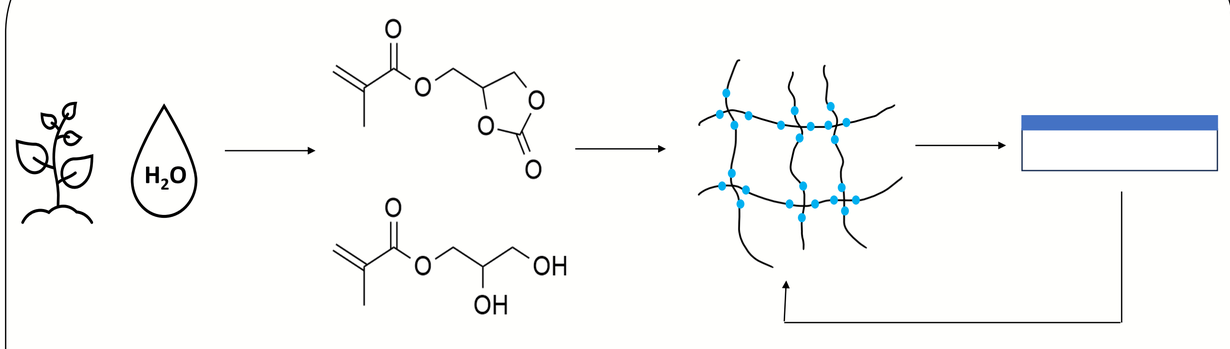
Background

- Coatings and adhesives hinder plastic recycling due to difficult and energy-intensive substrate removal, reducing overall recyclability. [1,2]
- Vitrimers are polymers with covalent adaptable networks that undergo bond exchange uniformly across temperatures. [3]
- This project aims to develop sustainable vitrimer-based coatings, relying on transesterification reactions, that can be cleanly removed from substrates.
- Renewable, biomass-derived carbon sources and solvent-free photopolymerization will be used for direct substrate application.

Overview

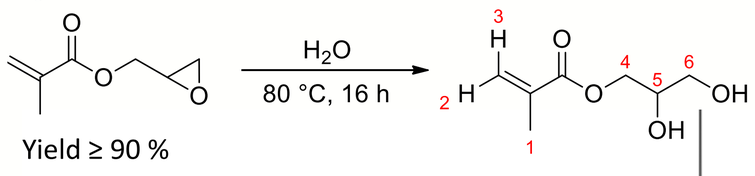


Biomass & Renewable Resources

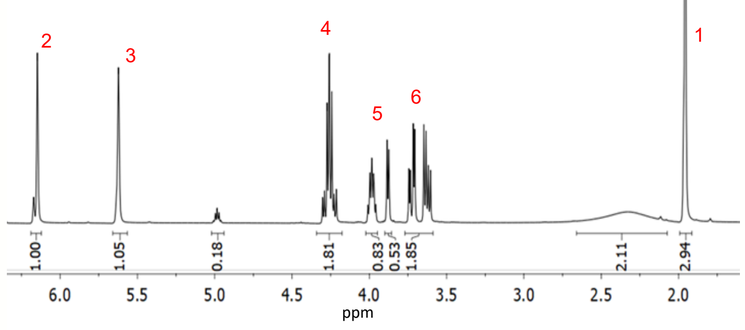
Functional Monomers

Removable and Recyclable Coatings from Vitrimers

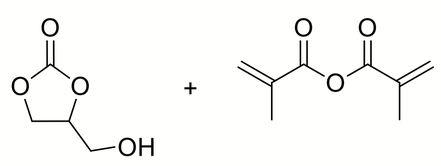
Synthesis of Functional Monomers



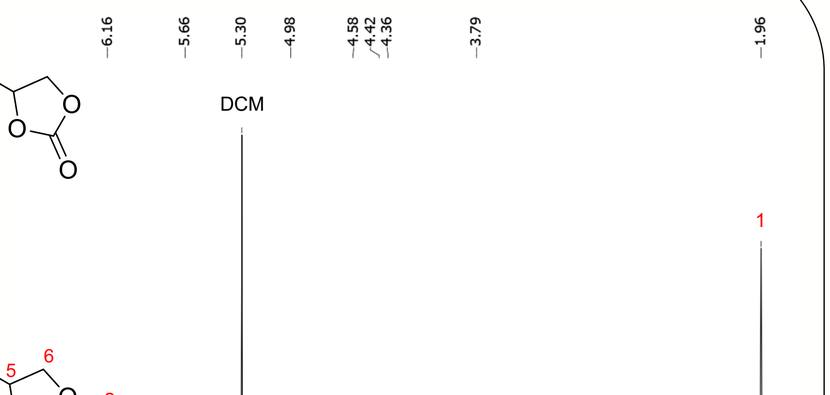
Yield ≥ 90 %



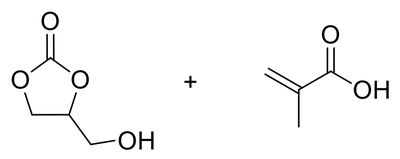
Methacrylation



Yield ≈ 10-20 %

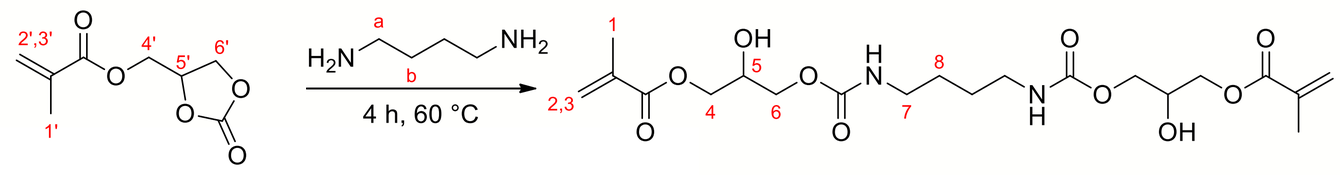


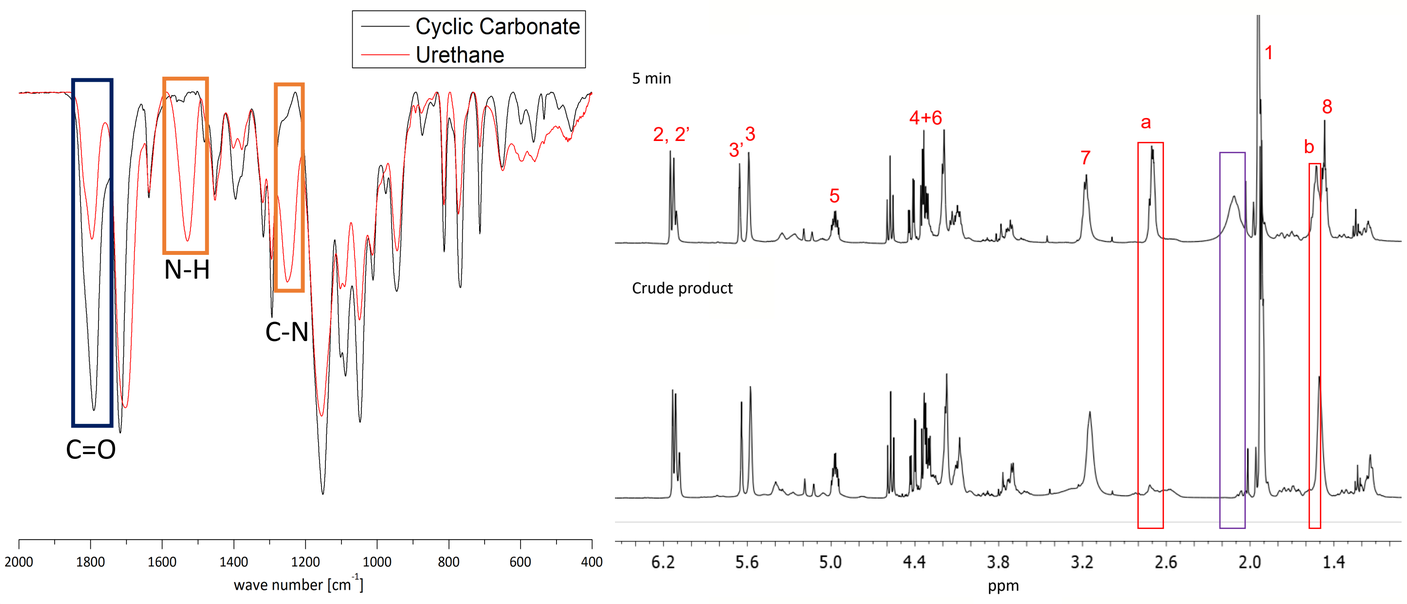
Steglich-Esterification



Yield ≈ 60-70 %

Aminolysis

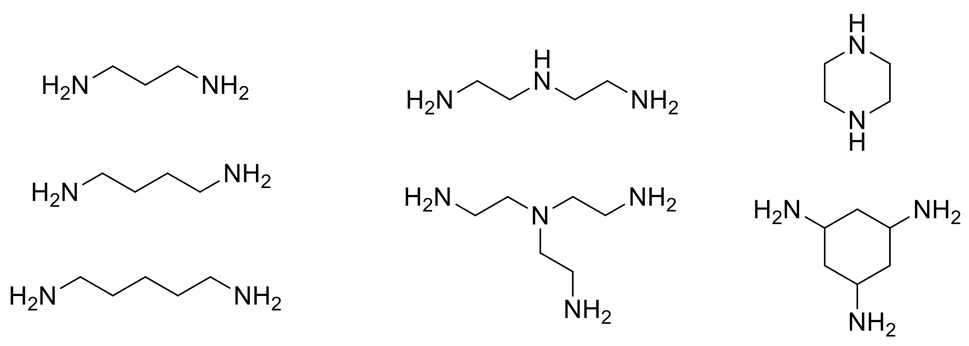




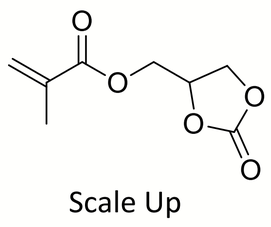
Bulk synthesis, Conversion ≈ 70 %

Workup / Purification to be conducted

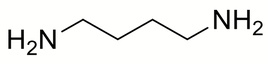
Possible linker structures:



Outlook



Scale Up
100 g



Purification Method
Different linkers

Development of UV-curable, reprocessable solutions

References & Acknowledgement

1. Bryan D. Vogt, Kristoffer K. Stokes, and Sanat K. Kumar; *ACS Applied Polymer Materials,* **2021** *3* (9), 4325-4346; DOI: 10.1021/acsapm.1c00648
2. Jung, H. et al., *Chemosphere*, **2023**, 138089 https://doi.org/10.1016/j.chemosphere.2023.138089
3. Denissen, W., Winne, J. M. & Du Prez, F. E.; *Chem. Sci.*, **2016**, 7, 30-38 https://doi.org/10.1039/c5sc02223a

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