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Ph.D. thesis (2020-2023)
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New thermo/photo reversible prepolymers for LDM Manufacturing

Nouveau prépolymère thermo/photo réversible pour l'impression 3D en phase liquide.

FunPrint

Context / Objectives

Material

Biobased prepolymers.

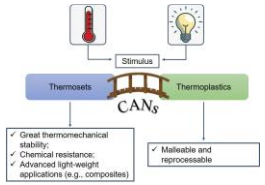
- From non-edible biomass.
- Reinforced with cellulosic material.

Cashew Nutshell

Process

3D Printing process

- Liquid Deposition Modelling.

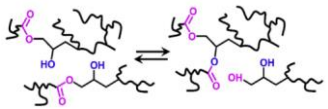


Covalent Adaptable Networks (1)

Recycling

Vitrimer or CAN technology

- Reversible crosslinking – bridge between thermosets and thermoplastics.
- Recyclability and reuse.



Dynamic transesterification reaction (2)

Possible application of CANs

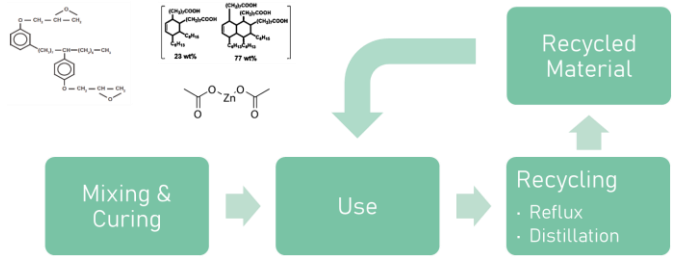
Funded by: Fondazione Compagnia di San Paolo

Fondazione Compagnia di SanPaolo

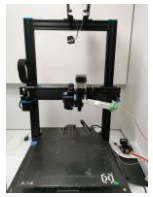
(1) Alabiso et Schlögl, 2020. "The impact of vitrimers on the industry of the future: chemistry, properties and sustainable forward-looking applications.
(2) Liu et al, 2020. "Recent development of repairable, malleable and recyclable thermosetting polymers through dynamic transesterification."

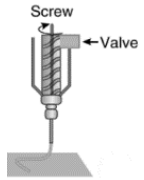
Methods

Material formulation



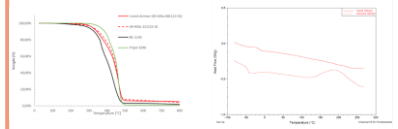
3D Printing by Liquid Deposition Modelling (LDM).



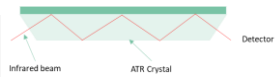


Screw-extrusion printer (3)

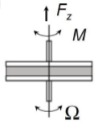
Characterization



Thermomechanical properties (TGA and DSC)



ATR Spectroscopy

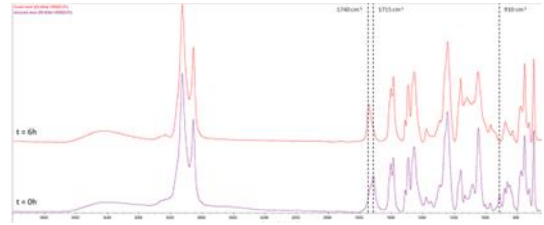


*Rotational **Rheometer***

(3) Murphy et Atala, 2014. "Bioprinting of tissues and organs."

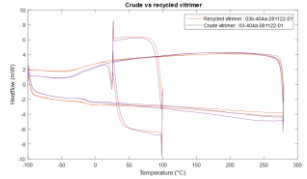
Results

Material production & recycling



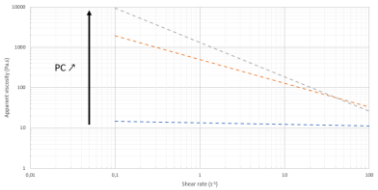
Epoxy consumption + ester formation → *Cured and possible transesterification*

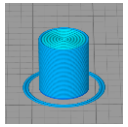
Crude vitrimer (top) & recycled vitrimer (bottom)



Similar thermomechanical properties after recycling

3D Printing





Shear Thinning behaviour ⇒ Printable