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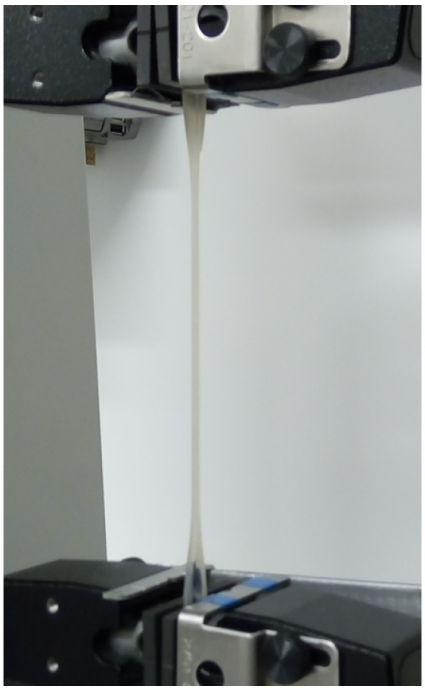
Recyclable elastomeric polylactic acid and ferulic acid derivatives based composites for biomedical and textile applications

AUTHORS
Antoine GALLOS / URD ABI - AGROPARISTECH, 3 RUE DES ROUGES TERRES, POMACLE

PURPOSE OF THE ABSTRACT

Poly-L,L-lactide (PLA) is one of the most famous "bioplastics" catching attention over last decades. Many efforts were given to soften PLA, to improve its flexibility and to reduce its brittleness. The best results were obtained with reactive processes and covalent bonding between additives and the polymeric matrix. Non-covalent approaches often the time led to mitigated properties [1]. In this work, we turned a commercial PLA into an elastomeric material by a simple melt blending with a non-reactive biobased additive [1, 2]. The resulting material exhibit interesting properties such as shape-memory behavior and elasticity over 400% elongation with fully preserved transparency across visible wavelengths. We investigated the structure using both experimental and modeling approaches. It appears that the cohesion in the blend is ensured by non-covalent interactions only [2, 3]. Such "non-covalent reticulation" makes these blends suitable to be reprocessed with others additives or reinforced with organic or inorganic loads to serve as alternatives for thermoplastic polyurethane (TPU) for composites applications. A shape-memory composite with bio-resorption ability designed for the regeneration of bone defect is currently under development. Another promising application is the development of alternatives to leather for textile applications, where the elastomeric PLA is filled with inorganic pigment and deposited on a fabric using a calendering process. A chemical recycling process was investigated to ensure the sustainability of such materials. The recycling process allows to separate and to recover inorganic fillers, hydrogenated ferulic acid and lactic acid.

FIGURES



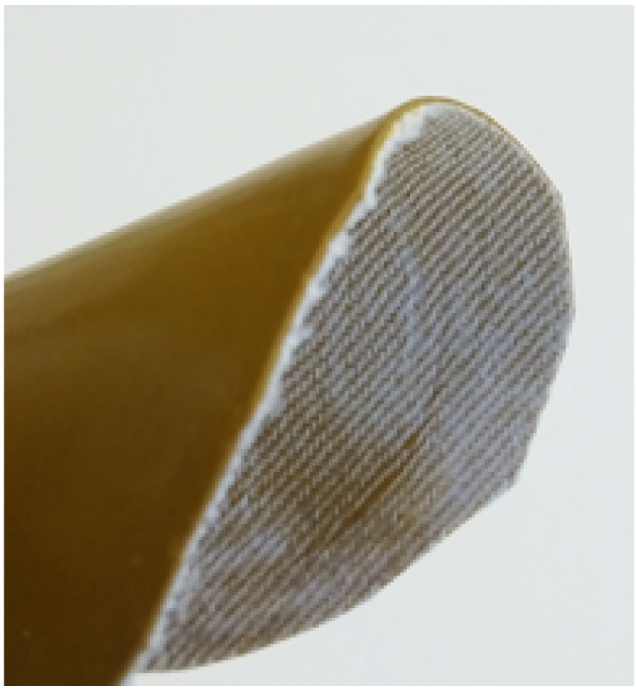


FIGURE 1

Tensile testing of elastomeric PLA

A tensile test specimen of elastomeric PLA (a commercial grade of PLA blended with a ferulic acid derivative) was clamped for a tensile test experiment showing a longitudinal deformation up to 400%. As can be seen on the figure, the whole specimen is defo

FIGURE 2

Sample of alternative to leather made with elastomeric PLA

The alternative to leather was made with elastomeric PLA (commercial grade of PLA blended with ferulic acid derivative) filled with mineal pigment (Sienna) and deposited on a fabric.

KEYWORDS

Polylactic acid | biocomposite | elastomer | chemical recycling

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