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Novel bio-based elastomeric polymer based on semi-interpenetrating poly(3-hydroxyalkanoate)s and sunflower oil using a trithiol as crosslinking agent

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Poly(3-hydroxyalkanoate)s (PHAs), have been suggested as green substitutes to replace petroleum-based commodity polymer because of their biodegradability, biocompatibility and versatility. Although PHAs are very promising material in the field of eco-friendly plastics, their intrinsic brittleness and narrow processing temperature window limit their range of application. As a consequence, many attempts have been made to develop PHA with better mechanical and thermal properties. In recent years, much attention has been focused on the development of polymeric materials from vegetable oils, a sustainable resource. Their competitive cost, worldwide availability and built-in functionality (ester functions and in saturations) make them attractive to reinforce various types of polymers. In this study, we reported a unique approach to toughen PHAs by increasing their elongation at break and enhancing their thermal stability using sunflower oil (SO). The strategy consisted of synthesis of a bio-based semi-interpenetrating (semi-IPNs) network by crosslinking sunflower oil and triméthylolpropane tris(3-mercaptopropionate), a trithiol using "click" thiol-ene reactions into linear PHA polymer matrix. This functionalization process that is characterized by high yields, high reaction rate and short reaction time was initiated photochemically by ultraviolet light in the presence of a photoinitiator 2,2-diméthoxy-2-phénylacétophénone (DMPA). The resulting semi-IPNs PHA/SO exhibited excellent flexibility and showed relatively good thermal stability. Mechanical analysis results have shown that semi-IPNs with 30 wt% of cross-linked sunflower oil displayed excellent properties with an increase of the elastic modulus (170%) as compared to pristine PHA (7%). Moreover, it has been demonstrated that the thermal stability of the semi-IPNs increased by incorporation sunflower oil into PHA matrix. Moreover, a single glass transition temperature for the semi-IPN containing sunflower oil up to 30% was observed with dynamic mechanical analysis (DMA), which suggested good compatibility between sunflower oil and PHA in the network.

Biography

Carine Mangeon is pursuing her PhD at the East Paris Institute of Chemistry and Materials Science, Thiais, France, since September 2014. Her scientist research deals with the development of new bio-based polymeric materials. The main goal of her study consists in developing and improving the properties of polyhydroxyalkanotaes (PHA) produced from bacterial strains in order to enhance their thermal and mechanical properties. She has published two patents and one publication in this research field.

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