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Self-Reinforced PLA Composites: Bio-based and Biodegradable Polymer Materials for Industrial Applications

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Since their introduction, plastic materials have changed completely our lifestyle, and nowadays the contemporary society strongly relies on these materials. The utilization of plastic materials must however be considered in relation to their environmental impact. Plastic feedstocks are directly related to petroleum resources, and after their use, plastic products end their life in landfills or they are burned in incinerators. The need in society for separation from petroleum resources, and the concern about waste disposal issues and global climate changes, have forced industry to start thinking about new solutions. A possible solution is represented by bio-based and biodegradable polymer materials. One of the most promising bio-based polymer is poly-lactic acid (PLA). PLA presents, however, two drawbacks that have limited its use in the industry: its relative low maximum utilization temperature, and its relative large brittleness. It is possible to resolve both these drawbacks through the design of so-called self-reinforced PLA composites, which are composites with PLA reinforcement fibers in a PLA matrix. Self-reinforced PLA composites are currently being investigated in the Bio4Self project, a Horizon 2020 project funded by the European Commission.

Self-reinforced polymer composites are composites where the reinforcement fibers and matrix are made by the same polymer (or by polymers belonging to the same family); this characteristic brings many advantages, such as the possibility to create perfect interfaces between fibers and matrix, and easy recycling of products via re-melting. The better properties of the reinforcement fibers are achieved through an alignment of the polymer chain molecular structure, which however must not be affected during composite processing, where fibers and matrix are heated up to melt the matrix.

A MSc student project within Bio4Self deals with processing and characterization of self-reinforced PLA composites. The mechanical properties of the PLA fibers are characterized and analyzed, and the processing of the composites is studied by investigating the effect on the mechanical properties of the composites.