Degradation of rPLA With the Non-Metal Catalyst (PLADEG) and Its Application in Vitrimer Synthesis

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PLA, largely derived from bio-renewable resources, is one of the most widely used bioplastics. With its biodegradability, low price and superior mechanical properties, PLA has been widely applied to daily goods. However, the rate of biodegradation is much slower than that of increasing production. Therefore, we foresee that the accumulation of PLA wastes can soon become an environmental issue. In order to address this concern, the chemical recycling of rPLA (recycled-PLA) would be an ideal solution because it can maintain the value and usefulness of PLA wastes. Herein, we investigate an eco-friendly process of recycling and upcyling rPLA. With our non-metal catalyst, PLADEG, PLA is degraded into lactate diol within 15 minutes under 150°C. Subsequently, lactate diol is utilized for upcycling process to synthesize vitrimers. Vitrimers are a new class of plastics that combine the advantageous features of thermoplastics and thermosets. Therefore, transforming PLA into vitrimers create functional materials with appealing mechanical properties and higher commercial value. Our vitrimers are prepared by the condensation polymerization in a reaction mixture of lactate diol, succinic acid and pentaerythritol. In some cases, the initial product will undergo chain extension using hexamethylene diisocyanate to increase the molecular weight of the prepolymers. The synthesized polymers are engineered using heat press method to yield polylactide vitrimers. In summary, our research achieve three goals: reducing the environmental loading of PLA wastes, adding value to rPLA, and elongating the lifecycle of PLA wastes.

Awards Won:
Third Award of $1,000