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Solid-state modification of poly(butylene terephthalate) with a photoreactive Cinnamamide monomer

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For the past 70 years, the ubiquity of plastics have revolutionized modern life. However, the wastes associated with these materials pose a persistent pressing energy and environmental challenge to science and industry [1]. To date, recycling and reuse is currently the most efficient approach to reduce plastic wastes but encounters significant drawbacks such as degradation, energy-intensive, selectivity and cost [1]-[3]. In this project, we propose to redesign post-consumer polyesters wastes and give them a second life with enhanced properties through an innovative and alternative upcycling approach implemented via solid-state modification (SSM). At first, the feasibility of the SSM between poly(butylene terephthalate) (PBT), a polyester and N,N-Bis(2-hydroxyethyl) Cinnamamide (BHECA) was demonstrated via differential scanning calorimetry (DSC) at a small scale. At the second step, the reaction conditions were then transferred to a gram-scale batch reactor with inherent enhanced mass and heat transfer processes compared to DSC, in order to further improve material properties. Interestingly, DSC and ^{1}H NMR of the synthesized copolyester via batch reactor revealed increased glass transition temperature (T_g) and demonstrated that exchange reactions between PBT and BHECA occurs and takes places with both the trans and cis conformation of BHECA but in majority with the cis moiety (61%).