SYNERGISTIC ENZYME MIXTURES TO REALIZE NEAR-COMPLETE DEPOLYMERIZATION IN BLENDS

Tech ID: 32525 / UC Case 2022-027-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	12,559,604	02/24/2026	2022-027

BRIEF DESCRIPTION

In this technology, the inventors introduce additives to purposely change the morphology of polycaprolactone (PCL) by increasing the bending and twisting of crystalline lamellae. These morphological changes immobilize chain-ends preferentially at the crystalline/amorphous interfaces and limit chain-end accessibility by the embedded processive enzyme. This chain end redistribution reduces the polymer-to-monomer conversion from >95% to less than 50%, causing formation of highly crystalline plastic pieces including microplastics.

By synergizing both random chain scission and processive depolymerization, it is feasible to navigate morphological changes in polymer/additive blends and to achieve near complete depolymerization. The random scission enzymes in the amorphous domains create new chain ends that are subsequently bound and depolymerized by processive enzymes. Present studies further highlight the importance to consider host polymer morphological effects on the reactions catalyzed by embedded catalytic species.

This is part of a patent family in compostable plastics.

SUGGESTED USES

Returning plastics back to small molecules generates value-added by-products that can be used for chemical feedstocks and/or microbial metabolization.

ADVANTAGES

Embedding catalysts inside of plastics affords accelerated chemical modification with programmable latency and pathways. Nanoscopically embedded enzymes can lead to near complete degradation of polyesters via chain-end mediated processive depolymerization. The overall degradation rate and pathways have a strong dependence on the morphology of semi-crystalline polyesters. Yet, most studies to date focus on pristine polymers instead of mixtures with additives and other components despite their nearly universal uses in plastic production.

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Bioactive Plastics With Programmable Degradation And Microplastic Elimination
- Near Complete Depolymerization Of Polyesters With Nano-Dispersed Enzymes
- Self-Assembled Concentric Nanoparticle Rings To Generate Orbital Angular Momentum
- Thermal Stabilization Of Embedded Proteins

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OTHER INFORMATION

KEYWORDS

compostable, plastic, polycaprolactone, polymer to monomer

CATEGORIZED AS

» **Agriculture & Animal Science**
» Chemicals
» Nutraceuticals
» **Environment**
» Other
» **Materials & Chemicals**
» Polymers

RELATED CASES

2022-027-0

- Population-Based Heteropolymer Design To Mimic Protein Mixtures In Biological Fluids
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