BIOACTIVE PLASTICS WITH PROGRAMMABLE DEGRADATION AND MICROPLASTIC ELIMINATION

Tech ID: 31769 / UC Case 2020-075-0

PATENT STATUS

Country	Type	Number	Dated	Case
Canada	Issued Patent	3,165,579	01/27/2026	2020-075
Germany	Issued Patent	60 2021 044 113.4	12/10/2025	2020-075
European Patent Office	Issued Patent	EP4084830	12/10/2025	2020-075
France	Issued Patent	EP4084830	12/10/2025	2020-075
United Kingdom	Issued Patent	EP4084830	12/10/2025	2020-075
Japan	Issued Patent	7702151	06/25/2025	2020-075
United States Of America	Issued Patent	12,281,208	04/22/2025	2020-075
China	Issued Patent	2021800080131	10/11/2024	2020-075

BRIEF DESCRIPTION

Although the plastic waste crisis has reached a breaking point, current recycling approaches are unable to remediate microplastic pollution. Biodegradable and renewable plastics have shown promise but impact neither microplastic elimination nor complete plastic recycling due to diffusion-limited enzymatic surface erosion and random chain scission. Here it is shown that nanoscopic dispersion of trace enzyme (e.g. lipase) in plastics (e.g. polycaprolactone [PCL]) leads to fully functional plastics with eco-friendly microplastic elimination and programmable degradation. Nanoscopic enzyme encapsulation leads to:

- continuous degradation to achieve 95% microplastic elimination
- a single chain-based degradation mechanism with repolymerizable small molecule by-products via selective chain end scission rather than random chain scission
- spatially- and temporally-programmable degradation of melt-processed host matrix due to the dependence of single chain degradation on local lamellae thickness regardless of bulk percent crystallinity formulation of conductive ink for 3-D printing with full recovery of the precious metal filler

With recent developments in synthetic biology and genome information, nanoscopically embedding catalytically active enzymes in plastics may lead to an immediate, environmentally friendly and technologically viable solution toward microplastic elimination and material recycling.

SUGGESTED USES

- plastic
- biomaterial
- coating and implants
- microelectrinic

ADVANTAGES

RELATED MATERIALS

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INVENTORS

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OTHER INFORMATION

CATEGORIZED AS

- **Agriculture & Animal Science**
  - Animal Science
  - Devices
  - Other
  - Processing and Packaging
- **Biotechnology**
  - Food
  - Other
- **Computer**
  - Hardware
- **Energy**
  - Other
- **Environment**
  - Other
- **Engineering**
  - Engineering
- **Materials & Chemicals**
  - Composites
  - Electronics Packaging
- **Research Tools**

RELATED CASES

2020-075-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

▶ Near Complete Depolymerization Of Polyesters With Nano-Dispersed Enzymes

▶ Synergistic Enzyme Mixtures to Realize Near-Complete Depolymerization in Blends

▶ Self-Assembled Concentric Nanoparticle Rings To Generate Orbital Angular Momentum

▶ Thermal Stabilization Of Embedded Proteins

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

▶ Preserving Protein Function Via Statistically Random Heteropolymers

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