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Tunable, Scalable, and Depolymerizable Polyolefins with Weakened C–C Bonds via Solution-Phase Polymerization

Scalable polyolefins that can be chemically depolymerized to high-purity monomers for true closed-loop recycling.

Single-use plastics are ubiquitous in everyday life, yet their continued use results in environmental pollution and drives petroleum consumption. While closed-loop reuse of plastics would significantly improve the sustainability of plastic products, there are few low-cost, scalable substitutes for the polyolefin materials used today. To address this, researchers at Purdue University have developed a solution-based processing technique to produce tunable and depolymerizable polyolefins. This technique can be used to produce hard/brittle or soft/stretchable polymers at scale for various polymer applications. The polymers can be melt-processed, allowing them to be extruded into varying shapes and thicknesses. This technology has applications among plastics or materials manufacturers looking to improve sustainability.

Advantages

- Solution-based processing

- Scalable and compatible with existing infrastructure

- Tunable mechanical properties

Applications

- Production of closed-loop recycling of materials

- Plastic/polymer production

- Chemical Engineering

Technology Validation:

Technology ID
2023-DOU-70047

Category
Buildings, Infrastructure, & Construction/Structural Health Monitoring
Chemicals & Advanced Materials/Specialty & Performance Chemicals
Chemicals & Advanced Materials/Polymer Science & Smart Materials

Further information
Will Buchanan
wdbuchanan@prf.org

View online

This technology has been validated through fabrication of dog-bone specimens that were tensile tested. Results showed that the mechanical properties of the synthesized polymers could be tuned from stiff (1.59 GPa Young's modulus) to malleable (0.009 GPa Young's modulus).

Additionally, depolymerization experiments were performed. Results showed demonstration of the reusability of the polymer, with a recovery yield of 92%. Depolymerization occurred over a 30 minute time span at 155 deg C, followed by additional heating at 255 deg C.

TRL: 3

Intellectual Property:

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Utility Patent, 2024-01-03, United States

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