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Photo-melt-bulk polymerization strategy for recyclable polydiene-derivatives

A solvent- and catalyst-free UV process that produces recyclable, flexible polydiene plastics with efficient depolymerization.

Researchers at Purdue University have developed a novel photo-melt-bulk polymerization (PMBP) method for producing recyclable polydiene derivatives, such as 1,3-butadiene-based polymers, that eliminates the need for solvents or catalysts. Traditional methods for synthesizing polydienes face challenges such as complex purification processes, high termination rates, and sensitivity to impurities, which limit control over molecular weight and polymer architecture. The new PMBP approach involves melting the diene and irradiating it with ultraviolet (UV) light. Experimental results indicate that this approach is not only simpler but also facilitates the depolymerization of the resulting polymer at elevated temperatures, making it a promising solution for producing recyclable and flexible polydiene derivatives for the chemical industry.

Technology Validation:

The ultra-clean photo-melt-bulk polymerization (PMBP) method was tested for synthesizing processable polymuconate esters (PMEs) without solvents, catalysts, or initiators. Additionally, PMBP enabled the synthesis of complex architectures like ABA tri-block copolymers and ABS-like plastics, with efficient depolymerization at elevated temperatures.

Advantages:

-Flexible

-Reduced Environmental Impact (recyclable)

-Cost Effective

-Energy-Efficient

-Scalable

Technology ID
2025-DOU-70850

Category
Chemicals & Advanced Materials/Specialty & Performance Chemicals
Chemicals & Advanced Materials/Polymer Science & Smart Materials
Chemicals & Advanced Materials/Green & Bio-Based Chemistry

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Applications:

-Flexible and durable materials

-Rubber products & toy products

-Medical devices

TRL: 4

Intellectual Property:

Utility Patent, N/A, United States

Provisional-Patent, 2024-09-19, United States

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