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Bio-based Elastomers from Recoverable Methyl Valerolactone (20160418, Dr. Marc Hillmyer)

Technology No. 20160418

IP Status: Issued US Patent; **Application #:** 15/712,997

Tunable Crosslinked Elastomers with Low Glass Transition Temperature

A novel method synthesizes low-cost, polymeric valerolactones with tunable mechanical properties and low glass transition temperatures. Chemically crosslinked poly(*β*-methyl-*δ*-valerolactone) (PMVL) elastomers are created from high molar mass PMVL homopolymers that can be chemically converted back to recover the monomer in high purity. In addition, the crosslinked PMVL materials are highly tunable and exhibit lower glass transition temperature values (near −50°C).

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Alternative to Petroleum Based Polyurethane

Currently available bioderived and/or elastomers based on recoverable monomers are not easily tunable, exhibit poor mechanical properties, and exhibit glass transition temperature values above −40°C, greatly limiting their applications. Commercial petroleum-derived polyurethanes are highly resistant to degradation and are environmentally unfriendly. Using recoverable aliphatic polyesters to produce thermoplastic elastomers requires rigorous reaction conditions and yields materials with poor solvent resistance, low thermal stability, and significant stress softening (Mullins effect). This method overcomes these obstacles by combining a MVL monomer and crosslinking methods. The low glass transition temperature allows these polymers to be used at lower temperatures than other biodegradable polymers and could be used in tires, gaskets, seals adhesive, sealant and damping products.

BENEFITS AND FEATURES:

- Chemically crosslinked PMVL elastomers
- Easily biodegradable; can be chemically converted back to monomer
- Tunable mechanical properties
- Lower glass transition temperature; suitable for cold conditions
- Fillers can be added to increase toughness and reduce elastomer cost

APPLICATIONS:

- Biodegradable/biobased materials
- Polyurethanes
- Elastomers
- Damping products for vibration and noise control
- Multiple industries (e.g., bedding/furniture, building/construction, automotive/tire, footwear, transportation, and packaging)
- Flexible foams (high resilience foam seating, microcellular foam seals and gaskets)
- Low-temperature sealant and adhesive applications

Phase of Development - Proof of concept; demonstrated on laboratory scale. Have made a variety of polymers at two different processing temperatures; have also made composites with up to 30 wt% fumed silica.

Researchers

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External Link (chem.umn.edu)

Publications

Renewable, Degradable, and Chemically Recyclable Cross-Linked Elastomers
Industrial & Engineering Chemistry Research, October 11, 2016 , 55 (42), pp 11097–11106

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