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Biodegradable elastomers for 3D printing at low temperatures

A method of using a block copolymer comprising PCL and a stretchable amorphous block such as P(βMδVL) or random P(CL-co-DLLA) for creating extruded structures with bioactive ingredients.

IP Status: Provisional Patent Application Filed; **Application #:** 63/061,830

Applications

- Copolymer for extrusion / 3D printing of structures

Key Benefits & Differentiators

- Melting temperature under 60°C preserves bioactive payload
- Mechanical properties suitable for inkjet/extrusion 3D printing
- Biodegradable and non-cytotoxic

Overview

Biodegradable thermoplastic materials are highly attractive for a variety of applications including medical devices loaded with bioactive agents. However, fabrication of thermoplastic, biodegradable elastomers into devices via thermoprocessing methods (such as extrusion and molding) or 3D printing typically requires heating above 100°C, which degrades most bioactive agents.

Researchers at the University of Minnesota have developed a biodegradable, thermoplastic block copolymer that can be thermoprocessed below 60°C. By combining semi-crystalline polycaprolactone (PCL) blocks and an amorphous and highly stretchable block, such as a poly β-methyl-δ-valerolactone P(βMδVL) block or a random poly(caprolactone-co-D,L-lactide) (P(CL-co-DLLA)) block, copolymers with attractive biodegradability, elastomeric, and melting properties are achieved. The unique material properties enable low-temperature molding and extrusion of structures loaded with bioactive materials, whose functional properties are preserved. This material could potentially be used for implantable products in the biomedical field. Lastly, the biodegradable nature of this material makes it safe for the environment when used for non-implantable products.

Phase of Development

TRL: 3-4
Lab-scale material synthesized and its mechanical properties (modulus, stretchability, and reversibility) have been characterized. Experiments to confirm biodegradability and non-cytotoxicity have been conducted. Researchers have successfully 3D printed using this material at 60°C. Experiments to encapsulate, retain, and preserved-bioactivity of a model enzyme have also been performed.

Desired Partnerships

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Technology ID
2020-241

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Researchers

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References

1. Panja, Sudipta, Allison Siehr, Anasuya Sahoo, Ronald A. Siegel, and Wei Shen. , https://doi.org/10.1021/acs.biomac.1c01197, Biomacromolecules (2021)