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Cold Draw Programmable Grayscale Digital Light Processing 3D Printed Shape-Morphing Structures and Methods of Forming the Same

Category: 4D Printing and Shape Memory Polymers

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Summary

This innovative technology leverages grayscale digital light processing (g-DLP) 3D printing to fabricate structures from shape memory polymers that can morph into different shapes post-printing. By mechanically deforming these printed parts at room temperature and then applying heat, the original 3D printed shape is recovered. The unique aspect of this technology is the ability to control the transition temperature locally using light intensity during printing, enabling the creation of parts with dramatic and precise shape changes.

Development Stage

Prototype and First Operational Test Complete

Problem Statement & Solution

Innovative advances in manufacturing technologies are crucial for developing more sophisticated and versatile materials. This technology introduces a novel application of grayscale digital light processing (g-DLP) 3D printing, enabling the creation of structures from shape memory polymers that can transform into different shapes post-production. By eliminating the traditional heating-cooling cycle required for programming shape memory polymers, this approach simplifies the fabrication process and enhances the functionality of the produced materials.

Researchers at the Georgia Institute of Technology are working to harness this technology to produce parts that can undergo dramatic shape changes with precise control over the transition temperatures, allowing for the creation of complex, multi-configuration morphing structures. This capability opens up new possibilities for advanced applications in fields requiring dynamic material properties.

Advantages

- Enables the fabrication of complex shape-morphing structures with precise control over material distribution and properties.
- Offers a simple and versatile cold-programming method that does not require heating, reducing energy costs and simplifying the process.
- Allows for the design of multi-shape morphing structures with tunable deformation and thermomechanical responses.
- Significantly expedites the fabrication process by transforming 2D shapes into 3D structures efficiently.

Commercial Applications

- Soft robotics: Creating robots with the ability to change shapes in response to environmental stimuli.
- Deployable systems: Manufacturing components that can morph into functional structures post-deployment.
- Wearable devices: Developing adaptable and comfortable wearables that can adjust their shape for better ergonomics.
- Medical devices: Producing stents, implants, and other medical devices that can morph for minimally invasive insertion and optimal performance.
- Shape-shifting antennas, sensors, and actuators for advanced communication systems, environmental monitoring, and smart materials.

Lead Inventor: Hang Qi, PhD

Intellectual Property Status: Patent application has filed

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