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香港城市大學
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Origami and 4D printing of elastomer-derived ceramic structure

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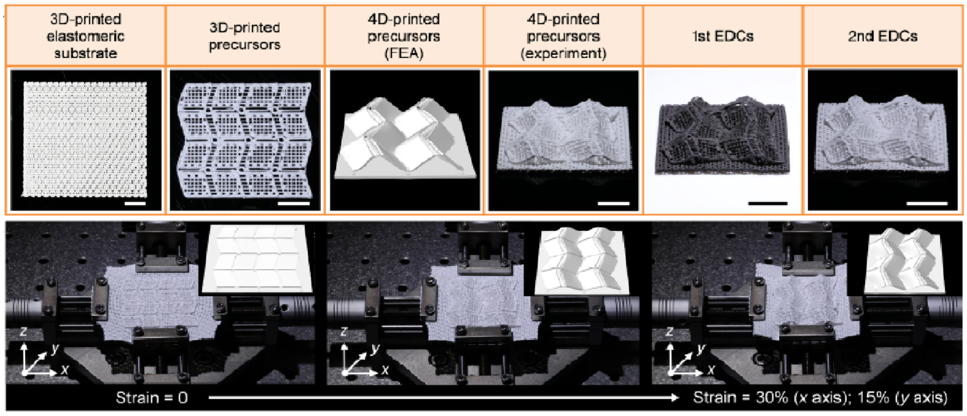

Opportunity

Four-dimensional (4D) printing involves conventional 3D printing followed by a shape-morphing step. It enables more complex shapes to be created than is possible with conventional 3D printing. Moreover, 4D printed objects and the techniques may be applied in many fields, including robotics, life science and biomimetic applications etc. Unfortunately, 3D-printed ceramic precursors are usually difficult to be deformed, hindering the development of 4D printing for ceramics. Although various materials, such as polymers, metals, ceramics, graphene and silicon, have emerged in shape-morphing assembly, ceramic structures derived from the existing soft precursors are not flexible and stretchable.

Technology

We developed elastomeric poly(dimethylsiloxane) matrix nanocomposites (NCs) that can be printed, deformed, and then transformed into silicon oxycarbide matrix NCs, making the growth of complex ceramic origami and 4D-printed ceramic structures possible. In addition, the printed ceramic precursors are soft and can be stretched beyond three times their initial length. Hierarchical elastomer-derived ceramics (EDCs) could be achieved with programmable architectures spanning three orders of magnitude, from 200 mm to 10 cm. This work starts a new chapter of printing high-resolution complex and mechanically robust ceramics, and this origami and 4D printing of ceramics is cost- efficient in terms of time due to geometrical flexibility of precursors.

IP Status

Patent granted

Technology Readiness Level (TRL) 4

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Advantages

- Programmable and customizable design of ceramic objects
- High fidelity of the geometric resolution in shape deformation for displacement control in stretching device
- Relatively cost-effective technique of ceramic additive manufacturing by the Direct Ink Writing (DIW)-heat treatment process
- Strength-scalable synergy of techniques and materials for industrial applications and scale production.

Applications

- Autonomous morphing structures
- Aerospace propulsion components and Space exploration
- Electronic devices and High-temperature microelectromechanical systems
- Medical devices and biomimetic applications