4D Printing of Thermally Responsive Polymeric Bilayers with Reversible Shape Reconfiguration in Air

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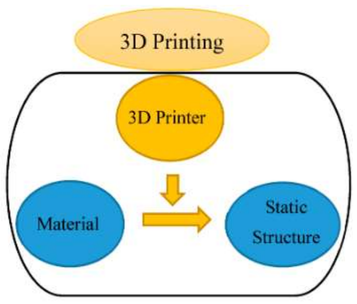
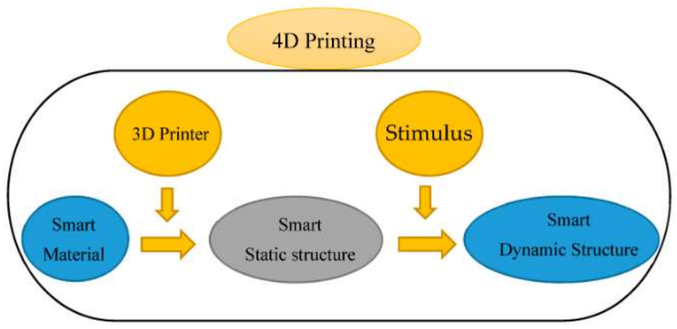
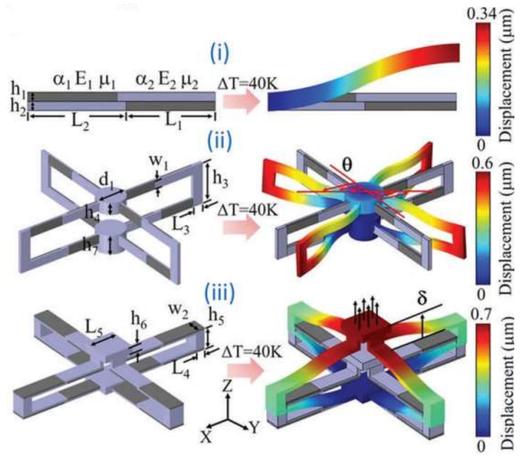
BACKGROUND

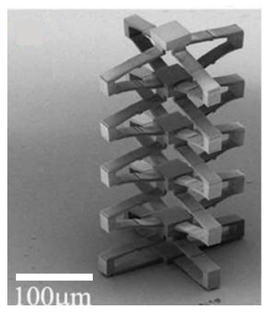
Difference between 3D and 4D



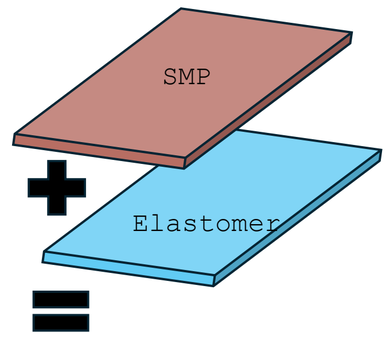


4D metamaterial





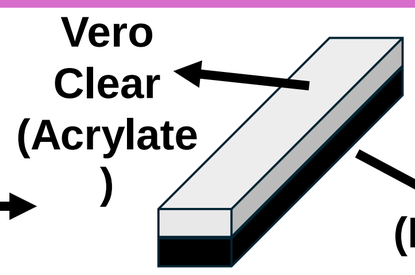
Motivation



4D STRUCTURES? REVERSIBILITY?

EXPERIMENTS

Polyjet Objet 260



Initial shape of the VC/Ag30 bilayer

T = 80 °C

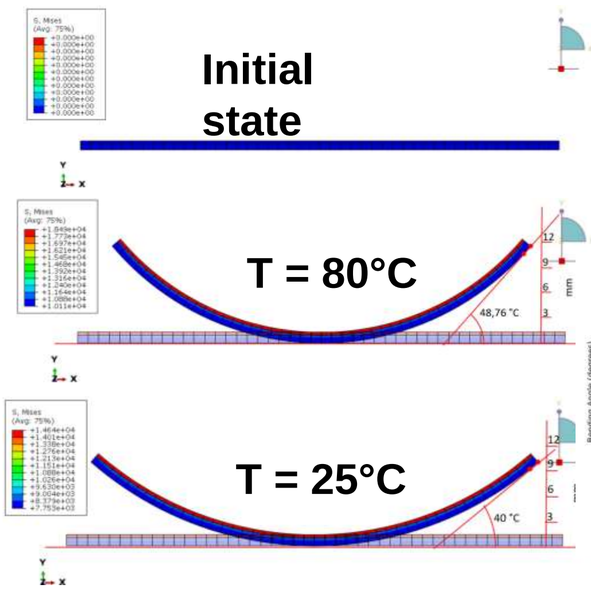
Hot plate

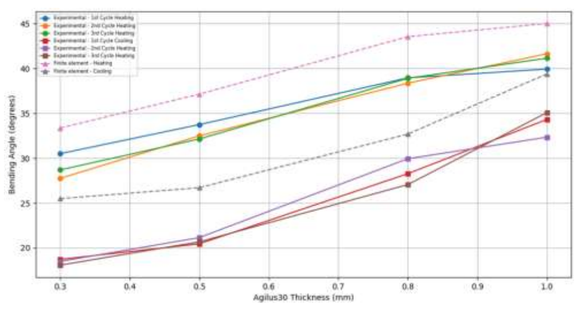
T = 30 °C

Room temperature plate

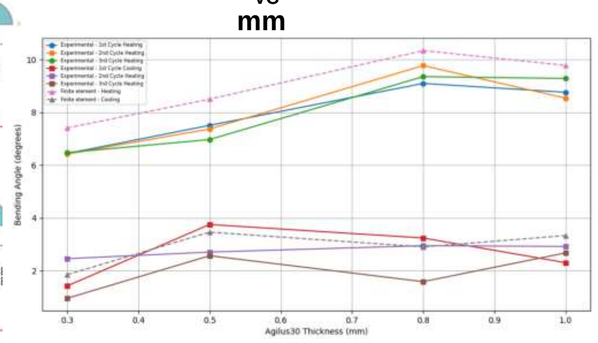
RESULTS

Simulation results



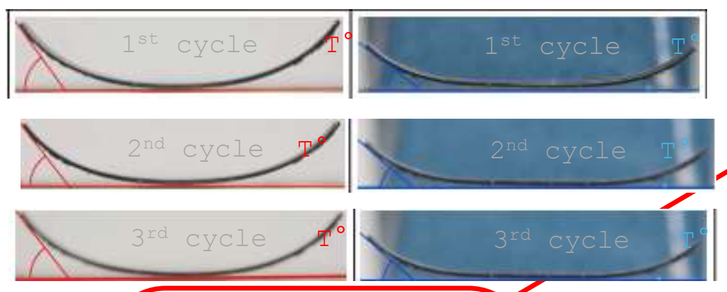


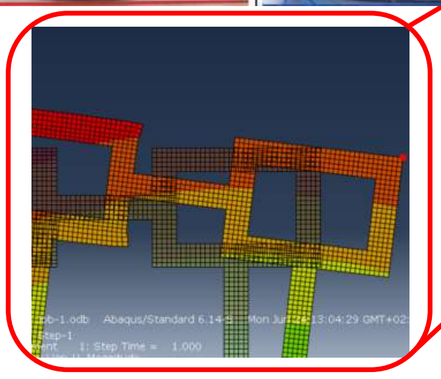
T_{VC}= 0.5 mm

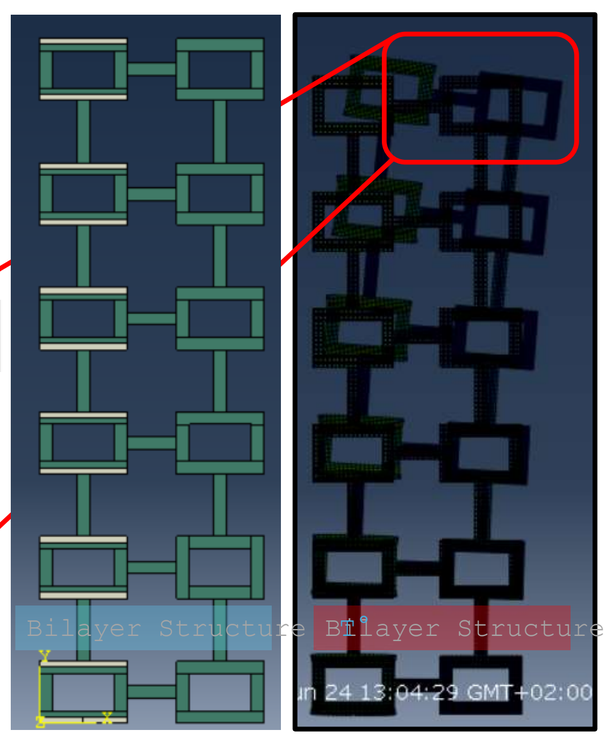


T_{VC}= 1.5 mm

Experimental results







CONCLUSIONS

- **Shape reconfiguration through a single-step printing process and a single thermal stimulus.**
- **Predicting the final geometry of the bi-layer structures using finite element analysis.**
- **Demonstrating the potential for achieving precise control over the deformation behavior.**
- **Fabrication of more intricate structures with tailored functionalities, further broadening the applicability of this approach in the development of dynamic and responsive materials.**

REFERENCES

[1] Q. Ji, J. Moughames et al. "4D Thermomechanical metamaterials for soft microrobotics." *Communications Materials* 2, (2021).
[2] M. Bodaghi, R. Noroozi, A. Zolfagharian et al. "4D Printing self-morphing structures", Materials (2019).

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