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Flow Programmed Liquid Crystal Elastomer Sheets

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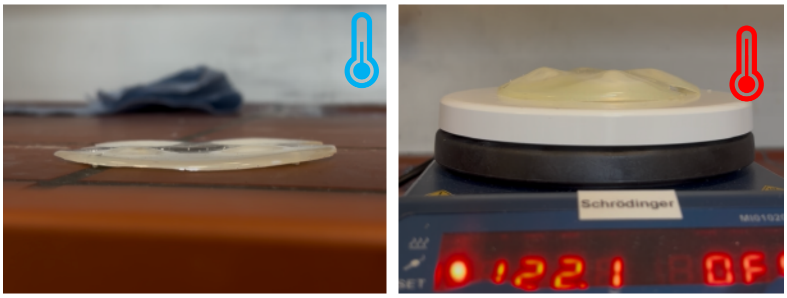
Liquid crystal elastomers (LCEs) are a class of smart, stimuli-responsive materials that combine the elasticity of polymer networks with the self-organising behaviour of liquid-crystalline mesogens, enabling reversible, programmable shape transformations. By patterning the liquid-crystal director field and polymerising the precursor, this anisotropic structure is fixed in the resulting elastomer. Upon heating above the nematic-isotropic transition, LCEs contract along the direction of the patterned director and expand perpendicular to it, resulting in a macroscopic actuation. This process is fully reversible upon cooling the liquid crystal elastomer [1].

Currently, director patterning in LCEs is typically achieved using photopatterned alignment. However, this approach is time-consuming, limits the material thickness to tens of micrometres, and is restricted to monomeric precursors [2]. To address these limitations and facilitate future industrial production, we introduce a flow-based patterning technique for LCEs. This method significantly accelerates the patterning process, enables straightforward upscaling of the precursor to dimensions of metres, and allows the patterning of complex director fields. This approach offers a promising route towards industrial production of LCE-based materials. In this work, we demonstrate flow-based patterning by writing four +1-defects within an LCE film and investigate the thermally induced actuation of the patterned film upon heating.



References

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[2] Guin et al., Nat. Comm. 9.1 (2018): 2531

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