Programming Shape Shifting and Locomotion through Anisotropy

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Conventional robots are rigid. Although robust, they are often heavy, bulky, tethered and non-adaptive to environmental changes. Soft robots are light-weight, compliant, and adaptive, and can achieve multi-degrees of freedom. However, their softness makes it difficult to control the shape change and locomotion, or lift heavy weights. To precisely and locally control the shapes and agile locomotion with considerable strains, we create thin films and filaments from liquid crystal elastomers (LCEs) and their composites. Through designs of geometric surface patterns, e.g. microchannels, we program the orientational elasticity in LCEs to direct folding of the 2D sheets into 3D shapes, which can be triggered by heat, light, and electric field. We then fabricate tendon-like filaments as high strength, dual-adaptive actuators in soft robotic applications, as well as programmable gaits to achieve different modes of locomotion.

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