Liquid-Crystalline Elastomer Micropillar Array for Haptic Actuation

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A new LCE micropillar array with two-dimensional prolate polydomain conformation of the polymer backbone and the mesogens has been successfully synthesized.[1] This new concept of the orientation of silicone-based LCE systems by uniaxial compression (biaxial orientation) allows for the obtaining of micropushers, with actuation temperatures around 55 ºC (Figure 1).

The two-dimensional prolate polydomain conformation of the LCE micropillars was confirmed by swelling, polarized optical microscopy and X-ray experiments, where the anisotropic swelling value above the unit and the planar distribution of the prolate polymer backbone and nematogens were observed.

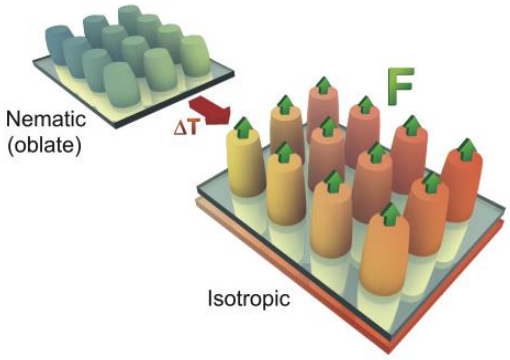

Figure 1: Actuation principle of the micropillar array by means of a phase transition with a macroscopic expansion along the axial direction of the micropillars upon heating.

The resulting LCE micropillars show an expansion factor of ε_z = 21% along the axial direction and a contraction factor of ε_r = 15% in the radial direction upon isotropization of the sample. These changes in the dimensions, together with the actuation force of F = 20 mN (σ_t = 5.6 kPa), and the possibility of obtaining different shapes on demand – besides the common LCE strip –, make the LCE materials very suitable candidates for haptic applications, as well as for their integration in Microsystem Technology, in the development of complex devices through a batch process.

References:
[1] N. Torras, K.E. Zinoviev, J. Esteve*, A. Sánchez-Ferrer*, *J. Mater. Chem. C* **1**, 5183-5190 (2013).

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