Electronic Supplementary Material (ESI) for Soft Matter.
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Supplementary Material for

Adaptable Liquid Crystal Elastomers with Transesterification-Based Bond Exchange Reactions

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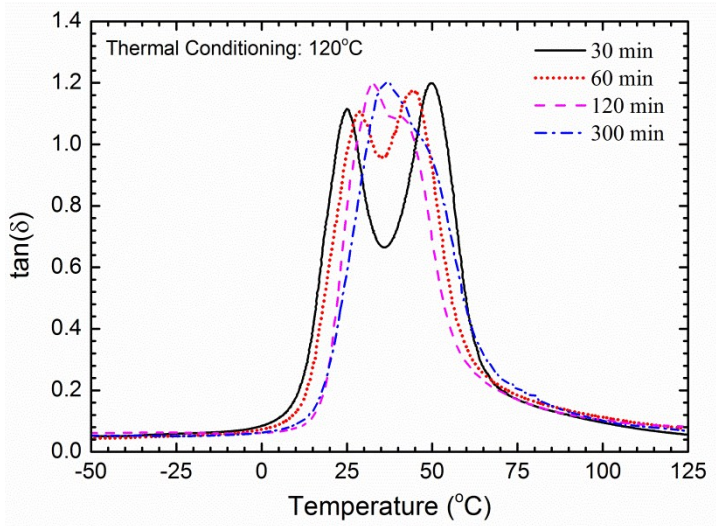
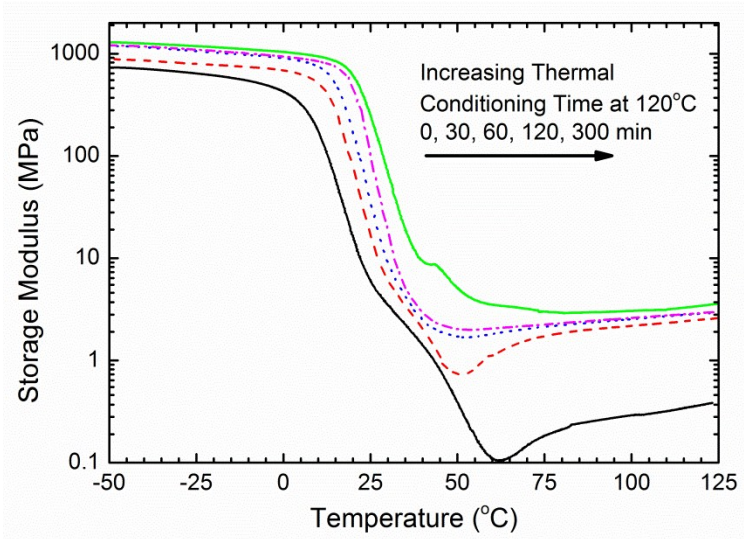
S1. Influence of free-standing heating on the phase transition of adaptable LCEs

Four polydomain LCE samples were exposed to free-standing heating at a temperature of 120 °C for 30, 60, 120, and 300 minutes respectively. Subsequent to the heat treatment, DMA tests were performed on each sample using a frequency of 1 Hz and a temperature rate of 2°C/min. The tan δ and storage modulus curves for these samples are presented in Figure S1. It is seen that as the duration of free-standing increases, the second peak in the tan δ curve, which is the characteristic of the phase transition of LCE, diminishes and eventually converges with the glass transition peak. This suggests that the loss of mesogen structures in the LCE samples. Additional evidence of this is shown in the storage modulus curves, with the soft elasticity valley disappearing as the increment of heating time.



(a)



(b)

Figure S1. *DMA measurements of LCE samples after free-standing heating at 120°C for different times. Temperature ramp rate is 2°C/min and frequency is 1 Hz. (a) Evolution of tan δ. (b) Evolution of storage modulus.*

S2. Control test on LCE network without BER capability

LCE networks without transesterification catalyst (TBD) was synthesized with the same starting materials (RM257, thiol spacer, and cross-linker) and identical stoichiometry, except for the dipropylamine (DPA) being used to induce the polymerization of LCE. Without TBD, there is no BER involved in the network.

As a control experiment, this LCE polymer was subject to the same programming and actuation conditions shown in Fig. 6 of the manuscript. The resulting strain behavior is

shown in Figure S2. It is apparent that there is no indication on the creep-induced alignment in the LCE network. First, the strain of the LCE sample was unchanged when a constant stress was maintained during the creep programming. The strain increment during the cooling step was resulted from the phase transition of LCE. During the actuation step, there was no free-standing two-two shape change. The small strain change was resulted from the thermal expansion of polymer network.

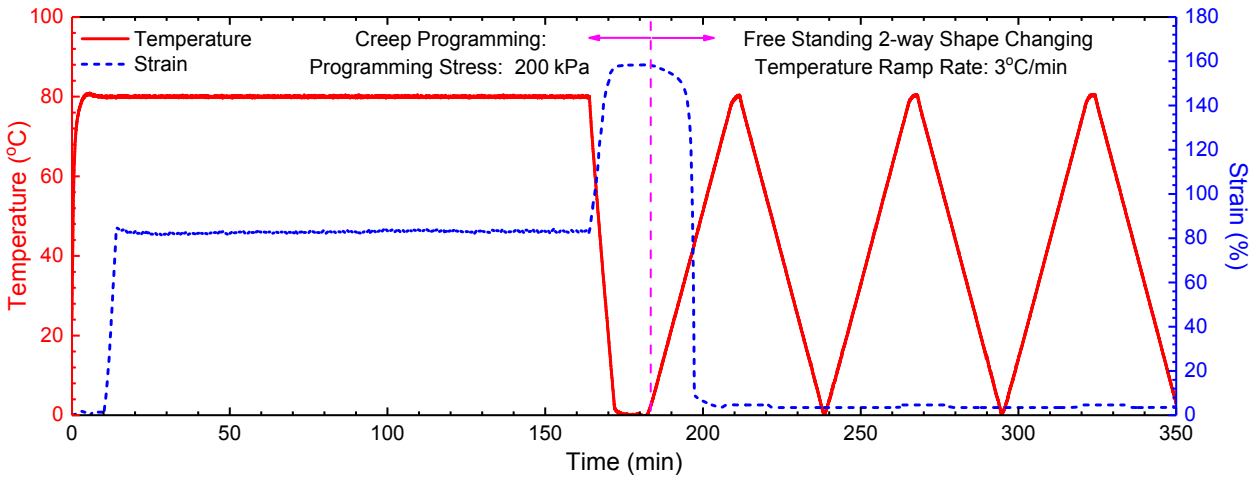


Figure S2: *The creep programming and actuation cycle of the control LCE sample without BER involved.*

S3. Dissolution of adaptable LCE in ethanol

Ethanol was used to dissolve the adaptable LCE samples. As shown in Figure S3, after soaking the adaptable LCE samples in ethanol, and heated at 90°C for 12 hours, the solid samples were fully dissolved into liquid form, and the polymer solution is homogeneous at the room temperature.

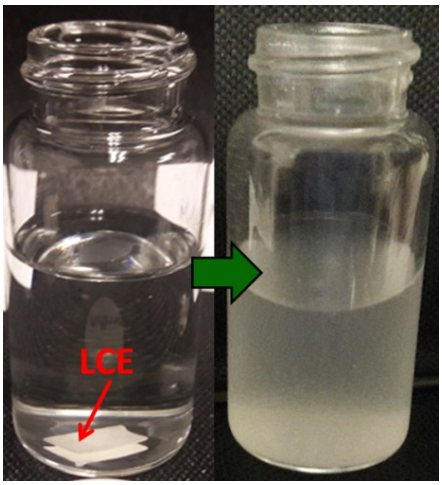


Figure S3: *Two pieces of adaptable LCE samples were fully dissolved in ethanol after being heated at 90°C for 12 hours.*