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Fast Electromechanical Response in Liquid Crystal Elastomer Nanocomposites RAFAEL VERDUZCO, ADITYA AGRAWAL, JEFF JACOT, TOMI ADETIBA, Rice University — Liquid crystal elastomers (LCEs) combine the elasticity of polymer networks with the fluidity and responsiveness of liquid crystals. LCEs can respond to a variety of external stimuli – heat, light, electric and magnetic fields – with large and reversible shape-changes. However, the response can be slow and/or require large external fields. Here, we present our recent work with LCE bilayers and LCE composite materials that demonstrates LCEs can respond quickly and with 3-D shape changes. Nematic LCE bilayers are prepared by depositing a PS film on top of a nematic LCE, and the bilayers exhibit reversible wrinkling, folding, and curling with temperature. The shape change of LCE bilayers is quantitatively predicted using finite-element modeling. Next, we show that a fast response to an electric field is achieved in nematic LCE composites. While typical nematic LCEs are relatively unresponsive to electric fields, LCE composites with 2 wt % carbon black can reversibly contract and expand in response to a 40 V electric field. The response time (0.1 – 10 Hz) and amplitude of shape change (1 – 20 %) depends on the external field and carbon black content. These composites may be useful for biomedical applications, such as substrates for dynamic cell culture and biocompatible scaffolds for heart tissue regeneration. Neonatal rat ventricular myocytes remain viable on LCE-carbon black bilayer substrates, and aligned myocyte cell sheets were successfully grown on LCE-composite bilayers.

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