Understanding the Interaction of Mesogen Alignment in On-demand Processes

PI: Anesia Auguste, Air Force Research Laboratory
Academic Collaborator: Jennifer Lewis, Harvard University

Liquid crystal elastomers (LCEs) exhibit unique anisotropic actuation and deformation responses that are desirable in many DoD applications such as soft robots, active optical devices, and substrates for flexible devices. Additive manufacturing of LCEs using direct ink write (DIW) have demonstrated alignment in the print direction, which dictates the anisotropic response, with highly aligned LCEs exhibiting large and reversible responses to external stimuli. However, the DIW printed LCEs traditionally use a gantry system where the alignment is commonly limited to a planarly aligned LCE. This research proposes to utilize a robotic arm with 6 degrees of freedom for DIW printing of LCEs, going beyond the limitations of traditional gantry systems. The aim is to investigate the relationship between printing parameters, material properties, and LCE alignment in 3D printed structures, with a focus on understanding LCE alignment at printed interfaces and within out-of-plane architectures. Ultimately, this research seeks to enable the design and control of flexible, morphing, complex architectures with unique thermal actuation properties and deformation profiles.