Materials Research Science and Engineering Center

Sigma-Aldrich Inaugural Lecture

in conjunction with the
Harvard Applied Mechanics Colloquia

Wednesday, April 3, 2019
4:30 -5:30 p.m.
Pierce Hall, Room 209

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Exploiting Directed Self Assembly to Enable Functional Performance in Liquid Crystalline Elastomers

Liquid crystalline materials are pervasive, enabling devices in our homes, purses, and pockets. It has been long-known that liquid crystallinity in polymers enables exceptional characteristics in high performance applications such as transparent armor or bulletproof vests. This talk will generally focus on a specific class of liquid crystalline polymeric materials: liquid crystalline elastomers. These materials were predicted by de Gennes to have exceptional promise as artificial muscles, owing to the unique assimilation of anisotropy and elasticity. Subsequent experimental studies have confirmed the salient features of these materials, with respect to other forms of stimuli-responsive soft matter, are large stroke actuation up to 400% as well "soft elasticity" (stretch at minimal stress).

This presentation will survey our efforts in directing the self-assembly of these materials to realize distinctive functional behavior with implications to soft robotics, flexible electronics, and biology. Most notably, enabled by the chemistries and processing methods developed in my laboratories, we have prepared liquid crystal elastomers with distinctive actuation and mechanical properties realizing nearly 20 J/kg work capacities in homogenous material compositions. Local control of orientation dictates nonuniformity in the elastic properties, which we recently have shown could be a powerful means of ruggedizing flexible electronic devices. Facile preparation of optical films, prepared with the cholesteric phase, capable of concurrent shape and color change will also be discussed.