Johns Hopkins University
Department of Mechanical Engineering
2021 Spring Virtual Seminar Series: Class 530.803

Thursday, April 29, 2021 | 3:00 PM – 4:00 PM
REGISTRATION LINK | ZOOM LINK | Passcode: 446835

"Programming Intelligence through Geometry, Topology, and Anisotropy"

Presented by Professor Shu Yang
Department of Materials Science & Engineering, University of Pennsylvania

Programmable shape-shifting materials can take different physical forms to achieve multifunctionality in a dynamic and controllable manner. By introducing holes and cuts in 2D sheets macroscopically, we demonstrate dramatic shape change and super-conformability via expanding or collapsing of the hole arrays without deforming individual lattice units. When choosing the cuts and geometry correctly, we show folding into the third dimension, known as kirigami. We explore their potential applications in water harvesting, super-stretchable and shape conformable medical devices, as well as bioinspired robotics.

We then take geometry to nano- and microscales by programming anisotropy in liquid crystal elastomers (LCEs) in the forms of reversibly deformable films, fibers, and droplets. Through inverse engineering, that is pre-programming inhomogeneous local deformations in LCEs, we show shape morphing into arbitrary 3D shapes. By incorporating 1D and 2D nanomaterials in LCEs, we demonstrate photo- and electrothermally responsive tendon-like actuators and light-reprogrammable shapes.

Shu Yang is a Professor in the Departments of Materials Science & Engineering, and Chemical & Biomolecular Engineering at University of Pennsylvania. Her group is interested in synthesis, fabrication, and assembly of soft materials including polymers, liquid crystals, and colloids and their composites, and use geometry to create highly flexible, stretchable, super-conformable, and foldable materials and devices. Her lab explores the potential applications of the smart and bioinspired materials, including self-cleaning coatings, dry adhesives, smart windows, sensors, actuators for robotics, and biomedical devices. Yang received her B.S. degree from Fudan University, and Ph. D. degree from Cornell University. She worked at Bell Laboratories, Lucent Technologies as a Member of Technical Staff before joining Penn. She received George H. Heilmeier Faculty Award for Excellence in Research from Penn Engineering. She is a Fellow of Materials Research Society (MRS), Division of Soft Matter (DSOFT) from American Physical Society (APS), Division of Polymeric Materials: Science and Engineering from American Chemical Society (ACS), and National Academy of Inventors. She was elected as Innovators under 35 by MIT's Technology Review.