Joint Condensed Matter and Center for Soft Matter and Biological Physics Seminar

Prof. Michael D. Bartlett

[(Mechanical Engineering, Virginia Tech)](#)

"Multi-functional Soft Materials for Electronics and Adhesives"

Date/Time: Monday, 9 November 2020,

4:00pm -5:00pm

Virtual Zoom

Zoom Link: https://virginiatech.zoom.us/j/86335998700

Abstract: Multi-functional soft materials and interfaces create intriguing new opportunities to enhance performance through programmable and adaptable properties. I will discuss two examples of this approach: 1) Novel material architectures of solid-liquid soft composites for soft machines and deformable, self-healing electronics, and 2) Switchable adhesives through programmable interfacial structures and stiffness. For soft composites, I will present an all-soft matter approach that combines soft elastomers with dispersions of liquid-phase eutectic Ga-In (EGaIn) metal alloy microdroplets. Experimental and theoretical investigations show that liquid metal droplets incorporated into elastomers enables exceptional combinations of soft elasticity and electrical and thermal properties with extreme toughness, autonomously self-healing circuits, and damage detection. I will then show how rigidity can be controlled through droplet architecture and composition. For switchable adhesives, I will present a framework for designing adhesives through kirigami, the Japanese art of paper cutting, and pneumatically controlled soft membranes. By incorporating kirigami-inspired structures at interfaces, we can enhance adhesive force by ∼100x across a spatially patterned sheet while tuning adhesion in different directions for high capacity yet easy release interfaces. We will also show how pneumatically controlled shape and rigidity tuning can be coupled to rapidly switch adhesion (≈0.1 s) across a wide range of programmable adhesion forces with measured switching ratios as high as 1300x. These approaches provide model systems to study fundamental material properties while enabling electronic skins, soft robots, and 'smart' adhesives for a variety of soft matter systems.

Michael Bartlett is an Assistant Professor of Mechanical Engineering at Virginia Tech. His research investigates and creates soft multifunctional materials and interfaces with highly tunable mechanical and functional properties for deformable electronics and soft robotics, adaptive materials, and 'smart' adhesives. He received his BSE in Materials Science and Engineering from the University of Michigan in 2008 and completed his Ph.D. in Polymer Science and Engineering at the University of Massachusetts Amherst in 2013 studying bio-inspired adhesion. After obtaining his Ph.D. he worked as a Senior Research Engineer in the Corporate Research Laboratory at 3M, as a Postdoctoral Fellow in Mechanical Engineering at Carnegie Mellon University, and was an Assistant Professor at Iowa State University before joining Virginia Tech in 2020. His research has resulted in publications, patents, media coverage through outlets such as the Discovery Channel, and awards including a DARPA Young Faculty Award, DARPA Director's Fellowship, the Early Career Scientist Award from the Adhesion Society, a 3M Non-Tenured Faculty Award, and an Outstanding Faculty Award from the Iowa State Engineering Student Council (student nominated). More at: www.bartlett.me.vt.edu

Hosted by: Prof. Uwe Täuber, Physics, Virginia Tech