SDSU | College of Engineering Mechanical Engineering

Mechanical Engineering Seminar Series

January, 20th 2026, 11:00AM

Dean's Conference Room, E-203E

Title: Unraveling – and Controlling – the Complex Structure - Mechanics Relationships of PEGDA Hydrogels

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Abstract: Poly(ethylene glycol) diacrylate (PEGDA) hydrogels are important engineering materials. They are biocompatible, mechanically tunable, can be fabricated at low cost, and functionalized, enabling their use in tissue engineering, drug delivery, and microfluidics. PEGDA-based materials are also easily photopolymerized and photocrosslinked, enabling high-resolution fabrication of intricate structures with tailored mechanical properties, for example, through 3D printing. Despite these broad applications, we are only beginning to understand how to design PEGDA gels for specific use cases. In sharp contrast to "classical" or "ideal" polymer networks consisting of a single chain type connected via pointlike crosslinkers, PEGDA hydrogels possess a unique microstructure of highly interconnected bottlebrushes. The relationships between formulation, processing, structure and mechanics in such complex and heterogeneous networks are poorly understood and classical polymer theories fail to capture critical features. As a result, material design has typically been accomplished via one-off optimization for a particular application with little understanding of how to tune or target properties.

By combining careful design, precise experimental characterization and modeling, we have recently demonstrated that we can predict the mechanical properties of PEGDA hydrogels using minimal inputs such as the molecular weight and initial concentration of macromonomers. Moreover, we can control PEGDA polymerization kinetics through carefully designed pulsed illumination. Through this research, we hope to unlock exciting new capabilities in on-demand manufacturing, and enable precise fabrication of hydrogels with targeted structural and mechanical properties from a single precursor solution simply by subjecting them to different pulses of light. These advances will meet critical manufacturing and industry needs in aerospace, health, and robotics, and hold particular promise for use in resource-limited environments such as in deep space exploration.

Brief Bio: Megan T. Valentine is a Professor of Mechanical Engineering at the University of California, Santa Barbara. Her interdisciplinary research group investigates many aspects of biological and bioinspired materials, with an emphasis on understanding how forces are generated and transmitted in living materials and how the extraordinary features of living systems can be captured in manmade materials. This highly interdisciplinary experimental work lies at the intersection of engineering, physics, biology and chemistry, and advances diverse application areas, ranging from marine-inspired materials to mechanobiology to soft robotics. Megan received her B.S from Lehigh University, M.S. from UPenn and Ph.D. from Harvard, all in Physics. She completed a postdoctoral fellowship at Stanford in the Department of Biological Sciences, where she was the recipient of a Damon Runyon Cancer Research Postdoctoral Fellowship, and a Burroughs Wellcome Career Award at the Scientific Interface. Her awards include an NSF CAREER Award for her work on neuron mechanics, and a Fulbright Scholar Award to study adhesion mechanics in Paris, France. She is a Fellow of the American Physical Society and American Institute for Medical and Biological Engineering.