THE OHIO STATE UNIVERSITY

The William G. Lowrie Department of Chemical and Biomolecular Engineering Graduate Program

Cordially invites you to attend a seminar on

Shape-Morphing Polymers: Towards "Smart" Medical Devices

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Associate Professor

Biomedical Engineering, Materials Science and Engineering

Texas A&M University

Thursday, September 17th, 11:30 AM

Zoom Webinar URL:
https://osu.zoom.us/j/97117564048?pwd=cW5DSG8xYmNHdlM5NmJBYm9qWXg1UT09
Password: 058721

Bio

Taylor Ware is an Associate Professor in Biomedical Engineering and Materials Science and Engineering at Texas A&M University. Prior to joining TAMU in August 2020, he graduated *summa cum laude* with his B.S. from the Georgia Institute of Technology (2009) and with his Ph.D. from the University of Texas at Dallas (2013) in Materials Science and Engineering. Taylor completed postdoctoral training at the Materials and Manufacturing Directorate at the Air Force Research Laboratory. Dr. Ware was an Assistant Professor from 2015-2020 at the University of Texas at Dallas. His research interests include biomaterials, liquid crystal materials, flexible electronics, and the interfacing of these technologies in medical devices. Dr. Ware was a recipient of the National Science Foundation Graduate Research Fellowship (2011), the Air Force Young Investigator Award (2017), and the NSF CAREER award (2018).

Abstract

Stimuli-responsive polymers respond to their environment without requiring motors, sensors, or power supplies. These materials can replace the functions of traditional machines in conditions or at scales, such as in the human body, where traditional actuators, electronics, and batteries are difficult to employ. Here, two orthogonal strategies, one non-living and one living, to create materials that respond in a complex manner to specific environmental conditions will be discussed. First, we will discuss controlling molecular orientation, and therefore the stimulus-response, in liquid crystal elastomers. Using processing techniques (e.g., directed self-assembly and 3D printing) and materials formulation strategies, shape change, geometry, and activation temperature can be precisely controlled. We will discuss the potential applications of these materials as substrates for stretchable electronics (Figure) and as artificial muscles. Notably, the stimulus-response of these and many other smart materials is derived wholly from physical properties, and as a result, these materials require powerful stimuli, such as heat, to induce shape change. By comparison, the stimulus-response of living organisms can be triggered by weak physical stimuli or specific biochemicals. To bridge the gap between living cells and engineered materials, we will discuss a new strategy to fabricate living Baker's yeast –polyacrylamide hydrogel composites capable of undergoing programmed shape change (Figure). As the cells are higher modulus (~100×) than the gel, cell proliferation results in a macroscopic shape change of the composite. Importantly, genetic manipulation of the yeast enables the stimulus that induces shape change to be controlled. For example, we will discuss composites where volume change on exposure to a single biochemical (L-histidine) is 14× higher than volume change when exposed to highly similar biochemicals (D-histidine and other amino acids). These living composites may enable new strategies for medical devices like autonomous drug-delivery systems.

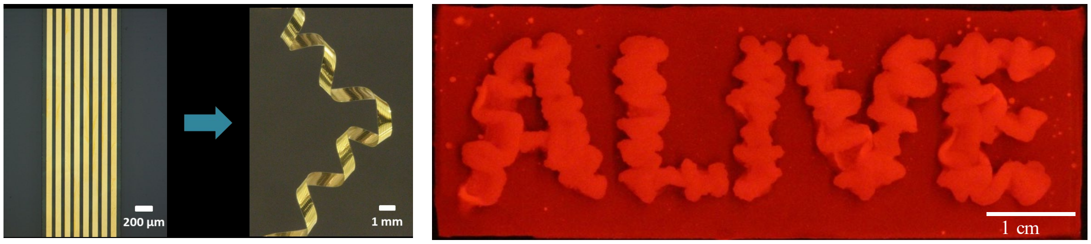

Figure – Shape-morphing liquid crystal elastomers can enable 3D electronics (Left). Composites of living cells and synthetic hydrogels can be programmed to undergo controllable shape change in response to specific biochemical stimuli (Right).