

MATERIALS SCIENCE and ENGINEERING SEMINAR



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Materials Science and Engineering

Pennsylvania State University

Enhancing Actuation Properties in Strain Crystallized Polymer Fibers

Shape memory polymers store elastic energy by trapping stretched polymer chains in an extended state, which is analogous to a spring. Essentially, the work available by a spring is constrained by the spring constant and displacement of the spring. The work presented here reveals a new method to further increase the useable work in shape memory polymers beyond the stored elastic energy in stretched chains. Specifically, a new class of fiber actuators have been reported that contract or rotate when triggered by heat or hydration. The fibers, termed “strain crystallized actuators” (SCAs), are produced by combining solution-phase block copolymer self-assembly and strain-programmed crystallization. The strained fibers consist of highly aligned nanoscale structures with alternating crystalline and amorphous domains, resembling the ordered and striated pattern of mammalian skeletal muscles. The usable work generated by the fibers is a combination of elastically stored energy (i.e., a spring) and energy stored through a phase change (i.e., transitioning between crystalline and amorphous solid states). The presentation highlights new insight into increasing the actuation properties of shape memory polymers.

BIOGRAPHY

Prof. Rob Hickey is currently an Associate Professor in the Department of Materials Science and Engineering at The Pennsylvania State University. He received his B.S. and Ph.D. in Chemistry at Widener University (2007) and the University of Pennsylvania (2013), respectively. Before starting his independent career at Penn State in 2016, he was a postdoctoral researcher at the University of Minnesota (2013 – 2016). The Hickey group investigates non-equilibrium chemical and self-assembly methods to create hierarchically ordered polymeric materials. Rob received the John H. Dillon Medal from APS (2025), the Humboldt Fellowship for Experienced Researchers (2023), the NSF CAREER Award (2020), the Air Force Office of Scientific Research Young Investigator Prize (2019), and he was recognized as an ACS PMSE Young Investigator in 2019.

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2/26/2025**

10:30 a.m.

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