

Collaborative Research : Surface and Actuation Kinetics of Stimulus-Responsive Hydrogels

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Sponsor:

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Principal Investigator:

John Dolbow

Co-Principal Investigator:

Stefan Zauscher

A collaborative effort between researchers at Duke University and Washington University is supported to investigate the surface and actuation kinetics of stimulus responsive hydrogels (SRHs). These materials are polymer gels that exhibit a large change in volume and surface physiochemical properties during a reversible phase transition. SRHs have the potential to overcome some of the fundamental limitations of micro-actuation and sensing devices that currently use electromagnetic or piezoelectric actuators. The overall characteristics of SRHs point toward devices that are biocompatible, operate with minimal power input, and provide a range of motion that is difficult to achieve with existing servomechanisms.

The proposed work will combine experiment, theory, and computation with the goal of advancing technologies based on these multifunctional materials. Experiments to be conducted at Duke will include:

1. optical measurements of volume displacement changes in SRHs using a novel optical-mechanical setup;
2. tribological measurements of SRHs using a parallel-disk rheometer; and
3. fine-grained, spatially resolved force adhesion and friction force maps using colloidal probe microscopy.

In conjunction with these efforts, researchers at Washington University will develop physically consistent bulk and interfacial constitutive models. Finally, numerical simulations of some of the experiments will be conducted at both institutions to correlate material parameters and gain predictive capabilities for rational design with SRHs.