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You are invited to join us for a talk as part of our semester colloquium series

Presenter: Dr. Ryan Poling-Skutvik

Date & Time: Friday October 18, 2024 (4:00 - 4:50 PM)

Location: East Hall Room 112

Title: Dynamics-Centered Design of Soft Materials

Abstract:
In contrast to traditional hard materials, such as metals and ceramics, soft materials are characterized by their deformability and viscoelastic relaxations. As a result, soft matter has the potential to replicate many characteristic properties of biological systems, including self-replication, hierarchical assembly, and functional signaling pathways. Unfortunately, synthetic soft matter systems often fail to achieve the performance required to fully mimic biological systems, in large part due to a lack of sufficient control over the interplay between dynamics and mechanics. Here, we demonstrate how dynamics must be integrated into the description of material properties and structure to approach biomimicry. With this approach, we investigate a novel class of soft matter building blocks – polymer-linked emulsions – that successfully replicate the structure, mechanics, and dynamics of soft biological tissue. On a fundamental level, this biomimicry arises from controlling the transition between the liquid-like dissipation of mechanical energy and the solid-like storage of elastic deformation. We further explore the implications of this stress-induced transition through the design of hydrogels with identical mechanics but different interparticle interactions. We demonstrate how soft materials are able to heal after failure and fully recover their elasticity through the rearrangement and restoration of interparticle associations. Overall, our findings provide insight into the relationship between structure and dynamics of soft materials, advancing our understanding of fundamental physics and achieving improved biomimetic control over their properties.

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