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Tech L150

10:00AM

Dynamics of Globular Polymers and the Problem of Blood Clotting

The dynamics of polymers in flow determine the rheological properties of polymeric liquids, which in turn have important applications in varied fields such as turbulent-drag reduction, plastic processing, food products or cosmetics. In our body the dynamics of biopolymers is also essential for many biological functions. In this talk I will present our work on understanding the role of globular polymers in an extremely important function for humans, namely, blood clotting. In particular, I will discuss the flow-induced unfolding of a long globular multimeric protein, the so-called Von Willebrand Factor, and its role during the initial stages of blood clotting. Complex flow geometries are considered and it is shown that elongational stresses can play an important, if not predominant, role in the process of unfolding. Flow-induced unfolding represents an attractive mechanism to mechanically activate polymers, which can be tailored to occur only under very precise chemical and physical conditions. The unfolding of globular polymers also has some attractive features such as surface-enhanced unfolding, a mechanism that is presumably exploited in our body. To finalize, I will elaborate on extensions of this work and their significance for creating novel responsive materials and adhesives.

2:00PM

Self-Assembled Microscopic Swimmers and Walkers

Nature has evolved a variety of locomotion schemes at the microscopic scale that are useful to search for nutrients, escape a threat, or fight foreign pathogens. These mechanisms are also used to transport viscous fluids, or direct the motion of cells in the human body. Among the most common motifs employed to propel organisms at the microscopic scale one finds cilia and flagella, both of which are long semi-flexible filaments. In this talk I will present our work on designing and characterizing theoretically and experimentally self-assembled microscopic swimmers and walkers. Our design in the former category is a sperm-like swimmer that is driven by a rotary magnetic field. This swimmer exhibits a nontrivial motion reversal transition above a critical frequency due to a drag-induced instability. In terms of ciliated surfaces, we have created carpets of chain-like rotors that self-assemble under the influence of a rotating magnetic field. Due to the coupling of rotation and translation near the surface, these systems behave as microscopic conveyor belts useful for transporting larger objects in a controlled fashion. I will finalize by presenting a perspective on future work in this area and discuss its potential for creating novel microfluidic systems.

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