Chemical Engineering Special Seminar

The Friction and Adhesion of Polymeric Systems: The Characterization of Thin Brush Lubricants And Superhydrophobic Surface Interactions

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108 West Village H

Interest in friction and adhesion has increased as a result of research developments into both solid and fluid interfaces. Achievements in the field of nanoscale devices have increased demand for improved lubricants on that length-scale, as the dominance of surface effects makes friction and adhesion of particular concern. These phenomena also have important contributions in fluid flow, as advancements in superhydrophobic surfaces have allowed for significant levels of slip and drag reduction. In both areas of research, the influence of polymers on interfacial interactions has the potential for reducing friction and adhesion, thus resulting in improved conditions for a wide range of applications.

In this seminar, I will discuss efforts to apply polymeric solutions to both fields of research to create conditions of low friction and adhesion. Specifically in terms of solid friction, thin films of polydimethylsiloxane (PDMS) networks tethered to self-assembled monolayers (SAM) were developed to function as optimal microscale lubricants. These PDMS-SAM hybrids were found to exhibit extremely low friction coefficients, as low as 0.0012, which is the lowest ever recorded for a dry lubricant. The friction properties were determined to result from low shear stress and dramatically small contribution of adhesion to the friction force. In investigating fluid friction, polymeric flow over superhydrophobic surfaces was studied in an attempt to enhance the drag reduction and slip phenomena that can occur in each separate component. Goniometry and microfluidic measurements were conducted to determine interfacial interactions and friction properties. Overall, I will discuss results and analysis in the context of previous friction and adhesion studies, as well as potential future work on drag reduction and lubrication experiments and applications.

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Dr. Lucas J. T. Landherr received his PhD in Chemical Engineering from Cornell University in 2010, where he developed a series of thin films PDMS lubricants that exhibited dramatically low friction coefficients. He was awarded an NRC Fellowship and conducted his postdoctoral studies at the National Institute of Standards and Technology, where he continued his research by analyzing polymeric interactions at superhydrophobic interfaces. He has received several teaching awards and currently works as an Assistant Academic Specialist in the Chemical Engineering Department at Northeastern University.