

Mechanical Engineering Department Seminar

3:30pm October 31, 2018

1130 Mechanical Engineering

111 Church Street SE, Minneapolis, MN 55455

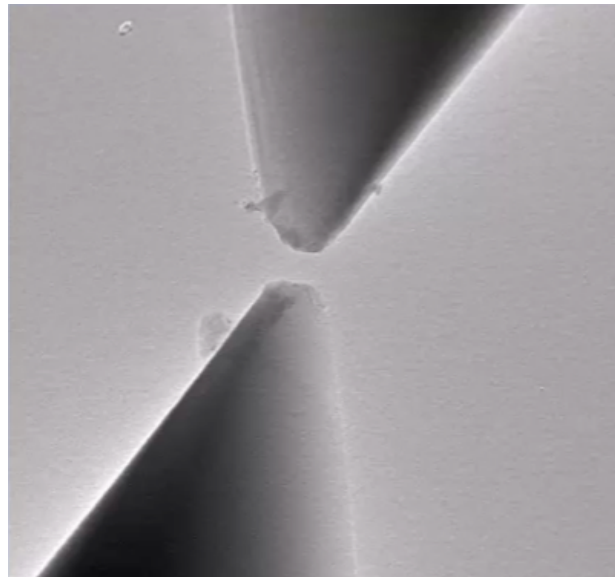


Fundamental Insights into Adhesion, Friction, and Wear via Nanoscale In Situ Approaches

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New insights into friction and lubrication from atomic force microscopy (AFM) are presented. First, nanocontacts with 2-dimensional materials like graphene are discussed, where friction depends on the number of layers. An initial model attributing this to puckering [1] is now enhanced by molecular dynamics (MD) simulations showing a strong role of energy barriers due to interfacial pinning and commensurability [2]. I will then discuss nanoscale asperity-on-asperity sliding experiments conducted using a nanoindentation apparatus inside a transmission electron microscope, allowing for atomic-scale resolution of contact formation, sliding, and adhesive separation of two silicon nanoasperities. Forming and separating the contacts without sliding revealed small adhesion forces; sliding during resulted in nearly 20 times increase. These effects were repeatable multiple times. We attribute this surprising sliding-dependent adhesion to the removal of passivating terminal species (likely hydrogen atoms) from the surfaces, followed by re-adsorption of these species after separating the surfaces.



Bio: Robert Carpick is John Henry Towne Professor, Dept. of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, where he has served as Department Chair since 2011. Previously, he was a faculty member at the University of Wisconsin-Madison (2000-2007). He received his B.Sc. from the University of Toronto (1991), and his Ph.D. from the University of California at Berkeley (1997), both in Physics, and was a postdoc at Sandia National Laboratory (1998-1999). He studies nanotribology, nanomechanics, and scanning probes. He is the recipient of a NSF CAREER award (2001), the ASEE Outstanding New Mechanics Educator award (2003), the ASME Newkirk award (2009), an R&D 100 Award (2009), and is a Fellow of the American Physical Society, the AVS, the Materials Research Society, and the Society of Tribologists and Lubrication Engineers. He holds 6 patents and has authored over 170 peer-reviewed journal publications.