PURDUE UNIVERSITY | Materials Engineering COLLEGE OF ENGINEERING

Understanding the Behavior of Contacting Surfaces using *In situ* Experiments in a Transmission Electron Microscope

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Abstract: Contacting, sliding surfaces are found in nearly every mechanical system from transportation and manufacturing to biomedicine and energy. The field of *tribology* seeks to explain the fundamental mechanisms underlying adhesion, friction, and wear at these surfaces. However, experimental investigation is complicated by the fact that the contacting interface is buried from view, and inaccessible with conventional experimental tools. This talk will discuss nanoscale contact experiments performed inside of a transmission electron microscope (TEM). This setup enables direct *in situ* observation of the contact interface while controlling displacement of the two bodies and measuring normal forces with sub-nanonewton resolution. Real-time electrical biasing of the nanocontact enables the characterization of the instantaneous electrical properties of the contact. These experiments are complemented by atomistic simulations of model materials that are matched in terms of shape, size, crystal structure, and loading conditions. Together, these investigations enable unprecedented insights into the atomic-scale phenomena governing the behavior of contacting surfaces.

In the first part of the talk, I will discuss investigations into adhesion and wear of nanoscale silicon probes. These findings demonstrate the atomic-scale interactions that govern contact and how these depend on load. In the second part of the talk, I will discuss the contact of platinum nanoprobes as a model for metallic contacts. Results from these investigations demonstrate the strong and unexpected role that dislocations play in determining contact size. Taken together, these findings have direct application to emerging nanoscale technologies, including nanoscale electromechanical devices, scanning probe metrology, and nanomanufacturing. They also reveal fundamental scientific insights into contacting surfaces that can be scaled up to devices at all length scales.

Biography: Tevis D. B. Jacobs is an assistant professor in the Department of Mechanical Engineering and Materials Science at the University of Pittsburgh. He received his Ph.D. in Materials Science and Engineering from the University of Pennsylvania, where he also did his post-doctoral work. He received M.Sc. and M.Phil. degrees from Stanford University and Cambridge University, respectively. He is a recipient of the National Science Foundation CAREER Award. His research focuses on uncovering the atomic-scale mechanisms governing the mechanical and physical properties of surfaces and interfaces.