The origin of friction: do we know enough to predict friction?

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Abstract

Since the term Tribology was coined in 1966 by Peter Jost in his report on the cost of friction, wear and corrosion to the UK economy (1.1-1.4% of UK GDP). As a result, the UK government established several national centers on Tribology. Since then, the world has invested extensively to the study of friction, wear, and lubrication. After 52 years, we have gain tremendous knowledge on Tribology. Many technical problems have been solved and the technology of wear prevention through material science and lubrication. Today, carbon emission has become the top priority to combat global warming. In transportation, fuel economy improvement is the top priority to reduce oil consumption and emission, which rests on the ability of controlling friction between sliding surfaces.

How much do we know about friction? Well, friction is a transient quantity as a result of the energy dissipation when one surface slides against another surface under load. It depends on numerous factors, such as materials properties, speed, load, lubrication, and surface roughness, and humidity, etc. So if all these parameters are defined, then we will know the friction? Well, not necessarily……What is the gap between what we know about friction and our ability to predict friction a priori?

The lecture will trace the origin of friction, how it evolves, and how our understanding of it is marred by misconceptions and too many exceptions. A series of simple scratch tests on well-defined substrates will be used to illustrate the nature of resistance force, friction as we know it.

Biography

Hsu studied boundary lubrication under Prof. Elma Klaus at Pa State University. After graduation, he joined Amoco Chemicals to develop lubricant additives. After 4 years, he joined National Institute of Standards and Technology, a US National Lab. to lead the effort of Tribochemistry, Nanotechnology, and materials science. In 2009, he joined George Washington University to lead the Energy Initiative.

His research interest includes new materials lubrication, tribochemistry, wear maps, wear prediction, and nanolubrication. Recently, he has an industrial consortium under DOE sponsorship to develop the next generation of fuel efficient lubricants and chemistries.

He has published over 250 papers, books, and reports. He has received 8 US patents and currently has 4 world patents pending. He has over 5000 citation with the H index of 40 and has given over 50 Plenary Lectures and Keynote in many countries. He is a Fellow of STLE, Fellow of ASME, and has over 130 graduated students, postdocs, and visiting professors studying in his laboratory.