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DEPARTMENT OF MECHANICAL ENGINEERING

SEMINAR

to be held on Thursday, January 3, 2019, 11:00

in the Seminar Room (#117) of the Mechanical Engineering Building (#55)
at the Campus of the Ben-Gurion University of the Negev

Reconstruction Surface Potential from Nano-tribological Measurements

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Abstract:

Friction is a phenomenon encountered in everyday life, ranging from the macro- (earthquakes, violin playing, machinery, etc.) to the nano-scales (electronic devices, biological machinery etc.), where two surfaces come into contact and move with respect to each other, resulting in an irreversible energy dissipation. One of the key features that characterize friction is the underlying interfacial interaction potential. Understanding the role of dissipation energy and surface potential in frictional mechanisms is essential for tribology, nanoscale fabrication, catalysis, adhesion and so on. To get an adequate estimation of the free energy landscape of an actual surface, high quality data is required. This necessity is met in measurements performed with Atomic Force Microscope (AFM). The AFM enables probing nanoscale frictional forces due to its ability to approach the 'single-asperity' level, and measure the dynamical interaction between a cantilever tip and the surface of interest, resulting in atomic stick-slip force pattern. In such experiments, estimation of the surface energy corrugation is typically carried out within the phenomenological framework of the Prandtl-Tomlinson model, which does not provide comprehensive information on the surface potential. We propose to face this inverse problem and reconstruct physically meaningful potential maps out of the recorded friction signals through application of the nonequilibrium work relation, or more specifically, the Jarzynski equality. Such implementation is beneficial to technological applications as molecular optimization of catalysts, and additionally to micro- and nano-electro-mechanical systems (MEMS and NEMS), where high surface-to-volume ratio amplifies damages and energetic inefficiency caused friction.

Bio: Dr. Ronen Berkovich earned his B.Sc. degree in Chemical Engineering from the Technion. After spending several years as a process-engineer in the industry, he went on to pursue a Ph.D. (direct) in theoretical Chemical Physics at Tel-Aviv University, under the supervision of Prof. Yossi Klafter and Prof. Michael Urbakh. He then moved to Columbia University at New-York City as a post-doctoral fellow under mentoring of Prof. Julio Fernandez. Since 2013, Dr. Berkovich is a faculty member in the Department of Chemical Engineering at Ben-Gurion University. His research focuses on experimental and theoretical aspects of statistical mechanics in the fields of single molecule biophysics and nanotribology (atomic friction).

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