Ben-Gurion University of the Negev
Blaustein Institutes for Desert Research
The Swiss Institute for Dryland Environmental and Energy Research
Alexandre Yersin Department of Solar Energy and Environmental Physics

Title:

Atomic Scale Friction: From Understanding to Control

Michael Urbakh

School of Chemistry, Tel Aviv University

Abstract:

Frictional motion plays a central role in diverse systems and phenomena that span vast ranges of scales, from the nanometer contacts inherent in micro- and nanomachines and biological molecular motors to the geophysical scales characteristic for earthquakes. Despite the practical and fundamental importance of friction and the growing efforts in the field, many key aspects of dynamics of friction are still not well understood. One of the main difficulties in understanding and predicting frictional response is the complexity of highly non-equilibrium processes going on in any tribological contact which include detachment and re-attachment of multiple microscopic contacts (bonds) between the surfaces in relative motion while still in contact.

In this lecture I will discuss microscopic models, which establish relationships between the interfacial dynamics and frictional phenomena. In particular, I will show that experimentally observed velocity and temperature dependencies of nanoscale friction can be rationalized by explicitly considering the influence of temperature on the formation and rupturing of microscopic contacts. Understanding microscopic mechanisms of frictional phenomena allowed us to suggest new ways to switch and control surface interactions, reversibly and non-invasively, at the molecular level, and thereby tune friction. I will focus on three approaches to control frictional forces: (i) using incommensurate "superlubric" contacts, (ii) via application of electric field and (iii) via externally imposed vibrations of small amplitude and energy. The ability to control and manipulate friction during sliding is extremely important for a large variety of applications in automotive and electronics industries, and even in medicine.

Date & Location:

Tuesday, December 19, 2017, 11:00
Lecture room, Physics Building (ground floor)