The Iby and Aladar Fleischman
Faculty of Engineering
Department of Materials Science and Engineering

אוניברסיטת תל-אביב
TEL AVIV UNIVERSITY

הפקולטה להנדסה
ע"ש איבי ואלדר פליישמן
המחלקה למדע והנדסה של חומרים

You are cordially invited to attend this special seminar to be held on

Tuesday, March 1st, 12:00
Room 206, Wolfson Building of Mechanical Engineering

Electromechanical Properties of Multi-Layer Graphene Contacts

Dr. Elad Koren
IBM Research - Zurich

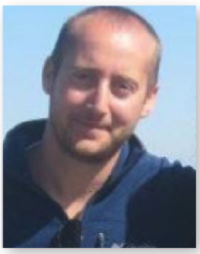
Graphene and layered materials in general exhibit rich physics and application potential owing to the exceptional physical properties which arise from the intricate π-orbital coupling and, in particular, from the symmetry breaking in twisted bi-layer systems.

From a mechanical aspect, a rotational mismatch is known to strongly suppress adhesion and friction forces, an effect which is known as superlubricity.

Despite of the potential technological relevance, rotationally mismatched (non-commensurate) 2D layered systems are still only poorly understood. We performed an experimental study using cylindrical pillars made of Highly Oriented Pyrolytic Graphite (HOPG). We show that the friction force originates from a genuine lattice interaction between the rotated sliding surfaces, hall mark signatures being the scaling of the friction force with the cross-section area to the power of 0.35 and the observation of lattice peaks in the power spectrum of the friction force. The dominant conservative shear force is due to the interface adhesion energy which gives rise to a force opposing the creation of new surface area. Exploiting these principles we fabricated bi-stable nano-mechanical memory cells and rotational bearing structures in which the rotation axis is locked solely by adhesion forces.

In addition, we experimentally address the electrical transport across a bilayer graphene interface with a well-defined and in-situ controllable rotation angle between the layers (angular precision of ~ 0.1º). The overall measured angular dependence of the conductivity is consistent with a phonon assisted transport mechanism which preserves the electron momentum of conduction electrons passing the interface. An intriguing observation are sharp conductivity peaks at specific angles correspond to a commensurate crystalline superstructure leading to a coherent 2-dimensional electronic interface state. Such states, predicted by theory, form the basis for a new class of artificial 2-dimensional bi-layer materials in weakly coupled layered systems with hitherto unexplored properties and applications.

Biosketch



Elad Koren is a principle investigator in the Physics of Nanoscale Systems group of the Science & Technology department at IBM Research–Zurich. His research is focused on nanoscale electromechanical properties of 2-dimensional (2D) layered materials. Elad holds B.Sc in Biophysics and M.Sc in Physical Chemistry with the emphasis on photovoltaics, both are from Bar Ilan University, Israel. He received his PhD degree in Engineering, Physical Electronics from Tel Aviv University, Israel, in 2012 for his dissertation entitled "Nanoscale-electronic characterization of Si nanowires" under the supervision of Prof. Yossi Rosenwaks.