Chez Pierre

Presents ...

Wednesday December 4, 2024

1:00 pm -2:00 pm

Duboc Room – 4-331

Special Chez Pierre Seminar

Moshe Ben Shalom, Tel Aviv University

"Super-lubircant Switching of Coupled Periodic Crystals ".

Electric switching of crystalline materials away from their structural phase transition temperature is considered impractical due to the large energy required to break solid bonds. Recently, however, we demonstrated electric field switching of periodic van der Waals (vdW) stacking configurations (so-called vdW polytypes) at room temperature, much below their slipping transition temperature into disordered turbostratic stackings. Apparently, the external field is sufficient to shift successive layers against relatively weak vdW attraction by sliding preexisting boundary dislocations between structural configurations with opposite internal polarizations [1]. In a couple of recent works, we were able to extend this electric switching control to many vdW polytypes with various stacking-dependent properties, enabling appealing multi-ferroic responses [2-4]. The challenge lies in maintaining the commensurate structural stability while supporting dislocation nucleation and sliding instabilities between the layers for switching [5,6]. The talk will discuss these delicate elastic interactions, the electronic interlayer band hybridizations, and the diverse stacking-dependent transport, optical, and magnetic properties. Focusing on the typical stacking energies, and discrete symmetries in polytypes made of mono and binary compound monolayers, I will aim to emphasis appealing "Slide-Tronics" opportunities laying ahead, such as interfacial ferroelectricity [1], ladder-like cumulative polarization [2,3], elemental and yet polar graphitic polytypes [4], and elastically coupled switching dynamics of nanometer scale single-crystalline islands [5,6].

1]"Interfacial ferroelectricity by van-der-Waals sliding"
https://arxiv.org/abs/2010.05182 (Science, 2021)
[2]"Cumulative Polarization in Conductive Interfacial Ferroelectrics"
https://arxiv.org/abs/2206.12215 (Nature, 2022)
[3] “Polarization Saturation in Multilayered Interfacial Ferroelectrics”
https://arxiv.org/abs/2407.20303 (ADMAT, 2023)
[4]"Spontaneous Electric Polarization in Graphene Polytypes"
https://arxiv.org/abs/2305.10890 (ADPR, 2023)
[5]"Sliding van der Waals Polytypes"
https://arxiv.org/abs/2408.06088 (Nature Review Phys. 2024)
[6]"Switchable Crystalline Islands in Super Lubricant Arrays"
https://arxiv.org/abs/2409.07225 (Nature, in press)