Unveiling the tunneling phenomena in graphene-graphene homojunctions for emerging device applications

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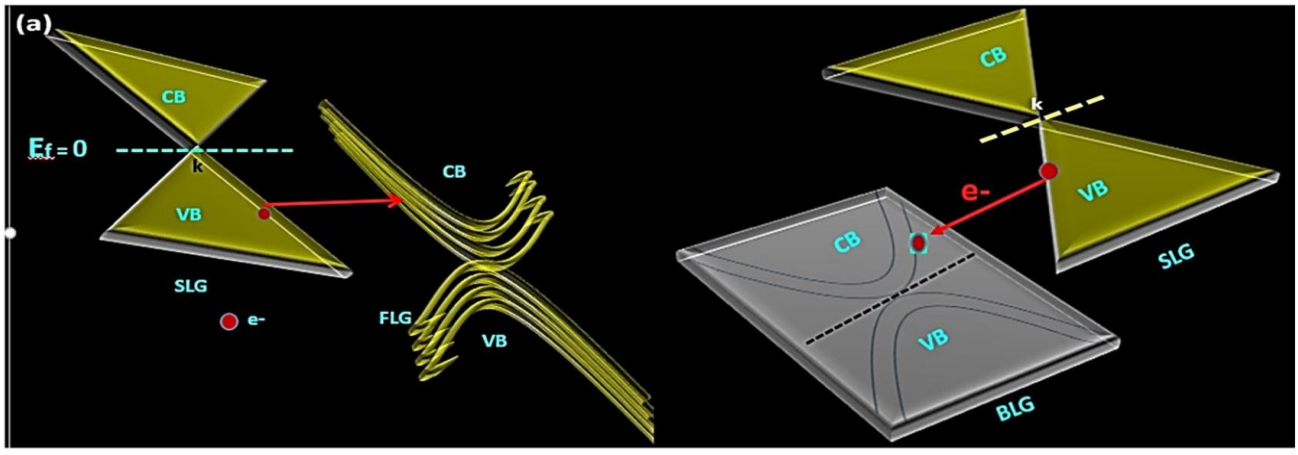
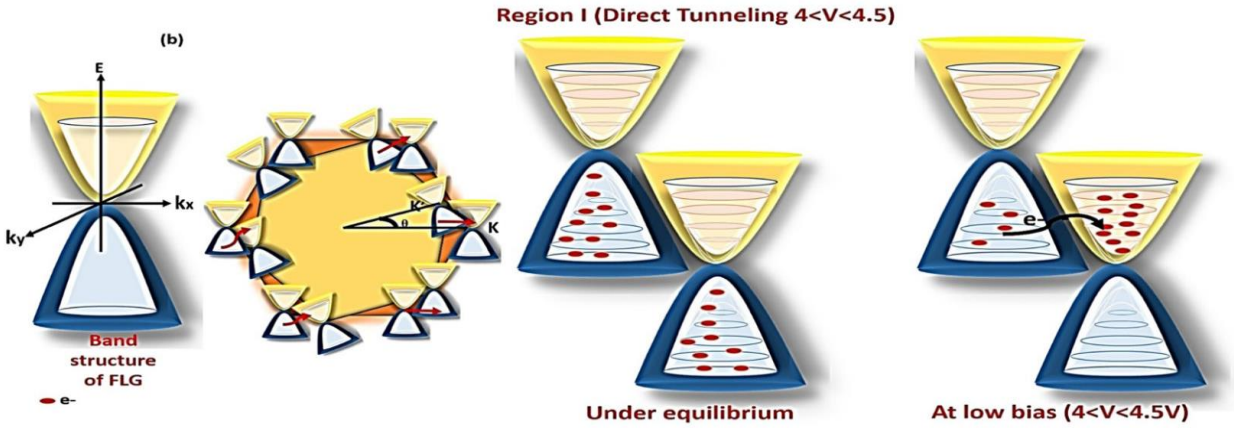
Graphene, the 2D form of carbon based material exists as a mono layer arrangement of atoms in a honeycomb lattice, has sparked the science and technology sectors in view of its astonishing electrical and thermal properties, together with its elasticity and mechanical strength.
Motivated by the idea that high-quality graphene always produces innovative aspects of physics. In this outline, a novel class of two dimensional (2D) assembly namely thickness controlled homo-junctions with a configuration similar to graphene–insulator-graphene is introduced in this work. We demonstrate 2D-2D quantum tunneling between two graphene stacks in which van der Waals gap serves the purpose of tunneling barrier. The nonlinear I-V characteristics with improved current switching ratio (I_{on}/I_{off}) of ~10^6 coupled with counterclockwise current hysteresis which are the signatures of a memristive devices has been validated in the tunneling regime. It is the first time to report on revealing thickness modulated 2D homo junctions in exfoliated graphenic material and to disclose the involved tunneling mechanism for switching applications. This work promises well for the possibilities of graphene sheets for the realization of two terminal configured devices as a substitute of three terminal graphene based field effect transistors (GFETs) in the area of resistive switching memories. As graphene being a versatile candidate possessing durable future in nano-electronics, therefore understanding deep insights of its charge carrier transport mechanism under range of bias voltages is prerequisite. Strikingly, an unconventional approach for improving on/off ratio of graphene based resistive switching devices has been put forward.





(a) Pictorial representation of band to band tunneling of charge carriers in SLG-FLG, SLG-BLG (b) FLG-FLG configuration.

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