Electron Transport in Crossed Graphene Nanoribbon Devices: 4-Terminal *ab initio* Simulations

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Abstract

With the aim of exploring the potential of graphene in electronics, a lot of effort has been spent on the energy-gap engineering so to allow having an off state. Recently, it has been reported theoretically a current switching mechanism by voltage control in a graphene crossbar made by two 14-armchair nanoribbons (GNRs) rotated by 90°[1].

It has been also recently shown that different stacking in bilayer GNRs leads to significant changes on the electronic properties [2]. Therefore, in order to investigate the possibilities of using crossed GNRs as ON/OFF devices, we have studied the electronic and transport properties of those systems as function of their relative rotation angle and inter-layer distance.

Our calculations were performed with TranSIESTA code [3], which has been recently generalized, based on ref. [4], to consider $N \geqslant 1$ arbitrarily distributed electrodes at finite bias. We find that the transmission along each individual GNR and among them strongly depends on the stacking. For a 60°rotation angle, one finds an almost perfect match of the ribbons' honeycomb lattice in the crossing region, resulting in a strong scattering effect that also translates into an increased inter-layer transmission.

References:
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