A fully tunable Klein tunneling contact junction in graphene

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Boron nitride supported or encapsulated graphene exhibit a large mobility with a ballistic length limited by acoustic phonons to at room temperature. It opens the way for a ballistic graphene electronics including standard Field effect transistors but also new architectures exploiting geometrical Dirac Fermion optics [1]. The main limitation to the performance of ballistic devices becomes the contact resistance, an issue which has been mostly addressed empirically.

A graphene contact is a composite element made of two intrinsic contributions: the metal-graphene tunnel resistance and the contact junction resistance. The latter is due to the discontinuity between metallic doping in the contacted area and field-effect doping in the channel. The junction transparency and resistance depend on the junction length and the doping on both sides. Metallic doping itself stems from the work function imbalance between graphene and metal; the resulting electronic transfer is partially screened by the metal itself depending on the thickness of the double charge double layer at the metal-graphene interface [2].

In this work [3] we address directly the tunability of a contact junction using independent local back gates for the channel and the contacts. With 30-nm inter-gate gaps and h-BN gate insulator, we realize high-transparency and fully tunable contact junctions. Our device demonstrates contact doping reversal and active contact doping control up to GHz frequencies. This finding opens new functionalities in graphene electronics and optoelectronics. As an example we demonstrate the gain switching capability of our bi-gate device.

References

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Figures

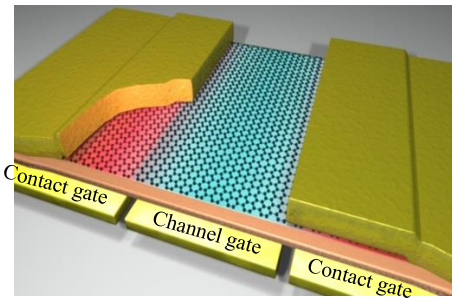

Figure 1. Graphene device with local and independent channel and contact gating.