Graphene *p-n* junctions (GPNJ) for Electrical Switching

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The strong angular dependence of carrier transport[1] in GPNJ can be used to make devices that enable a new class of architecture for reconfigurable logic and interconnects[2]. In this work, this angular dependence of carrier transport is experimentally verified in a systematic study of the GPNJ resistance as a function of the angle between the graphene channel and the junction. A *p-n* junction in a graphene channel is created electrostatically by the bias on a pair of split-gates buried under the gate dielectric, as shown in Fig. 1. The total resistance of 2-terminal graphene devices is measured as a function of doping induced by both the gates, as shown in Fig. 2. From the total resistance, the junction resistance is extracted by subtracting the contact and channel resistances. When the junction resistance is plotted for different angles between the channel and the junction, an enhanced resistance peak for tilted channels is observed, as shown in Figs. 3 (CVD-grown graphene) and 4 (mechanically exfoliated graphene). Calculations done in the ballistic transport limit reproduce these observed features.

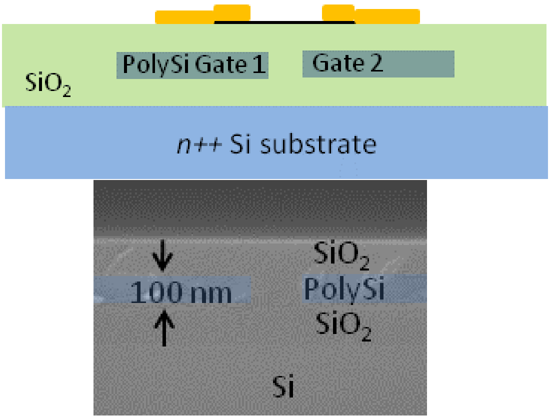

Fig. 1. Wafer cross-section (a) schematic, (b) SEM image, showing the buried gates.

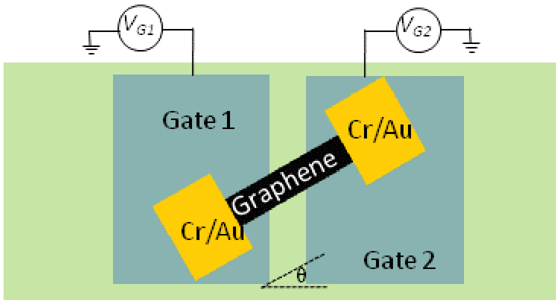

Fig. 2. Schematic top view of tilted GPNJ created on top of buried split-gates.

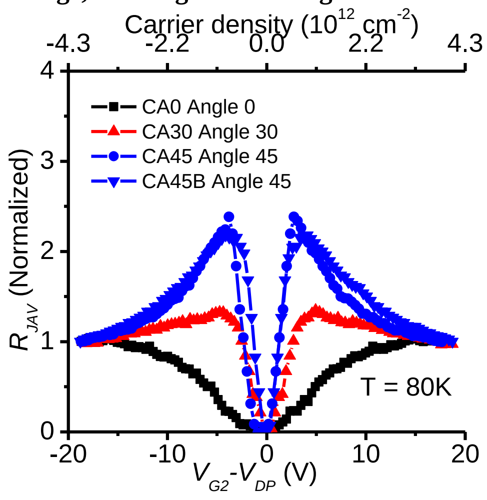

Fig. 3. Normalized junction resistance as a function of. doping level V_{G1}-V_{DP} for different channel-junction angle for CVD-grown GPNJ.

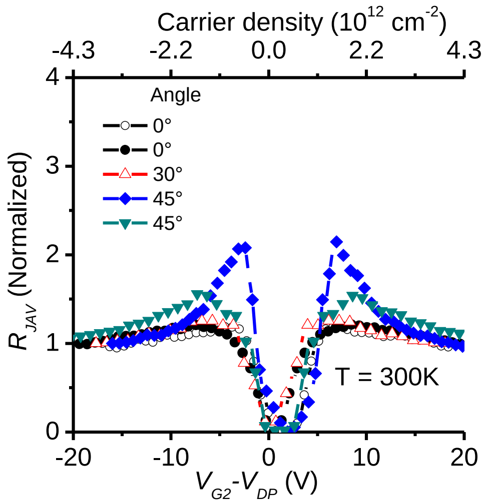

Fig. 4. Normalized junction resistance as a function of doping level V_{G1}-V_{DP} for different channel-junction angle for mechanically exfoliated GPNJ.

[1] Cheianov et al. *Phys. Rev.* B **74**, 041403(R), (2006)
[2] Tanachutiwat et al. ***47th*** *ACM/IEEE DAC*, 883-888, (2010)