Screening property of bi-layer graphene investigated with scanning gate microscopy

Vishal Panchal [1,2], Alexander Tzalenchuk [1] and Olga Kazakova [1]

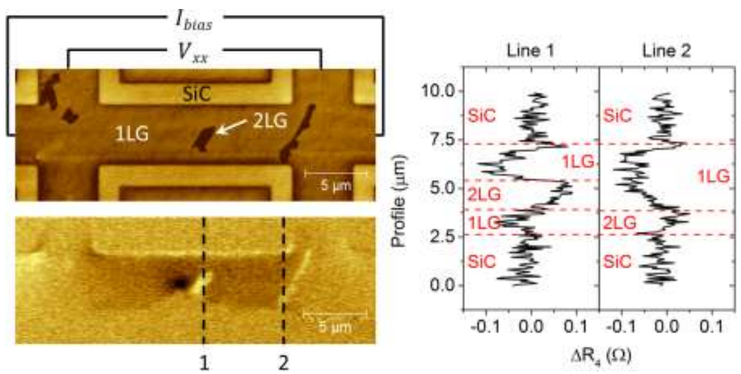
[1] *National Physical Laboratory, Hampton Road, Teddington, TW11 0LW, UK*
[2] *Royal Holloway, University of London, Egham Hill, Egham, Surrey, TW20 0EX, UK*

Devices fabricated out epitaxial graphene grown on SiC have shown great promise for commercialization [1,2]. However, due to the complicated growth procedures of epitaxial graphene, the best of samples contain ~95% single-layer (1LG) and ~5% bi-layer (2LG) graphene coverage [3]. Such samples have been shown to exhibit a work function difference of ~110±21 meV between 1LG and 2LG [4], which can affect the transport properties of graphene devices. Here, we investigate how the 2LG islands screen the local electric field produced by the scanning probe.

Scanning gate microscopy (SGM) is performed using an electrically conductive probe scanning the double-cross graphene Hall bar at a constant 15 nm lift height, while a DC bias voltage (V_g = +3 V) is applied to the probe. The device is current biased at I_{bias} = 10 µA and a lock-in amplifier, referenced to the mechanical resonance of the cantilever, measures the AC longitudinal voltage (V_{xx}) between the two crosses. The SGM image is generated by recording V_{xx}, pixel by pixel.

The SGM image (Fig. 1) shows a decrease in resistance of ΔR_4 = –80 mΩ with respect to the background when the probe is gating the 1LG channel. However, gating at the 2LG screens the electric field, restoring the resistance of the channel to the background value (dashed line #2). Moreover, gating at the 2LG located at the center of the channel has an opposite effect of increasing the resistance by R_4 = +70 mΩ (dashed line #1). Thus, we show that the presence of isolated 2LG islands can affect transport measurements. The screening efficiency will depend on geometry of 2LG domains and their exact position with respect to the leads. These measurements allow investigating the possible effect of decoupling between individual layers of graphene.

[1] V. Panchal *et al.*, J. Appl. Phys. **111**, 07E509 (2012).
[2] Y.-M. Lin *et al.*, Science **327**, 662 (2010).
[3] V. Panchal *et al.*, 12th IEEE Conf. on Nanotechnology (2012).
[4] O. Kazakova *et al.*, Crystals. **3**, in press (2013).



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