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Wafer-scale homogeneity of transport properties in epitaxial graphene

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Graphene grown on silicon carbide by high-temperature annealing (SiC/G) is a strong contender in the race to large-scale graphene electronics. A major challenge in this technology is to produce homogeneous monolayer graphene on a wafer scale. When the electronic properties of SiC/G are probed on a large scale, variability of ~1-2 orders of magnitude in resistivity, carrier density and mobility have been reported [1]. It is of great practical importance to understand the origin of wafer-scale variations in view of future large-scale integration of SiC/G devices.

In this work we report that monolayer SiC/G is electrically homogeneous at the wafer scale and that the macroscopic variations of electrical parameters of SiC/G are related to the presence of bilayer graphene domains, a byproduct of graphene growth on SiC [2]. By carefully aligning micron scale Hall bar devices on strictly monolayer regions of SiC/G, we show that 14 monolayer devices distributed over a macroscopic distance show no deviation in carrier density/mobility. In contrast, a spread in electrical properties is observed for SiC/G devices that contain bilayer domains, with variations directly linked to the amount of bilayer in each device. Our findings highlight the importance of growing homogeneous graphene on SiC in order to enable large-scale integration of SiC/G-based devices.

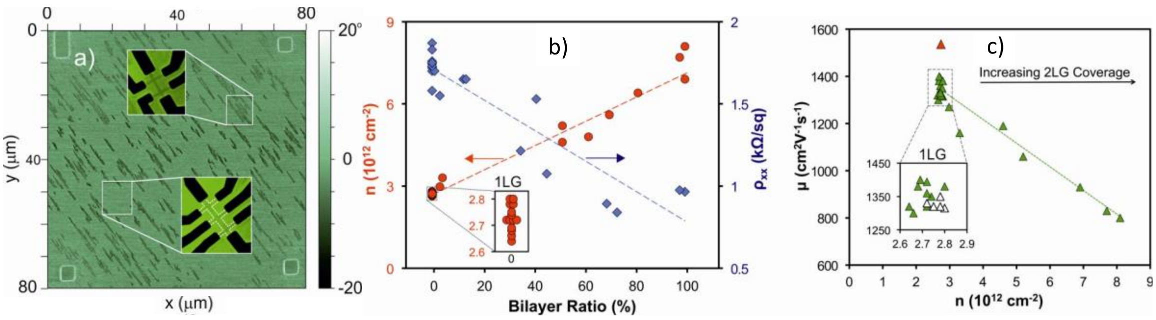

Fig. 1 Hall bar devices (25) patterned on well-defined regions of SiC/G (a) Phase-contrast AFM scans show bilayer regions (dark) in otherwise monolayer SiC/G (b) Carrier density and mobility at room temperature. were found to depend on the bilayer ratio. (c) Electron doping (resistivity) increases (decreases) linearly for increasing proportion of bilayer graphene in the device. Note a tight spread of monolayer carrier density (inset).

References

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2. Yager, T. et al., Carbon, 87, 409 (2015)

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