Mapping surface potential of epitaxial graphene on SiC(0001) using ultrahigh-vacuum Kelvin probe microscopy

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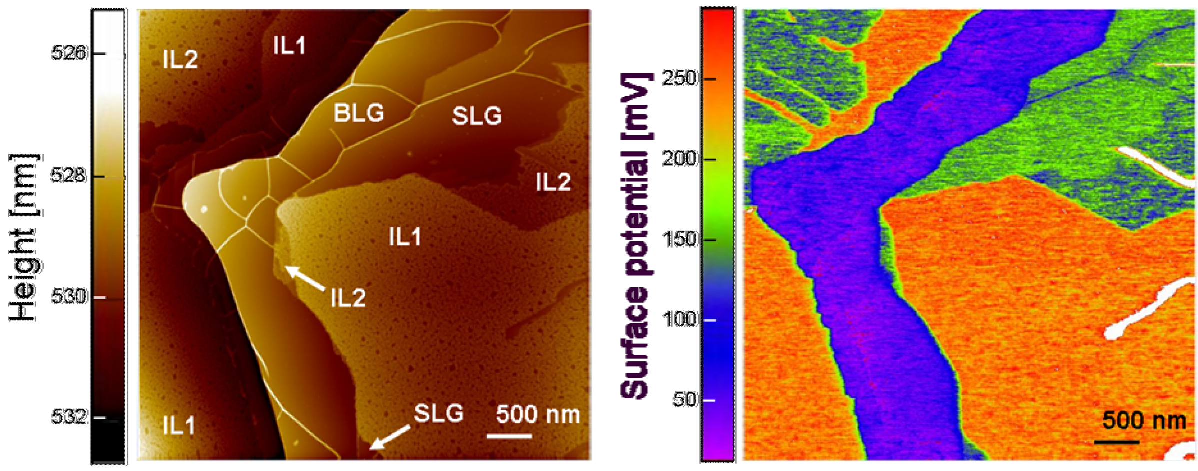
Growth of epitaxial graphene on SiC offers a possible route to wafer-scale production of device-quality graphene. However, the mobility of charge carriers in SiC(0001) epitaxial graphene is generally measured to be an order of magnitude lower than exfoliated graphene on SiO_2, despite the considerable topographic roughness and charge disorder of SiO_2. Further, the extent to which charge disorder governs the mobility in SiC epitaxial graphene has not been firmly established.

Here we present ultrahigh-vacuum scanning Kelvin probe microscopy (SKPM) measurements of IFL (interfacial layer), 1L, and 2L epitaxial graphene on SiC(0001). We map the surface potential over length scales from few-nm to micron scale, and extract its spatial correlation. Measurements quantify both the lateral variation in surface potential within a layer and the potential step between layers. The 1L – 2L potential step is measured to be ~100 meV (this value is consistent with previous measurements [1], and indicates moderate doping $n \leq 5 \times 10^{12}$ cm^{-2}), and its profile provides a metric for spatial resolution in the SKPM measurement. The surface potential variation within the graphene monolayer is 4 meV rms, a factor 10 lower than that observed for graphene/SiO_2. Greater variation is found within the IFL, where the lateral variation is 32 meV rms (yet 3× lower than SiO_2). These results indicate a relatively smooth potential landscape, yet low carrier mobility, and thus challenge present theoretical understanding of transport in graphene. This work is supported by the University of Maryland MRSEC under Grant No. DMR 05-20471 and the U.S. ONR MURI. MRSEC Shared Experimental Facilities were used in this work, and additional infrastructure support was provided by the UMD CNAM and NanoCenter.



References

[1] Y.-J. Yu *et al.* Nano Letters **9**, 3430-3434 (2009).