MAR11-2010-002016

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

The Ordering and Electronic Structure of Multilayer Epitaxial Graphene on SiC[1]

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The structural definition of graphene as a single sheet of hexagonal carbon limits how we view this material. It is the electronic properties of a single isolated graphene sheet that actually defines and motivates current graphene research. Remarkably, the best example of the idealized band structure of graphene comes does not come from a single graphene layer but from multilayer films grown on SiC. Multilayer epitaxial graphene (MEG) not only shows all the 2D properties expected for an isolated graphene sheet, but it the scalability to large scale integrated carbon circuits. I will show that the reason for this remarkable property, i.e. that a multilayer graphene films behaving like a single graphene sheet, is due to MEG's unique stacking. MEG films have a quasi-ordered rotational stacking that breaks the Bernal stacking symmetry associated with graphite. Angle resolved photoemission spectroscopy (ARPES) data demonstrates that the bands are linear at the K-point of these films. We can also show that the rotated stacking is highly ordered and that less than 20% of the graphene sheets in the film are Bernal stacked. I will also show that ARPES measurements on MEG films demonstrate serious inadequacies with both tight binding and ab initio formalisms. In particular the data shows no reductions in the Fermi velocity or the formation of Van Hove singularity that have been consistently predicted for this material.

[1]I wish to acknowledge funding from the NSF under Grants No. DMR-0820382 and DMR-1005880.