MAR14-2014-020862

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Interlayer strain solitons in bilayer graphene

PAUL MCEUEN, Cornell University

The interlayer registry between graphene layers can have dramatic effects on the physical and electronic properties of few-layer graphene. For example, in the presence of a perpendicular electric field, a band gap appears in the electronic spectrum of so-called Bernal-stacked graphene. This band gap is intimately tied to a structural spontaneous symmetry-breaking, where one of the graphene layers shifts by an atomic spacing with respect to the other. This shift can happen in multiple directions, resulting in stacking domains with soliton-like structural boundaries between them. Theorists have recently proposed that novel electronic states exist at these boundaries, but very little is known about their structural properties. Here we use electron microscopy to measure with nanoscale and atomic resolution the widths, motion, and topological structure of soliton boundaries and related topological defects in bilayer graphene [1]. We find that each soliton consists of an atomic-scale registry shift between the two graphene layers occurring over 6-11 nm. We infer the minimal energy barrier to interlayer translation and observe soliton motion during in-situ heating. The abundance of these structures across a variety samples, as well as their unusual properties, suggests that they will have substantial effects on the electronic and mechanical properties of bilayer graphene.

[1] Jonathan S. Alden, Adam W. Tsen, Pinshane Y. Huang, Robert Hovden, Lola Brown, Jiwoong Park, David A. Muller, and Paul L. McEuen, PNAS 110, 11256-11260 (2013)