Electronic characterization of 9A-type GNR on H:Si(100) using scanning tunneling microscopy and spectroscopy

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We present the electronic characterization of a new solution-synthesized graphene nanoribbon (GNR). The GNR was synthesized with two different precursors to form coves along the length of an N=9 armchair GNR. The GNR also contains two different functional end groups, NO_2 and NH_2, with each synthesized to attach to the two different precursors. Atomically precise graphene nanoribbons with functional end groups have the potential for further modification and integration into complex electronic structures. We use the dry-contact transfer (DCT) method to exfoliate the GNRs onto hydrogen passivated Si(100) in a room temperature ultra-high vacuum (UHV) scanning tunneling microscope (STM). The bandgap and density of states are probed using scanning tunneling spectroscopy (STS) and current imaging tunneling spectroscopy (CITS). We find that GNRs tend to cluster in groups and potentially form weak bonds at the functionalized ends. We also find evidence of missing phenyl groups during synthesis which form 120° turns and extra-large coves in the final structure of the GNR as shown in figure 1. Simulation data indicates that the DFT bandgap is 1.4 eV and an increased density of states over the NO_2 end group. Experimentally we see that one end of the GNR appears to be metallic using STS, which we attribute to the NO_2 end group. The bandgap appears to have a lateral dependence along the GNR which will be explored in more detail. Finally, we present the effects of nanolithography across the GNR.

Figures

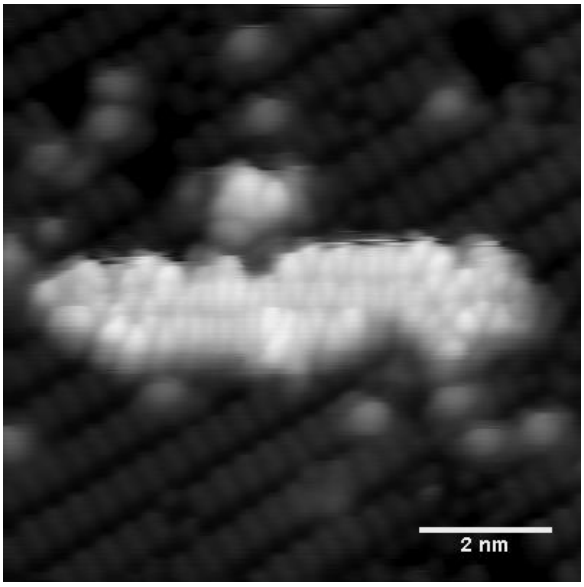

Figure 1: N=9 armchair GNR with coves on H:Si(100). A regular size cove is visible to the left of the large cove along the top of the GNR. 5 pA, -2 V.