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Mapping edge-state wavefunctions in chiral graphene nanoribbons YEN-CHIA CHEN, DIMAS G. DE OTEYZA, XIAOWEI ZHANG, DAVID STRUBBE, Department of Physics, University of California at Berkeley, LIYING JIAO, Department of Chemistry and Laboratory for Advanced Materials, Stanford University, ALEX ZETTL, Department of Physics, University of California at Berkeley, HONGJIE DAI, Department of Chemistry and Laboratory for Advanced Materials, Stanford University, STEVEN G. LOUIE, MICHAEL F. CROMMIE, Department of Physics, University of California at Berkeley — The electronic behavior of graphene is readily tunable through nanoscale patterning. A particularly important structural motif is the nanoribbon (GNR), a narrow strip of graphene defined by its width, length, and edge properties. GNRs, due to quantum confinement and edge effects, have been predicted to exhibit many novel behaviors, such as tunable energy gaps and the presence of magnetic edge states. Here we report measurement of the local electronic structure of GNRs with highly ordered edges obtained by unzipping carbon nanotubes. Due to variation in the precursor nanotubes, this synthesis method generally produces single- or multi-layered nanoribbons with varying widths, lengths and chiralities. We have combined scanning tunneling microscopy (STM) and spectroscopy (STS) to simultaneously characterize the structural and electronic properties of these GNRs at the atomic scale. In particular, we observe 1D edge states that exhibit an energy gap that is dependent on nanoribbon width and the chirality. We have further spatially mapped patterns in the electronic local density of states associated with different GNR spectroscopic resonances. These patterns are compared with theoretical simulations.

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