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Scanning Tunneling Spectroscopy of a Gated Single- and Bilayer Graphene Devices in the Quantum Hall Regime

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We have performed scanning tunneling spectroscopy (STS) measurements on a gated single- and bilayer graphene devices. The combination of STM/STS capability and an electrostatic back gate enables us to investigate the interactions of Dirac particles with local impurities at the atomic scale in zero magnetic field and in the quantum Hall regime while varying the Fermi-energy with respect to a Dirac (charge neutrality) point. In an applied magnetic field, well-resolved Landau levels (LLs) following the Dirac particle scaling are observed in both single- and bilayer graphene. Additionally, in single layer graphene, spatial dispersion of LLs caused by disorder potential lead to formation of graphene quantum dots (QDs). The tunneling spectra measured as a function of gate and sample biases are governed by Coulomb blockade physics. In contrast, no QDs are seen in bilayer devices. Instead, the main feature of the spectra is an energy gap formed around the charge neutrality point. The possible origin of energy gap will be discussed in a context of broken layer symmetry caused by gate electric field and disorder potential variation. Other noticeable features in the tunneling spectra of single- and bilayer graphene such as the formation of electron- and hole-puddles and the Fermi-level pinning effect will be discussed.