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High Resolution Tunneling Spectroscopy of Graphene in Strong and Weak Disorder Potentials

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Using scanning tunneling spectroscopy (STS), the local density of states can be mapped in real space to give insight into the role the local disorder potential plays in determining the 2-dimensional electron gas (2DEG) properties. In this talk I describe studies using scanning tunneling spectroscopy to examine various graphene systems with varying degrees of disorder. The amount of disorder depends on how the graphene was made. In the growth of graphene on the Si-face termination of SiC in UHV, local defects are found which contribute to strong inter- and intra-valley scattering [1]. Medium disorder is found in exfoliated graphene on SiO_2. Using a back-gated exfoliated graphene device on SiO_2 we observe a Landau level spectrum and charging resonances [2] that are completely different from previous STS measurements on weak disorder graphene systems. Applying a gating potential allows us to obtain "STS gate maps" which show the graphene 2DEG breaking up into a network of interacting quantum dots formed at the potential hills and valleys of the SiO_2-induced disorder potential. Graphene grown on the C-face termination of SiC is shown to have weak disorder with Landau level line widths approaching thermal limits at liquid He temperatures [3]. Using a new STM system operating at 10 mK, we are able to resolve a graphene "quartet" of the N=1 Landau level [4]. The quartet structure shows the complete lifting of the valley and spin degeneracies, which we determine as a function of magnetic field.

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