Magneto-Optical Spectroscopy of Graphene on Boron Nitride Substrate

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Introduction

Hexagonal boron nitride (BN) has recently emerged as an excellent substrate for graphene, owing to its intrinsic flat surface and its ability to modify the electronic structure of graphene.[1-3] Due to the lattice mismatch, graphene placed on top of BN substrate will always form a moiré pattern. Thus, a new type of nanoscale graphene superlattice is produced by the periodic potential induced by BN, and superlattice mini-bands and new mini-Dirac cone emerge.[1] Electrons in two dimensions (2D) moving under a magnetic field will develop discrete Landau levels. 2D electrons subjected to both a magnetic field and a periodic electrostatic potential exhibit a self-similar recursive energy spectrum, known as Hofstadter's butterfly.

Experimental

In our experiment, the graphene samples are directly grown on BN substrate by plasma enhanced chemical vapor deposition.[4] The resulting large area graphene has a zero angle mismatch to BN substrate. Magneto-optical spectroscopy was measured at NHMFL. We measured the relative transmission spectra (T(B)/T(0T)), the transmission spectrum in magnetic field T(B) normalized by that in zero field T(0T), of graphene/BN samples in magnetic fields up to 35 T (cell 8). The applied magnetic field is perpendicular to graphene samples.

Results and Discussion

Figure 1(a) shows normalized IR transmission spectra (T(B)/T(0T)). The dip features in T(B)/T(0T) spectra correspond to peaks in absorption, which are related to Landau level transitions of graphene on BN. It is worth noting that above 31T, a new strong absorption feature indicated by the blue triangle in Fig.1 (a) starts to emerge at 2051 cm^{-1}. Figure 1 (b) displays the evolution behaviors of these dip features in the magnetic fields.

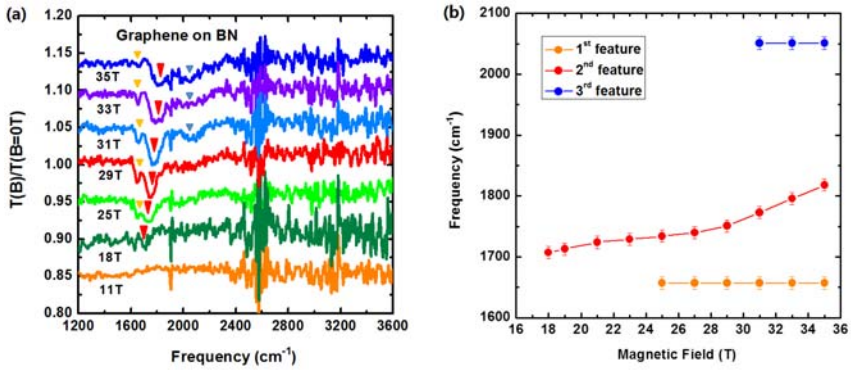

Figure 1: (a) IR transmission spectra in magnetic field T(B) normalized by zero-field transmission T(0T). (b) The magnetic field dependence of the energies of the three dip features.

Conclusions

The energy range of these features are in the vicinity of the new secondary mini-Dirac points, which may reflect the fine structures of the "Hofstadter spectrum" near mini-Dirac points of graphene on BN in magnetic field.

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