Observation of an Intrinsic Bandgap in Graphene/Boron-Nitride Heterostructures

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Introduction

Van der Waals heterostructures formed by assembling different two-dimensional atomic crystals into stacks can lead to many new phenomena. In particular, graphene/boron-nitride (BN) heterostructures have emerged as a very promising system for band engineering of graphene. Here we report the observation of a large intrinsic bandgap in epitaxial graphene/boron-nitride heterostructures with zero crystallographic alignment angle [1].

Experimental

In our experiments, graphene was epitaxially grown on h-BN by remote plasma enhanced chemical vapor deposition [1]. IR transmission spectra were measured using a Fourier transform infrared (IR) spectrometer at SCM3 and cell 8.

Results and Discussion

Figure 1 depicts a schematic of the moire pattern in graphene/BN. We studied the inter-Landau-level (LL) transitions in this system. The energies of all observed transitions exhibit an approximate linear dependence on sqrt(B), and they all show non-zero energy intercepts at zero magnetic field under linear extrapolations in stark contrast to the LL transitions of pristine graphene. Our data suggest a bandgap of 38meV (440K) at the main Dirac point of graphene [1]. Moreover, the Landau level transitions are characterized by effective Fermi velocities with a critical dependence on specific transitions and magnetic field [1]. These findings highlight the important role of many body interactions in determining the fundamental properties of graphene heterostructures.

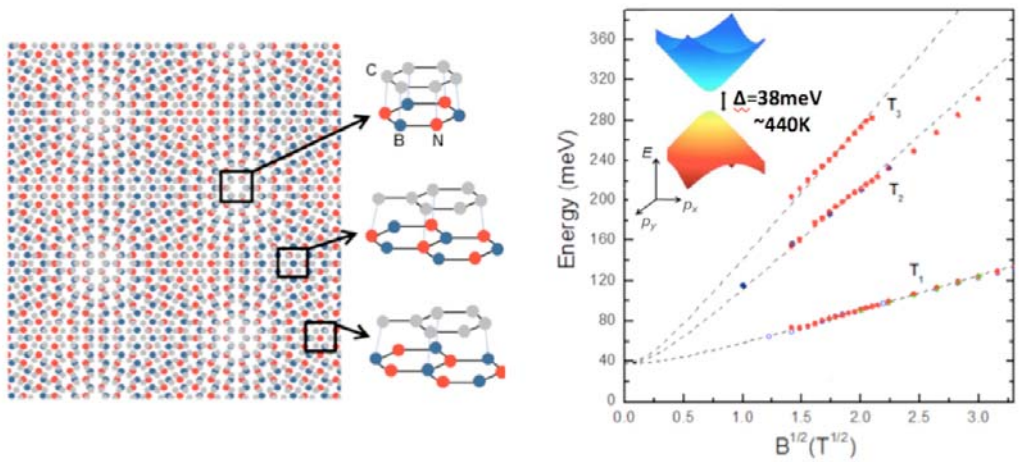

Figure 1: Top, Schematic of the moire pattern in graphene/h-BN with zero rotation angle. Bottom, Landau level transition energies measured by infrared spectroscopy plotted versus sqrt(B). Inset, our data indicate a gap of ~440K at the Dirac point.

Conclusions

We have observed a bandgap of ~38 meV (440K) in graphene/h-BN heterostructures. The intrinsic gap value reported here is important for fundamental understanding of the bandgap and many body interaction effects in this system.

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References

[1] Zhi-Guo Chen et al, Nature Communications 5, 4461 (2014).