

Simultaneous Investigation of Magnetoresistance (MR) and Twisted Angle of Twisted Bilayer Graphene

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Introduction

Twisted bilayer graphene system is expected to show different behavior compared with single layer graphene. That is because two sets of Dirac cones in reciprocal space interact with each other and have modified electronic band structure. Fermi velocity renormalization and van Hove singularity (vHs) anticipated by theoretical researches [1] are observed by STM experiments [2]. Even though several transport experiments were carried out, angle dependence study is still deficient due to difficulty to measure the twisted angle. Here, we investigate magnetoresistance (MR) and twisted angle of two kinds of twisted bilayer graphene, simultaneously.

Experimental

Twisted bilayer graphene was fabricated by transferring CVD graphene on electron transparent substrate, SiNx, twice. We prepared two kinds of twisted angle, 2° and 18° and measured MR of twisted bilayer graphene up to 35 Tesla using resistive magnet at NHMFL. Twisted angle was measured by TEM diffraction experiment after transport measurement.

Results and Discussion

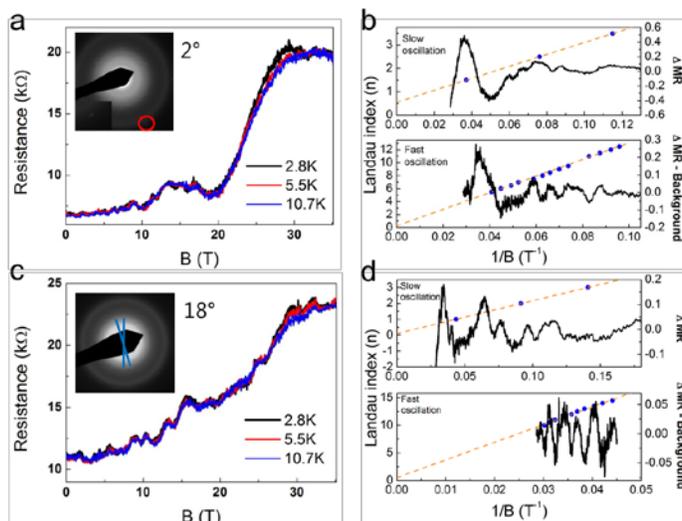


Figure 1. MR of twisted bilayer graphene. (a), (c) MR of 2° and 18° twisted bilayer graphene, respectively. (b), (d) Landau fan diagram of 2° and 18° twisted bilayer graphene, respectively.

frequencies, respectively. We obtained finite intercept and those are similar with that of single layer graphene.

2° and 18° twisted angles resulted from TEM diffraction experiment are shown in inset of Figure 1 a and c, respectively. Both of the two twisted angle samples have shown magneto-oscillation behavior interpreted by Shubnikov de Haas oscillation in **Figure 1** a and c. Analyzing Landau fan diagram with subtracting background signal at 2.8 K, we observed two oscillations with different frequencies are superposed in each case in figure 1 b and d. That is the same result with previous reports [3]. Local minimum corresponds to n-th Landau level and intercept value is related with Berry's phase. We have obtained finite intercept values from 0.11 to 0.55. These non-zero intercept values indicate charge carriers similar with that of single layer graphene dominate in twisted bilayer graphene.

Conclusions

We have investigated MR and twisted angle simultaneously. 2° and 18° twisted case showed Shubnikov de Haas oscillations with superposed two

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