Magnetotransport of the ^{4}He-Adsorbed Bilayer Graphene

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Graphene, a two-dimensional (2D) sheet of carbon, is a promising material not only for investigating a basic physics about relativistic electrodynamics with massless Dirac fermions but also for opening up a realization of various electric devices such as the FET. On the other hand, graphene has another fascinating property where the 2D electron system is easily accessible from outside. Therefore, electron transport is sensitively modified by the adsorption or chemical adjunction of various kinds of molecules [1]. Thus it is challenging to investigate the affection of the adsorption of an inert gas on graphene, which may be considered to be the least in effect [2]. It is noteworthy that the various quantum phases of 2D ^{4}He film on graphite has been elaborately studied for a long period [3].

In this study, we carry out the magnetotransport measurements of ^{4}He-adsorbed bilayer graphene at the temperature of 7 K and the magnetic field up to 7 T. The bilayer graphene is prepared by the micromechanical cleavage technique mounted on the top of the 300 nm-thick SiO_2 on n^+-Si wafer. A Ti/Au contact leads are attached to graphene sheets by using electron-beam lithography. A mobility of the sample is about 2,500 cm^2/Vs at room temperature and number of layers is confirmed by the Raman spectroscopy. The magnetresistance R_{xx} is measured by the standard low frequency Lock-in technique with the current of 37.7 Hz and 50 nA. Helium 4 gas is introduced at low temperature to the well-annealed graphene into the sample cell. Grafoil sheet having 1.2 m^2 effective area is placed inside the cell to regulate the adsorption layers of ^{4}He. Figure 1 shows the R_{xx} change ΔR_{xx} from the pristine graphene as a function of gate voltage V_g and magnetic field B to 1/10 layers and one layer for ^{4}He-adsorbed graphene. The overall magnitudes of ΔR_{xx} for one layer are larger than the one for 1/10 layer. Signs of ΔR_{xx} clearly depend on the V_g for most B, reflected the R_{xx} oscillations in the pristine graphene. In the conference, we discuss the effects of the adsorption of the inert gas to magnetotransport and its origins in detail.

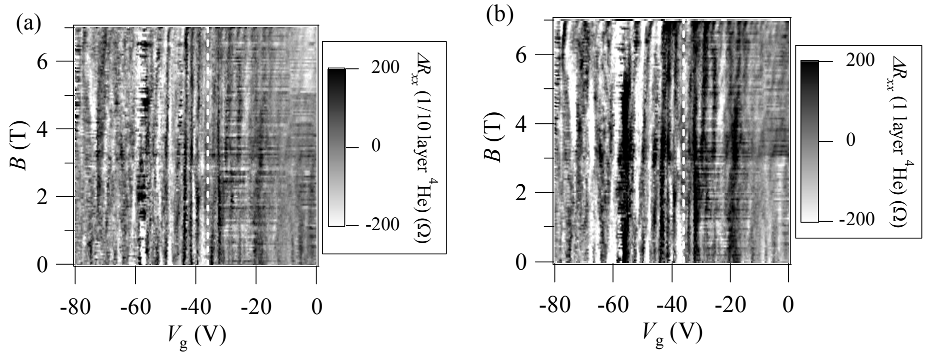

Fig. 1 Image plot of magnetoresistance change ΔR_{xx} as a function of gate voltage V_g and magnetic field B for (a) 1/10 layer and (b) one layer ^{4}He adsorbed graphene, respectively. Dashed lines indicate charge neutral points.

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