グラフェン量子ドット強磁性体接合における面内磁場下でのスピン輸送

Spin Transport in Ni/Graphene quantum device under in-plane magnetic field

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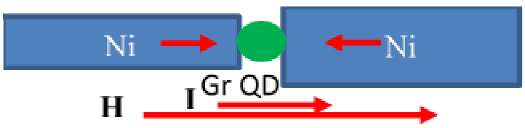
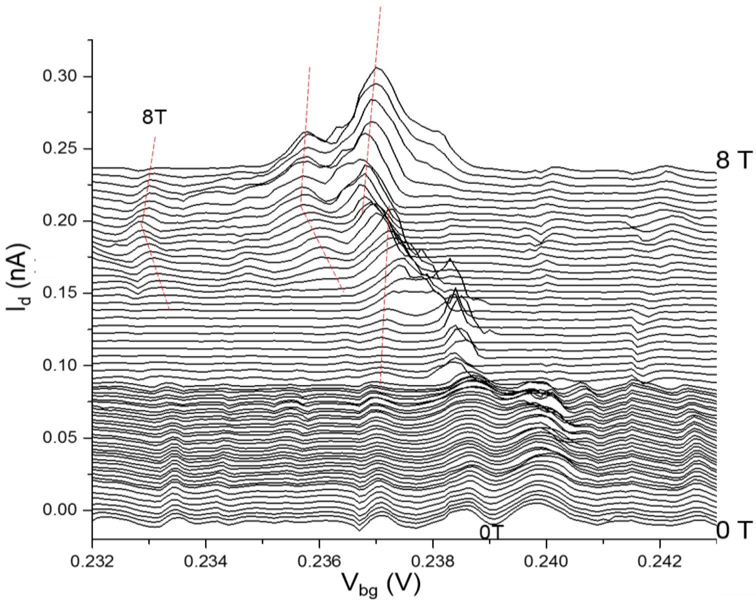
Graphene is expected material for application of spintronics and spin qubit because of weak spin-orbit interaction and low hyperfine interaction of electrons with carbon. In this study, we investigated ground and excited state transport through Ni/Graphene quantum dot device.

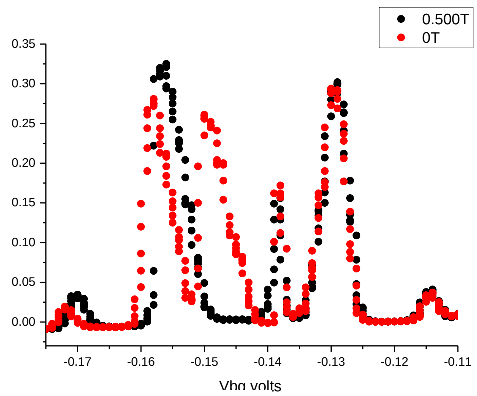
We fabricated graphene quantum dot devices using CVD graphene by electron-beam lithography. A schematic image of the device is shown in Fig. 1 (a). Graphene quantum dot has a diameter $d \approx 70$ nm. The graphene quantum dot is tuned by the back gate (bg). All measurements were performed in a dilution refrigerator with a base temperature of 20 mK. The successive filling of the electronic states is detected by transport measurements as a function of in-plane magnetic field, Fig. 1(a). A red shift of the current peak followed by a shift in the opposite direction was observed by increasing the applied magnetic field as shown in Fig. 1 (b). An additional peak in the transport current, Fig 1(c), is detected at the back gate voltage of -0.146 V when the applied magnetic field is less than 0.065 T. The additional peak can be explained by magnetic switching of the Ni electrodes from parallel to antiparallel with spin filtering transport.



(a)



(b)



(c)

Fig. 1: (a) Schematic diagram of the graphene quantum dot device, (b) the magnetic field dependence of (Id, V_{bg}), (c) $I(V_{bg})$ with and without applied magnetic field showing the magnetic field effect