The Diminishing Magneto-Resistance (MR) of Few Layer Mos_2

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Introduction

Molybdenum disulfide (MoS_2) is extensively studied as a promising material beyond graphene due to its two dimensional (2D) structure and the existence of band gap [1-3]. However magneto transport properties of MoS_2 are not much studied yet. We measured magneto transport properties of MoS_2. Interestingly, the magnetoresistance (MR) diminished as electric field increases. This behavior is similar with that of polyacetylene (PA) nanofibers [4]. The origin of vanishing MR in PA nanofibers is considered as spinless charged soliton carriers deconfined at high electric field. For polyaniline (PANI) and polythiophene (PT) nanofibers, the zero MR was not observed.

Experimental

The MoS_2 samples are mechanically exfoliated on SiO_2/Si substrate. 50 nm thick Au electrodes were fabricated through standard e-beam lithography and metal evaporation. The MR with 4 probe configuration was measured at different current levels (i.e. bias voltages) at 1.4 K. In this experiment, we applied the magnetic field up to 35 T in cell 8 in NHMFL, which is perpendicular to the MoS_2 device.

Results and Discussion

In Fig. 1(a), representative device shows temperature dependent I-V characteristic, where the flake is expected to be 5 layers by atomic force microscopy (AFM) measurement. As temperature decreases, the I-V curves change linear to non-linear, which agree well with typical semiconducting behavior. In Fig. 1(b), the positive MR was observed, which is consistent with previous report related to spin-orbit coupling. Interestingly, the MR is diminished as electric field is applied. But the magnitude is saturated above 80 µA excitation condition which corresponds to 5744.63 V/cm in terms of bias electric field. The behavior is analogous with MR of conducting polymer nanofibers, for example, PA, PANI and PT [4].

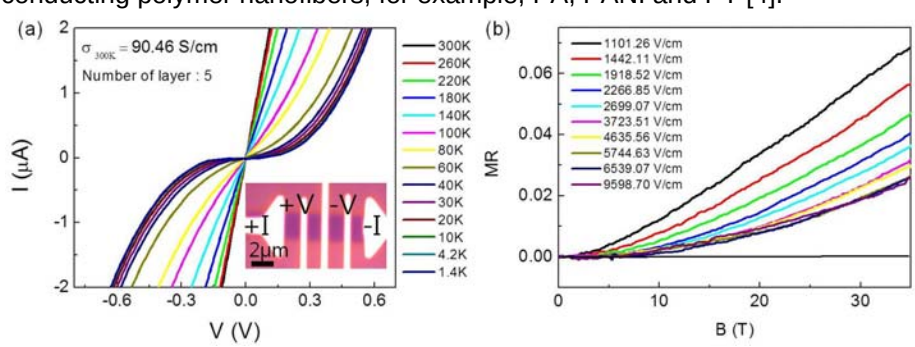

Fig. 1 (a) I-V curves with respect to temperature. Inset is optical image of the MoS_2 device. (b) MR of 5 layer MoS_2. The MR decreases as excitation current increases. Note that the MR shows saturation behavior above 80 µA.

Conclusions

We have observed the diminishing MR of 5 layers MoS_2 flake with high electric field. The behavior is similar with that of conducting polymer nanofibers. Hence, further studies are required to identify the origins.

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