The Diminishing Magnetoconductance in High Electric Fields in MoS_2 Flakes

S.J. Baek (Seoul National U., Physics); M. Park (Seoul National U., Physics); K.H. Kim (Seoul National U., Physics); Y.W. Park (Seoul National U., Physics)

Introduction

Molybdenum disulfide (MoS_2) flakes have been extensively studied and showed superconductivity [1], valley polarization [2], and a high on-off ratio [3]. The magnetic properties have also attracted interests so that spin-orbit coupling, valley scattering, and phase coherence lengths were studied by magneto-transport measurements [4]. We investigated the bias electric field dependence of magnetoconductance (MC) and found out that the MC diminished as the electric field increased. The diminishing MC is similar with that of polyacetylene nanofibers [5,6].

Experimental

We have performed MC and *I-V* characteristics measurements of few layers MoS_2. The MoS_2 flakes were mechanically exfoliated. 4 probe Ti/Au 10/50 nm electrodes were prepared on top of the sample. The MC was measured at different current levels (bias voltages) at different temperatures by using 2 or 4 probe configurations. The measurement was performed in cell 8, NHMFL using a 35 Tesla resistive magnet.

Results and Discussion

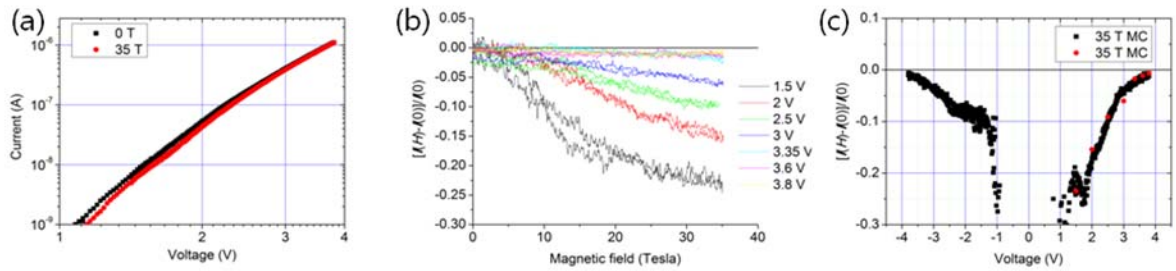

Fig. 1. Voltage dependence of MC of MoS_2 at 1.3 K. (a) *I-V* curves (log-log scale) at 0 Tesla and 35 Tesla of 5 layer-MoS_2 at 1.3 K. Current at 35 Tesla is lower than that of 0 Tesla and the two curves merge at high voltages. (b) MC of 5 layer-MoS_2 at 1.3 K at different excitation voltages. (c) From (a) and (b), the applied voltage dependent MC at 35 Tesla is plotted. Red dots represent 35 Tesla values of MC in (b).

I-V curves of 5 layer-MoS_2 at 1.3 K are shown in Figure 1 (a). The two *I-V* curves at 0 Tesla and 35 Tesla merge at high voltages. This finding is also represented in Figure 1 (b) and (c) where MC decreases almost to zero as the voltage increases. The MC became zero at 3.8 V (3.8×10^4 V/cm), implying a magneto-insensitive transport. Similar behaviors have also been observed in the 4 probe configuration.

Conclusions

We observed negative MC up to 35 Tesla in MoS2 flakes at 1.3 K. Interestingly the absolute value of the MC decreased as the source-drain electric field increased and eventually became zero.

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