MAGNETOTRANSPORT OF CONDUCTING POLYMER NANOFIBERS: HELICAL POLYACEYLENE AND POLYANILINE NANOFIBER

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Introduction
Conjugated polymer nanofibers are quasi one-dimensional (1-D) systems. Polyacetylene (PA) nanofibers are of particular interest because of their unique chemical structures. Recently, temperature dependent I-V characteristics of the polyacetylene nanofibers showed tunneling conduction between Luttinger liquids at T > 30 K [1, 2] and Coulomb blockade conduction at T < 30 K [3].

Experimental
Single R-helical PA fibers with a cross section typically 50 nm in height, 200 nm in width, and 10 µm in length, were deposited on top of the platinum electrodes of 2 µm spacings. The PA fibers were doped with iodine from vapor phase just before transport measurement. The transverse (H J) magnetoresistance (MR) of the iodine doped helical PA and the HCl doped polyaniline (PANI) nanofibers up to H = 30 tesla was measured using a resistive magnet at the NHMFL.

Results and Discussion
The current-voltage (I-V) characteristics for the R-helical PA and the PANI nanofibers were measured at low temperatures. The I-Vs at T < 60 K are symmetric and strongly nonlinear with narrow ohmic regions. The current starts to increase only above some voltage threshold (V_t) as temperature decreases. As shown in fig. 1(a) and 1(c), the low temperature I-Vs are nonlinear in both cases: with and without magnetic field. The measured MR was positive with magnitude ~15% for the helical PA and ~ 40% for the PANI at 30 tesla and at T =1.5 K. The positive MR in the wide range of magnetic field was temperature dependent and it decreases with increasing temperature as shown in Fig. 1(b) and 1(d). Although there are random oscillations, the MR data are analyzed by the quantum tunneling conduction.

Conclusions
We report MR and I-V characteristics of conducting polymer nanofibers, such as the iodine doped helical PA and the HCl doped PANI nanofibers. Positive MR were observed for both polymer nanofibers up to 30 tesla and the magnitude of MR decreases as temperature increases from 1.4K to 20K.

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References