

Insulating Phase in the Dynamically Nuclear Spin Polarized $\nu=2/3$ Quantum Hall State

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Dynamic nuclear spin polarization (DNP) is one of the most promising techniques to manipulate nuclear spins to utilize spin-electronics device such as quantum processing. In the fractional quantum Hall state (QHS), the Landau level filling factor $\nu=2/3$ QHS is suitable to carry out the DNP because of the affordable existence of the spin transition point. At the transition point where the spin-polarized and unpolarized domains are energetically degenerate, slow magnetic sweep greatly enhances the magnetoresistance R_{xx} [1] owing to the occurrence of the DNP through hyperfine interactions when electrons pass the domain wall [2]. However, the mechanism of the huge enhancement of the R_{xx} has not been revealed yet. One of the reasons is that such resistance-enhanced state (RES) is a transient state staying for several hundred seconds [3], and thus quick measurements are necessary to investigate the properties of the RES.

In this study, we have established the quick measurement scheme to observe the temperature dependence of the R_{xx} in the RES using the self-heating method by the large current, and confirm that the short-time application of the large current does not affect the intrinsic RES nature. Figure 1 demonstrates the temperature T dependence of the R_{xx} before and after the DNP. The DNP is carried out with 37.7 Hz and 60 nA AC current for about 30 min around $\nu=2/3$. The R_{xx} is measured with a low frequency lock-in technique with small current of 5 nA. Surprisingly, the temperature derivative of the R_{xx} is negative after DNP in contrast to that it is positive before DNP. This fact indicates that the RES is an insulating state. Figure 2 shows the $R_{xx}/T - T^{-1/2}$ plot after DNP, implying that the solid line is a standard fit in the 2-dimensional Anderson insulator [4]. In the conference, we discuss relationships between the origins and mechanisms of the RES and an Anderson localization induced by nuclear spin polarization in detail.

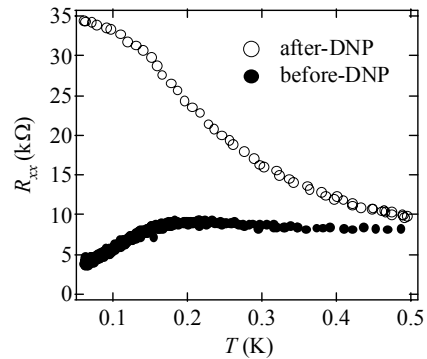


Fig. 1 Temperature dependence of the R_{xx} before and after DNP.

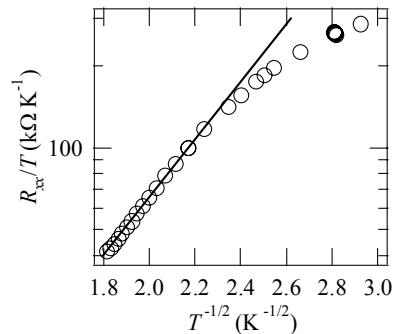


Fig. 2 $R_{xx}/T - T^{-1/2}$ plot after DNP.

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