Search For Quantum Oscillation In Transparent Perovskite Oxides (Ba,La)SnO_3 Under High Magnetic Fields

K.J. Yoo, K.H. Kim (Seoul National University, Physics)

Introduction

$BaSnO_3$ is a transparent conducting oxide which forms an ideal cubic perovskite structure and an optical gap of～3.1eV. One of the recent advances in transparent electronic materials has been made through the discovery of La doped $BaSnO_3$. The La doped $BaSnO_3$, in particular, shows unprecedentedly high *n*-type carrier mobility of ~320 $cm^2V^{-1}s^{-1}$ at room temperature[1]. The high mobility can be attributed to several physical properties of (Ba,La)SnO_3 such as small effective mass[2]. In order to investigate the effective mass and the Fermi surface of the Fermi liquid system, quantum oscillation observed in resistance or magnetic moment is one of key experimental methods.

Experimental

We grew the La doped $BaSnO_3$ single crystals using flux method. We placed the sample in a pick-up coil magnetometer for magnetization (dHvA) measurment. We also used a proximity detector oscillator (contactless transport) to investigate the SdH effect. The measurements were all done in a 60 T short pulse magnet and the sample was cooled down to 0.4 K using a Heilum 3 fridge and a gas handling system.

Results and Discussion

In the dHvA signal, oscillatory feature were observed in high magnetic field region, however, the frequencies of the oscillations are all different in each measurement (Inset of Fig.1). In addition, there is no obvious peak in frequency spectrum was shown except the peak of Cu quantum oscillation at in 60 kT. In the transport measurement (Fig.2), there was no oscillatory shape in the data. Thus, we could not measure the quantum oscillation. To observe the quantum oscillation, we may need sample of higher quality that shows higher mobility.

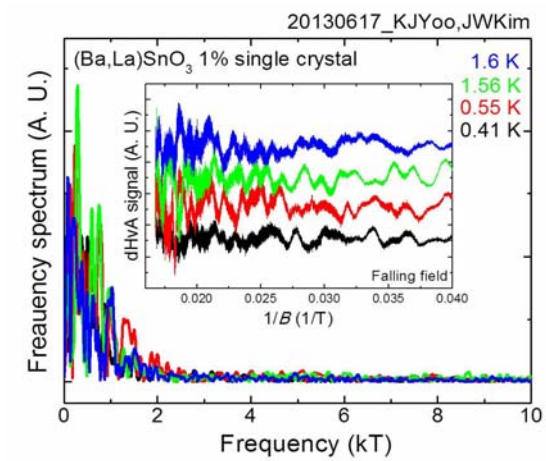

Figure 1. dHvA signal in (Ba,La)SnO_3 single crystal

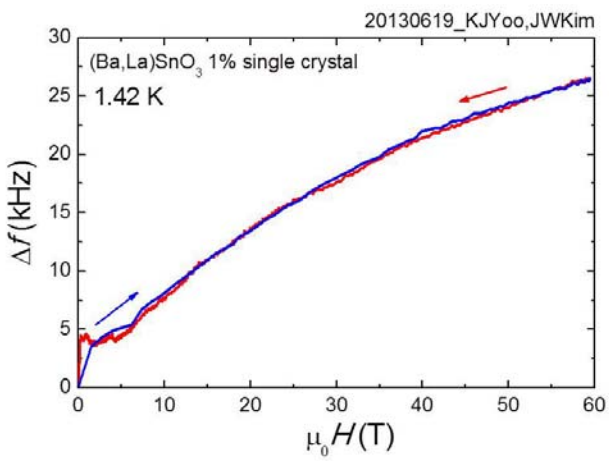

Figure 2. Frequency difference in PDO measurement of (Ba,La)SnO_3 single crystal at 1.42 K

Conclusions

In both of the dHvA and SdH measurement, we could not observe the quantum oscillation in the (Ba,La)SnO_3 single crystal, and higher quality samples maybe needed for measuring the quantum oscillation.

Acknowledgements

This work was financially supported by the National CRI funding and the Institute for Complex Adaptive Matter. A portion of this work was performed at the National High Magnetic Field Laboratory, which is supported by National Science Foundation Cooperative Agreement No. DMR-1157490, the State of Florida, and the U.S. Department of Energy.

References

[1] H. J. Kim *et al.,* Appl. Phys. Express **5**, 061102 (2012).
[2] H. J. Kim *et al.,* Phys. Rev. B **86**, 165205 (2012).