Magnetostriction measurements of 4d and 5d honeycomb materials by the recently developed piezoelectric strain gauge technique

Ding, X., Zapf, V.S., (NHMFL-PFF); Kim, J., Cheong. S.-W. (Rutgers)

Introduction

We reported extraordinarily large magnetic hysteresis loops with coercive magnetic fields of up to 55 T (record) in Sr_3NiIrO_6 (SNIO) and 52 T in Sr_3CoIrO_6. The magnetic hysteresis involves the field-induced evolution of quasi-one-dimensional chains in a frustrated triangular configuration. The striking magnetic behavior is likely to be linked to the unusual spin-orbit-entangled local state of the Ir4+ ion and its strong spin-orbit-lattice coupling. [1] A major unresolved question in the iridates SNIO and Sr_3CoIrO_6 is whether the coercive magnetic field is a magnetic phase transition or domain flipping. Magnetostriction measurements will distinguish between these two – for uniaxial domain flipping, no magnetostriction effect is predicted. We recently developed a new high-resolution technique for magnetostriction measurement in pulsed fields at cryogenic temperatures, which is known as the piezoelectric strain gauge (PSG). [2]

Experimental

We measured the field dependence of strain of SNIO single crystal by PSG in pulsed magnets at cryogenic temperatures. All measurements were performed in 65 T Multi shot magnet.

Results and Discussion

As shown in Fig. 1(a), the sample is small and irregular. In Fig. 1(b), a jump around 51 T in the strain data was observed, which is within the range of coercive fields [1].

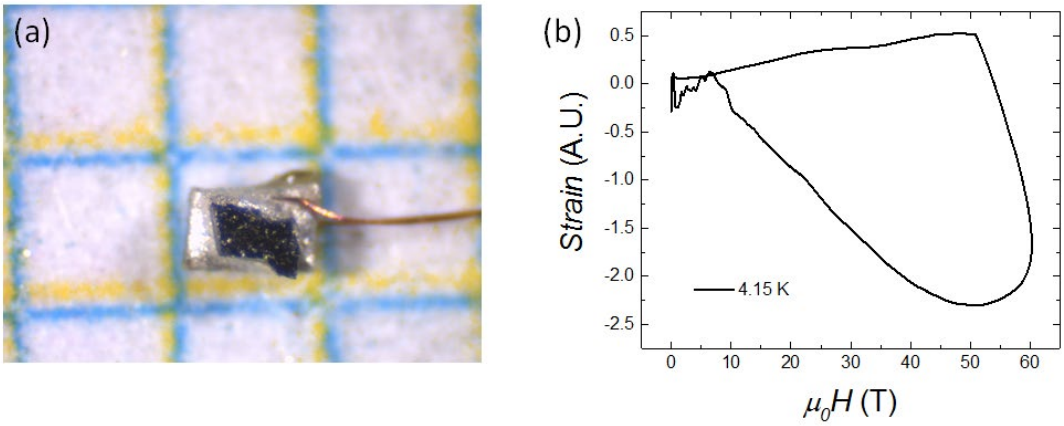

Figure 1 (a) Single crystal SNIO bonded to the PSG. The spacing of the blue grid is 1 mm. (b) Field dependence of strain measured by PSG at 4.15 K.

Conclusions

We did see some signal from the measurement. This data may refute the uniaxial domain flipping idea but additional data is needed.

Acknowledgements

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-1157490/1644779, the U.S. D.O.E. and the State of Florida. This scientific work was supported by LANL's LDRD program.

References

[1] J. Singleton, *et al.*, PRB **94**, 224408 (2016).
[2] X. Ding *et al*, Rev. Sci. Instrum. **89**, 085109 (2018).