Investigation of High Field Magnetization and Resistivity in non-Centrosymmetric Helimagnet ScFeGe

Karna, S.K., Hebert, J.K., Phelan, W.A., Young, D.P. (Louisiana State University), Cao, H., Tian, W. (ORNL), and DiTusa, J.F. (Louisiana State University)

Introduction

The magnetism found in non-centrosymmetric (NCS) structured magnetic materials, such as the transition metal-based *B20* structured compounds (chiral), has fascinated condensed matter physicists for decades. For example, MnSi hosts a Skyrmion lattice, a crystal of topologically stable knots of spin structure over a narrow range of temperature and magnetic field [1]. The cause of this interesting behavior is the Dzyaloshinskii-Moriya (D-M) interaction found only in NCS materials. The D-M interaction is also well known to create multiferroic behaviors in magnetic insulators [2]. This antisymmetric interaction, which stems from spin-orbit coupling, favors perpendicular arrangements of magnetic moments and its origin in magnetic metals is not well understood [3]. The DM interaction often gives rise to a subtle non-collinearity of the magnetic structures resulting in long wavelength helimagnetism or weak ferromagnetic moments in antiferromagnets. Here, we investigate the consequences and origins of the DM interaction in a NCS structured metal ScFeGe having mirror symmetry (achiral).

Experimental

The magnetic and transport measurements were made on single crystal of ScFeGe between 0 and 35 T respectively at Cell 8 and Cell 12 of the (NHMFL)

Results and Discussion

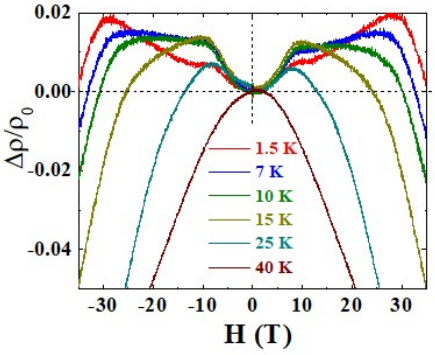

Fig.2: Field dependence of magnetoresistance at the indicated temperatures.

The magnetization measurements display a moderate anisotropy, a metamagnetic transition at 6.6 T when the field is oriented parallel to *a*- axis (in-plane field), and a lack of saturation even at 35 T fields (Fig.1). The magnetic moment obtained at 35 T is 0.55 μ_B close the magnetic moment ≈ 0.53μ_B (confined to the *ab* plane) obtained from neutron diffraction. The metamagnetic transition apparent in *M*(*H*) is associated with the appearance of a long wavelength modulation of the magnetic structure as seen in neutron diffraction. Our charge transport measurements display a discontinuous change to the resistivity along with a change in the sign of the magnetoresistance (MR) at T_N [Fig. 1d]. The MR changes character (Fig. 2) at the metamagnetic transition below ~12 K suggesting a change to the magnetic structure or dynamics. The closest comparison to ScFeGe may be Ho where a "fan" magnetic structure exists for intermediate fields [4].

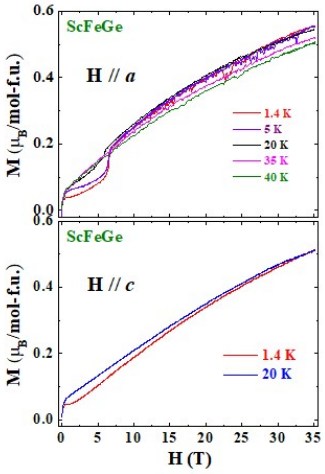

Fig.1: Field, H, dependence of the magnetization, M, (upper panel) parallel to a-axis and (lower panel) parallel to c-axis.

Conclusions

We have investigated the magnetic and structural properties of the non-centrosymmetric helimagnet ScFeGe via magnetization and transport measurements up to 35 T to compare with ongoing neutron diffraction measurements. In the magnetization, we observe a metamagnetic transition with threshold field of ≈ 6.6 T when *H* is parallel to the *ab* plane and a distinct difference between the data taken at 20 K and that at 1.4 K below 30 T. Our charge transport measurements display a discontinuous change to the resistivity along with a change in the sign of the magnetoresistance (MR) at T_N. The MR displays a distinct change in character near 27 T.

Acknowledgements

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References

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