Magnetization Study in $DyMnO_3$ Single Crystal

F. Wolff-Fabris (NHMFL-Los Alamos); M. Pekala and M. Ausloos (Liege University, Belgium)

Introduction

In fact magnetoelectrics and multiferroics materials, which exhibit mutual coupling of ferroelectricity and magnetism, have been the subject of great interest in recent years. This is the case for $RMnO_3$ (R=Sc, Y, Er, Ho, Tm, Yb, Lu, Tb) rare-earth manganites; they form an interesting family of compounds showing a wide variety of physical properties. In the orthorhombically distorted $TbMnO_3$ compound [1], the coexistence of antiferromagnetism and ferroelectricity is observed at low temperatures. This coexistence and the strong coupling of antiferromagnetism and ferroelectricity suggest the presence of a nonconventional coupling mechanism involving competing spin interactions. A multiferroic behavior arises as a consequence of the release of frustration of the applied magnetic field H. In this project we study the magnetic behavior of a $DyMnO_3$ single crystal.

Experimental

We have measured magnetization in function of magnetic field and temperature on $DyMnO_3$ single crystal using the VSM option of the 14 T PPMS. Magnetic fields along the b and c crystallographic axis up to 14 T were applied.

Results and Conclusion

The DC magnetization of the $DyMnO_3$ single crystal measured with magnetic field applied along the b and c crystallographic axes reveals a large magnetic anisotropy. Figure 1 shows that for the magnetic field applied along the c axis no magnetic transition is observed above 3 K and the simple Curie – Weiss type variation is seen both for the 0.05 and 1 T magnetic fields. The somewhat different behavior appears for the magnetic field oriented along the b axis, where the antiferromagnetic magnetization maximum is found at the Neel temperature T_N. This maximum shifts down from 7.5 to 5.5 K for magnetic fields varying from 0.05 to 1 T. This magnetization maximum seems to shift even below 3 K at 5 T field. The Neel temperature T_N of the single crystal studied is slightly lower than for the polycrystalline $DyMnO_3$ [2]. On the other hand, the somewhat lower T_N of 6 K reported for single crystal by Prokhenko et al [3] may be due to a quality of samples. The present observations are consistent with a picture assuming the sinusoidal incommensurate structure of Dy magnetic moments along the b axis below 15 K [3]. Below T_N this structure changes to the antiferromagnetic one. No magnetic irreversibility effects are noticed within an experimental accuracy in the FC and ZFC curves both for the b and c axis orientations. At temperatures higher than the magnetization maximum position the observed typical paramagnetic Curie Weiss behavior is observed, which is related to the superposed Dy and Mn sublattices.

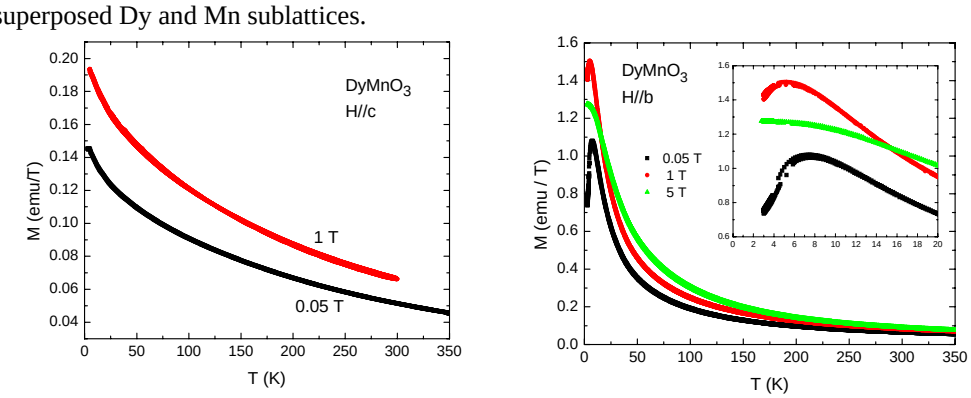

Figure 1 – DC Magnetization *vs* temperature for a $DyMnO_3$ single crystal.

References

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