

DIELECTRIC CONSTANT AND MAGNETIZATION STUDIES OF RMn_2O_5 ($R=Dy, Bi, \text{ and } Y$) CRYSTALS UP TO 45 TESLA

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Introduction

Recently reversible polarization (P) switching by magnetic field (H) has been found in $TbMn_2O_5$ [1], and the coupling between ferroic orders ('multiferroic') has attracted great interest in condensed matter physics. To further investigate the magnetoelectric coupling in RMn_2O_5 (R =Rare earth, Y and Bi), we applied high H up to 45 tesla to fully perturb the magnetic system.

Experimental

We have measured magnetization (M) and dielectric constant (ϵ) of RMn_2O_5 ($R=Dy, Bi, \text{ and } Y$) single crystals by an AC magnetometer and a capacitance bridge by use of a mid-pulse magnet in NHMFL-LANL, respectively. H was applied along a -axis and ϵ was measured along the b -axis for all crystals.

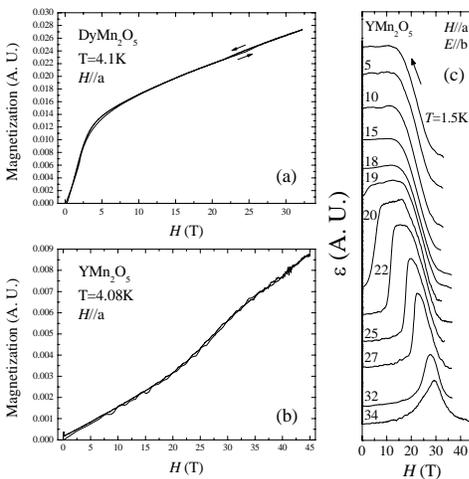


Fig. 1. (a), (b): Isothermal M vs. H for $DyMn_2O_5$ and YMn_2O_5 , respectively. (c) Isothermal ϵ with ramping down the H for YMn_2O_5 .

Figure 1 shows the isothermal M and ϵ with varying H . A M vs. H curve of $DyMn_2O_5$ up to 33 tesla is shown in Fig. 1(a). While the H -induced ordering of Dy spins occurs at ~ 2.5 tesla, no significant changes have been found at higher fields. For YMn_2O_5 , a change of slope in the M - H curve is found at ~ 20 tesla as shown in Fig. 1. (b). Furthermore, in the ϵ vs. H curve at 5 K (Fig. 1(c)), a mid-point of the ϵ change corresponds to H where a maximum slope in the M - H curve occurs. The isothermal ϵ vs. H has been systematically measured at various temperatures. These observations indicate a strong link between dielectric and magnetic properties that can be understood by the microscopic coupling mechanism of the system. [2]

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References

- [1] Hur, N., *et al.*, Nature, **429**, 392 (2004).
- [2] Haam, S.Y., *et al.*, (to be published).