DIELECTRIC CONSTANT AND MAGNETIZATION STUDIES OF $RMn_2O_5$ ($R=$Dy, Bi, 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$_2$O$_5$ [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 ($\varepsilon$) of $RMn_2O_5$ ($R=$Dy, Bi, 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 $\varepsilon$ was measured along the $b$-axis for all crystals.

![Magnetization vs. H for DyMn$_2$O$_5$ and YMn$_2$O$_5$.](image)

**Fig. 1.** (a), (b): Isothermal $M$ vs. $H$ for DyMn$_2$O$_5$ and YMn$_2$O$_5$, respectively. (c) Isothermal $\varepsilon$ with ramping down the $H$ for YMn$_2$O$_5$.

Figure 1 shows the isothermal $M$ and $\varepsilon$ with varying $H$. A $M$ vs. $H$ curve of DyMn$_2$O$_5$ 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$_2$O$_5$, a change of slope in the $M$-$H$ curve is found at ~20 tesla as shown in Fig. 1. (b). Furthermore, in the $\varepsilon$ vs. $H$ curve at 5 K (Fig. 1(c)), a mid-point of the $\varepsilon$ change corresponds to $H$ where a maximum slope in the $M$-$H$ curve occurs. The isothermal $\varepsilon$ 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