DA01

Multiferroics under strong magnetic fields

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We have systematically investigated electric/magnetic phase diagram of a series of multiferroic crystals RMn_2O_5 (R=Tb, Dy, Bi, and Y) through the magnetization (M), dielectric constant (ε), electrical polarization (P) and specific heat (C_p) measurements down to 0.6 K and under static and pulsed magnetic field (H) up to 45 tesla (T) at NHMFL. Comparative studies of the phase diagram reveal several unprecedented findings: (1) phase evolution of the incommensurate antiferromagnetic Mn d spin ordering and related magneto-dielectric effects up to 33 T, (2) a new high field phase coupled to an incommensurate Mn d spin ordering appearing around 20 T, (3) phase evolution coupled to rare earth f-spin ordering and resultant polarization changes, and (4) significant modification of phase boundaries due to strong d-f spin interaction. Based on the determined electric/magnetic phase diagram, we explain how the exchange striction mechanism can induce large polarization at high field region above 20 T in these series of RMn_2O_5 compounds. In the second part, we particularly discuss the intriguing electric/magnetic signals of $BiMn_2O_5$. At low temperatures below 5 K, $BiMn_2O_5$ exhibits a single magnetic-field-induced transition near H_c~18 T as evidenced by a sharp increase in magnetization. Interestingly, ε vs H curves show a sharp peak at H_c, of which magnitude systematically increases as temperature approaches proximity to a zero temperature. Furthermore, P changes its sign with increasing H from positive to negative at H_c without any hysteresis in H so that H_c coincides with the magnetic field at which P=0. The trajectory of which above three transitions occur follows the scaling relation $T_c(H) \sim (H-H_c)^{\alpha}$ with α=1/2. The shape of Cpversus H curve indicates that a magnetic-field-induced transition is close to the 2nd order down to ~ 0.6 K which is consistent with the absence of hysteresis in M, ε, and P measurements. Temperature dependent ε measurements under fixed magnetic field (Fig. 1) near H_c reveal that ε increases systematically as T decreases to ~ 4 K and slightly decreases down to 0.6 K, as similarly observed in quantum paraelectric $SrTiO_3$. All of these observations suggest an interesting possibility that $BiMn_2O_5$ can be a unique system to exhibit quantum fluctuation of ferroelectricity tuned by magnetic field.

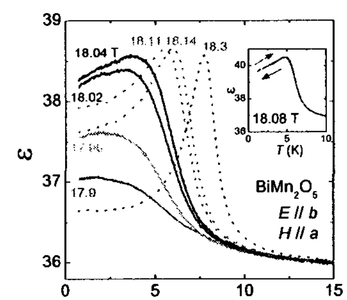

Fig. 1. ε vs T curve near H_c=18 T.

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DA02

Magnetic properties in $RTiO_3$ thin films

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$RTiO_3$, (R = Eu, Y) thin films were grown by using a pulsed laser deposition. The suitable choice of substrate as well as reducing growth condition allowed us to grow the epitaxial $YTiO_3$ thin films. The $YTiO_3$ film exhibited a clear ferromagnetic transition around 30 K with a saturation magnetization of about 0.7 μB/Ti.[1] Recently, novel magnetic and electric phase control in Epitaxial $EuTiO_3$ thin films was predicted from first principles calculation.[2] To verify this prediction, $EuTiO_3$ thin films were grown on various kinds of substrates with different lattice mismatch and their structural and magnetic properties were investigated.

REFERENCES

[1] S. C. Chae, Y. J. Chang, S. S. A. Seo, T. W. Noh, D.-W. Kim , and C. U. Jung, Appl. Phys. Lett. **89**, 182512 (2006).
[2] Craig J. Fennie and Karin M. Rabe, Phys. Rev. Lett., **97**, 267602 (2006).