A Series of Magnetic Phase Transitions of Spin 5/2 Triangular Lattice Antiferromagnet $Ba_3MnNb_2O_9$

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Introduction

We have investigated the magnetic phase transitions of spin 5/2 triangular lattice antiferromagnet (TLAF) $Ba_3MnNb_2O_9$. The magnetic ion (Mn^{2+}) in this compound forms equilateral triangular lattice, which has been predicted to have successive magnetic phase transitions and magnetization plateau due to frustrations [1]. We have built an *H-T* phase diagram revealing its richness of magnetic phases.

Experimental

A vibrating sample magnetometer was employed to measure DC magnetization of polycrystalline samples in cell 8 with the 35 T resistive magnet. AC magnetic susceptibility data were obtained with homemade AC susceptometers using the SCM2 magnet.

Results and Discussion

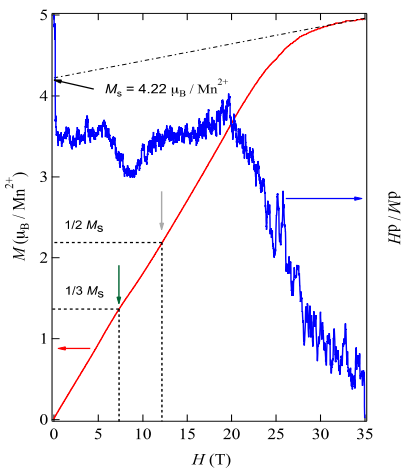

Fig. 1 The DC magnetization (red curve) and the first derivative of the DC magnetization (blue curve) at T = 1.4 K. Successive magnetic phase transitions are noted as down arrows.

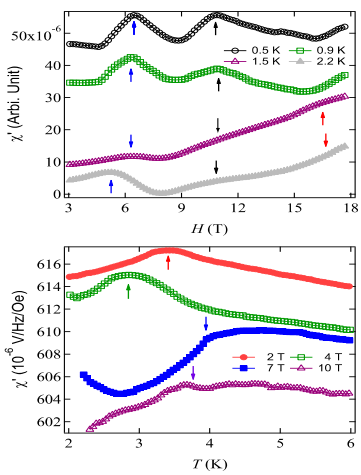

Fig. 2 The field (top) and the temperature dependence (bottom) of AC magnetic susceptibility.

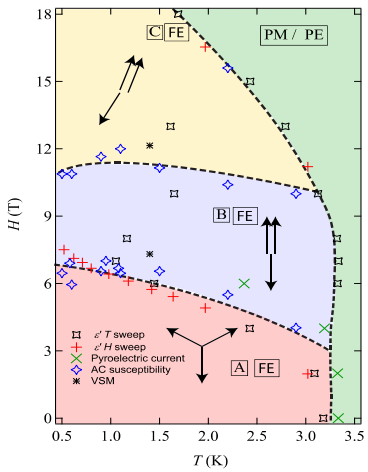

Fig. 3 *H-T* phase diagram of the $Ba_3MnNb_2O_9$ constructed from several different techniques. Black arrows represent spins and different symbols indicate different techniques employed.

The DC magnetization curve shows slope changes, which are clearly represented by the first derivative (d*M*/d*H*) of DC magnetization in Fig. 1. This slope changes signal magnetic phase transitions. The U shape of d*M*/d*H* and the 1/3 of the saturation moment (1/3 M_s) suggest the exotic magnetization plateau predicted by theory [2]. The AC magnetic susceptibility, which probes d*M*/d*H* directly, shows even clearer magnetic phase transitions as indicated with arrows in Fig. 2. Combining the results from different techniques, we have built an *H-T* phase diagram as shown in Fig. 3. The successive magnetic phase transitions and multiferroelectricity were observed at various spin states under magnetic fields. One notable feature is the broadening of the up-up-down phase (B-phase) with temperature, which implies the importance of thermal fluctuations in stabilizing the magnetization plateau in this compound.

Acknowledgements

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References

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[2] A.V. Chubukov, *et al*., J. Phys. Condens. Matter, **3**, 69 (1991).