Magnetoelectric Effect and Multiferroicity of Spin 5/2 Triangular Lattice Antiferromagnet $Ba_3MnNb_2O_9$

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Introduction

The dielectric constant and the pyroelectric current of $Ba_3MnNb_2O_9$, which is a quasi-two-dimensional spin-5/2 triangular lattice with trigonal structure [1] is measured to study the magnetoelectric (ME) properties.

Experimental

The dielectric constant and the pyroelectric current measurement were performed in SCM2. The pyroelectric current was measured using a Keithley 6517A electrometer on warming after cooling the sample in an electric field while cooling down from above T_N. The dielectric constant was measured using an Andeen-Hagerling AH-2700A capacitance bridge.

Results and Discussion

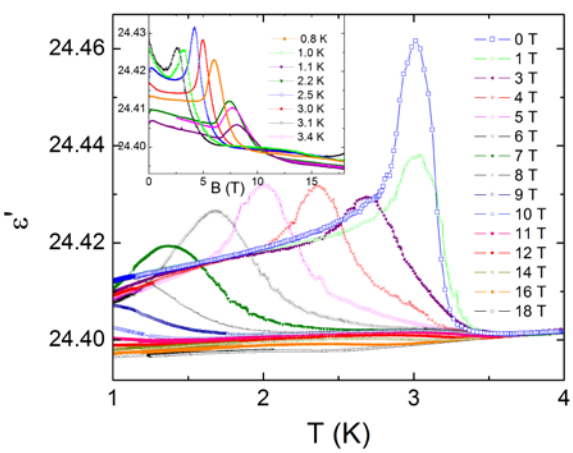

Figure 1. The *T*-dependence of the dielectric constant of $Ba_3MnNb_2O_9$. Inset: H-dependence.

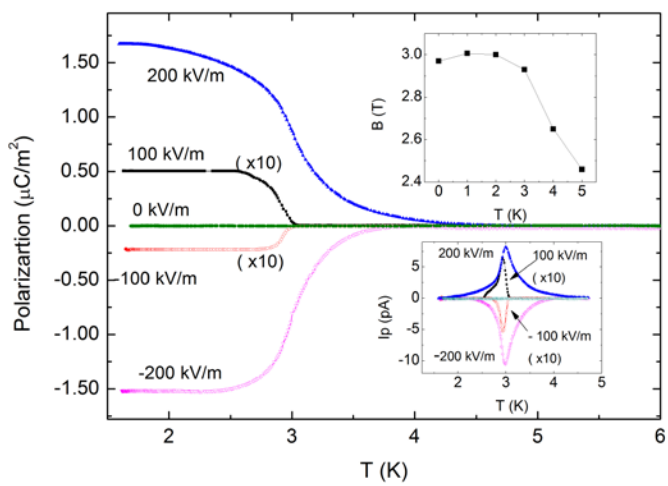

Figure 2. The *T*-dependence of the polarization and the pyroelectric current (lower inset) $Ba_3MnNb_2O_9$ at different poling fields. Upper Inset: BT-phase diagram from the polarization data under magnetic field.

The dielectric constant and the pyroelectric current show features associated with a ferroelectric transition (**Figures 1 and 2**) at the temperatures and fields where the antiferromagnetic long range ordering occurs. The multiferroicity and a successive magnetic transitions of a sister compound, $Ba_3NiNb_2O_9$ (S=1) has been recently reported [2], where the ferroelectric transition was observed even in the collinear spin structures. The field-temperature phase diagram of $Ba_3MnNb_2O_9$ is much simpler than that of $Ba_3NiNb_2O_9$, possibly due to the nature of the classical spins. Further studies are necessary to identify the spin structures below the AFM ordering and possible sub-phases under magnetic field.

Conclusions

The temperature and the field dependence of dielectric anomaly and the polarization of $Ba_3MnNb_2O_9$ suggest a presence of multiferroicity in this material. $Ba_3MnNb_2O_9$ provides a good opportunity to study the electric/magnetic ground states of triangular lattice antiferromagnets in comparison with other sister compounds with quantum spins.

Acknowledgements

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References

[1] Ramirez, A. P. Annu. Rev. Mater. Sci. **24**, 453 (1994).
[2] Hwang, J. *et al*., arXiv:1212.0485 and Phys. Rev. Lett. (in press).