Dielectric Relaxation Behavior of $ZnCr_2O_4$ in the Magnetically Ordered State

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Introduction

$ZnCr_2O_4$ is one of typical frustrated magnets with spinel structure at room temperature. Upon cooling, it goes through a structural phase transition accompanied by antiferromagnetic ordering at T_N = 12.5 K. Dielectric relaxation phenomena were observed above the transition temperature, which were ascribed to an existence of fluctuating short-range antiferromagnetic clusters [1]. We investigated the dielectric relaxation behavior below T_N in the magnetically ordered state, where the fluctuation effect should disappear.

Experimental

The real and imaginary part of dielectric constant single-crystalline $ZnCr_2O_4$ samples were measured at different temperature and the magnetic field ranges using a commercial capacitance bridge (AH 2700) with the SCM2 magnet.

Results and Discussion

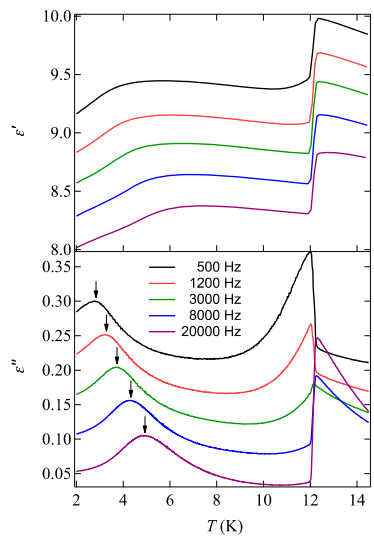

Fig. 1 High temperature real (***ε'***) and imaginary part (***ε''***) of dielectric constant at different frequencies for *H* = 0 T.

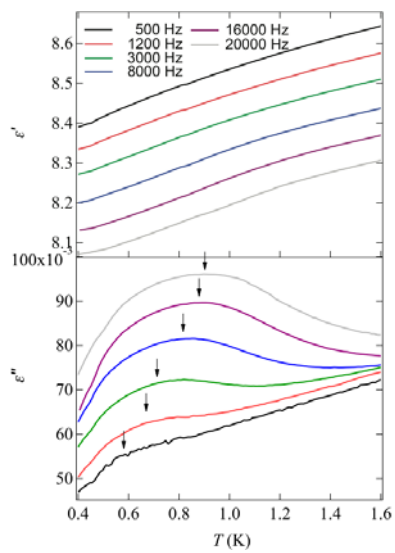

Fig. 2 Low temperature behavior of the dielectric constant at different frequencies for *H* = 0 T.

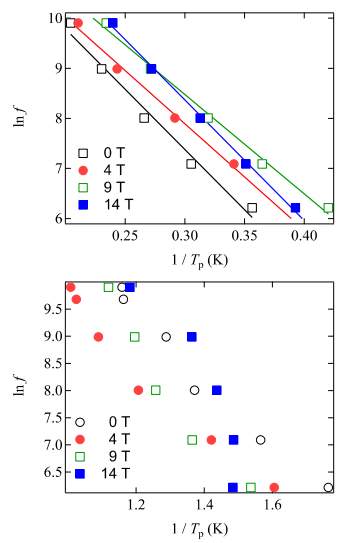

Fig. 3 Arrhenius plot of the peak temperature of ***ε''*** at high *T* (top) and low *T* (bottom) region at different fields.

The dielectric constant data obtained in the temperature range between 2 K and 14 K show an abrupt change near T_N = 12 K. This change implies the first-order structural phase transition as previous studies have reported [1]. In addition to that, successive dielectric relaxation processes were observed below T_N, as evidenced by the peaks of the imaginary part of the dielectric constant (ε''). The first ε'' peak occurs near 4 K (see Fig. 1) and the second dielectric relaxation near 0.8 K (see Fig. 2). We also measured the frequency dependent dielectric relaxation at under different fields (not shown here). Using the peak positions of ε''**,** Arrhenius plots are made as shown in Fig. 3. The high temperature relaxation process (Fig. 1) follows a conventional activation-type relaxation, while the low temperature relaxation (Fig. 2) shows a non-conventional behavior. The existence of the dielectric relaxation behavior in the magnetically ordered state was unexpected and calls for better understanding of the spin structure of $ZnCr_2O_4$ below T_N.

Acknowledgements

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References

[1] I. Kagomiya, *et al*., J. Phys. Soc. Jpn., **71**, 916 (2002).