

Spin-driven dielectric relaxation in a paraelectric phase of magneto-electric multiferroic CuFeO_2

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Magnetic oxide CuFeO_2 is a rare magneto-electric multiferroic where magnetic field-induced or nonmagnetic impurity-induced proper helical magnetic ordering generates a spontaneous electric polarization. We have measured the complex permittivity in various magnetic phases under an applied magnetic field up to 15 T, and found Debye-type-like dielectric dispersion with low relaxation frequency in only 4-sublattice(4SL) antiferromagnetic ground state. The relaxation frequency of dielectric dispersion shows interesting anisotropic magnetic field as well as temperature dependences. Although so-called Maxwell-Wagner effect in a dielectric system with heterogeneous nature can often explain this kind of magnetodielectric effect [1], we speculated that 4SL-specific magnetic domain wall motion must be responsible for the dielectric dispersion; As shown in Fig. 1(a), the magnetic domain wall moving back and forth, and corresponding displacement of oxygen near magnetic domain wall can be responsible for the dielectric dissipation. Here, we consider the magnetic domain wall is essentially the same as AD-type domain wall discussed in domain growth kinetics in the isosceles triangular Ising antiferromagnet CoNb_2O_6 [2].

In order to check the existence of the magnetic domain state in 4SL phase of CuFeO_2 , we have performed neutron diffraction experiments to determine the functional form of the scattering function, using the triple-axis neutron spectrometers HQR(T1-1) installed at JRR-3. The collimation open-40-40-40 was employed, and the wavelength of the incident neutron was 2.44 Å. As shown in Fig. 1(b), scattering profile of 4SL $(1/4, 1/4, 3/2)$ magnetic reflection is

entirely different from resolution-limited Gaussian and rather close to Lorentzian-specific to the magnetic domain state. The further detailed analysis using Multi-Profile-Deconvolution method [3] is now in progress.

References

- [1] G. Catalan, *APL* **88**, 102902 (2006).
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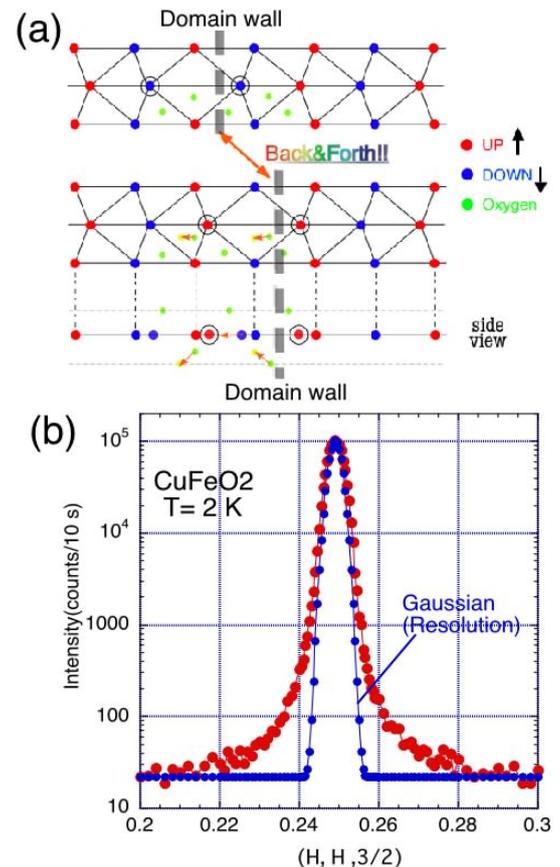


Fig. 1. a) Schematic drawings of magnetic domain wall moving back and forth, (b) scattering profile of 4SL $(1/4, 1/4, 3/2)$ magnetic reflection.