Electric and magnetic field controlled THz directional anisotropy

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Research of multiferroics is expected to lead to next-generation non-volatile memory devices [1], the so-called magnetoelectric (ME) memories, where the magnetic bits are controlled by electric field. This current-free, low-power consuming operation exploits the coupling between the magnetization and electric polarization coexisting in multiferroic materials [2,3]. Here we demonstrate the optical readout of ME memory states in $LiCoPO_4$ with Néel-type antiferromagnetic (AFM) order. The strong absorption difference of THz radiation between the two types of AFM domains in $LiCoPO_4$ can be exploited for the optical reading out of the ME memory state. This unusual contrast is attributed to the dynamic ME effect of the spin-wave excitations, as confirmed by our microscopic model. Besides the spin excitations, the model also describes the distinctive features of the observed static ME effect. The control and the optical readout of ME domains in $LiCoPO_4$ provides new concept for future ME memory devices built on antiferroelectric-antiferromagnetic insulators [4].

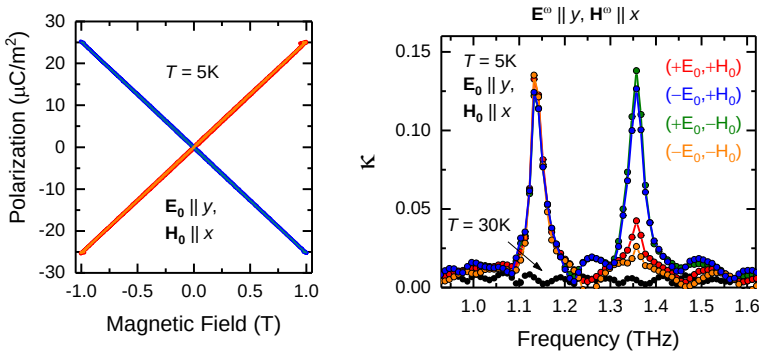

Figure. Sign of the ME effect in $LiCoPO_4$ is set by the application of crossed E_0 and H_0 poling fields upon cooling the sample below T_N. For the same or opposite sign of the poling fields, the static ME effect has positive or negative sign, respectively. Correspondingly, one of the magnetic resonances (1.35THz) at T=5K shows low or high absorption in the imaginary part refractive index spectrum. Color coding used in the two panels are the same, whereas the black curve corresponds to the absorption spectra measured in the paramagnetic phase.

References

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