Magnetism and lattice modulation of multiferroic RMn_2O_5 studied by synchrotron radiation x-ray

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Magnetic and dielectric properties of RMn_2O_5 (R=rare earth, Bi) have been extensively studied, showing that there are a rich variety of magnetoelectric effects, depending on the type of R^{3+} ion. Recently, we have paid attention to (Eu, Sm, Gd) Mn_2O_5 compounds of larger ionic radius group in rare earth family. Microscopic magnetic properties for (Eu, Sm, Gd) Mn_2O_5 have not been studied well so far, because neutron magnetic diffraction experiments for these compounds are almost impossible due to a large absorption of neutron by Eu, Sm, and Gd atoms. We measured superlattice reflections of (Eu, Sm)Mn_2O_5 with the lattice modulation vector q_L associated with the magnetic order (q_L=2q_M) by using Synchrotron X-ray diffraction. About (Gd,Sm)Mn_2O_5, we measured magnetic order q_M of (Gd,Sm)Mn_2O_5 by using resonant magnetic X-ray diffraction. The experiments were performed at BL4C in Photon Factory of KEK. We also measured permittivity, electric polarization and magnetic susceptibility for (Eu, Sm, Gd) Mn_2O_5.

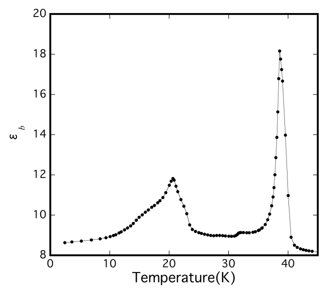

Fig. 1: Temperature dependence of permittivity for $EuMn_2O_5$ on heating.

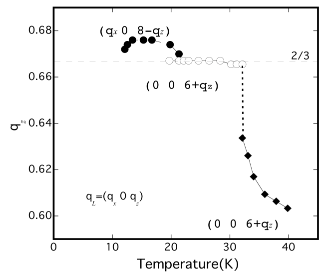

Fig. 2: Temperature dependence of lattice modulation wave vector q_z for $EuMn_2O_5$ on heating.

Figure 1 shows the permittivity curve of $EuMn_2O_5$, which has peaks around T = 40 K, 32 K and 20 K. Figure 2 shows the temperature dependence of the lattice modulation wave vector q_z in $EuMn_2O_5$ (q_x is not shown here). Below T_N ~ 40 K, lattice modulation characterized by the wave vector of $q_L = (q_x, 0, q_z)$ with $q_x = 0$ appears. At T = 32 K, q_z is locked at 2/3 value. On further cooling, both q_x and q_z becomes incommensurate. The results indicate that the magnetic phase transition and dielectric phase transition simultaneously occur.