Magnetic and Electric Properties in the Distorted Tetrahedral Spin Chain System $Cu_3Mo_2O_9$

T. Hosaka[a], S. Hachiuma[a], H. Kuroe[a], T. Sekine[a], M. Hase[b], K. Oka[c], T. Ito[c], H. Eisaki[c], M. Fujisawa[d], S. Okubo[d], and H. Ohta[d]

[a]Department of Physics, Sophia University, Tokyo, Japan
[b]National Institute for Materials Science (NIMS), Tsukuba, Japan
[c]National Institute of Advanced Industrial Science and Tecnology (AIST), Tsukuba, Japan
[d]Molecular Photoscience Research Center, Kobe University, Kobe, Japan

We study the multiferroic properties in the distorted tetrahedral quasi-one dimensional spin system $Cu_3Mo_2O_9$ and clarify that the antiferromagnetic order is formed together with ferroelectric properties at $T_N = 7.9$ K under zero magnetic field. In this system, the effects of the low dimensionality and the magnetic frustration are expected to appear simultaneously. We find that there are three different ferroelectric phases in the antiferroelectric phase and obtain the magnetic-field-temperature phase diagram in $Cu_3Mo_2O_9$ by measuring dielectric constant and spontaneous electric polarization when the magnetic field is applied parallel to the c axis. Around the tricritical point at 10 T and 8 K, the change of the direction in the electric polarization causes a colossal magnetocapacitance effect. We calculate the charge redistrbution in the small spin cluster made from two magnetic tetrahedra to demonstrate the electric polarization induced by the antiferromagnetism.