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Magnetocapacitance effect in $EuTiO_3$ and related compounds

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Perovskite titanates, $EuTiO_3$, contains Ti^{4+} ions, similarly with $BaTiO_3$ and $SrTiO_3$, and is expected to show ferroelectric instability. In addition, this compound contains Eu^{2+} ions with S=7/2 spin, which order antiferromagnetically at 5.5 K. We measured the dielectric constant of this compound [1], and found that large dielectric constants (> 400) critically decrease with antiferromagnetic ordering of the Eu spins at 5.5 K. We also found a large change of the dielectric constant under magnetic field (magnetocapacitance) by 7 % with 1.5 T at 2 K. From a comparison with a mean-field calculation, it was shown that the variation of dielectric constants scales with the pair correlation of the nearest-neighbor Eu spins. We also measured the magnetocapacitance of pyrochlore titanates, $R_2Ti_2O_7$ (R=rare earth) [2], having the same Ti^{4+}, but the magnetic moment is located on a pyrochlore lattice, and thus is dominated by geometrical frustration. By comparing the magnitude of mangetocapacitance with the square of magnetization, evidence of ferromagnetic (R=Ho) and antiferromagnetic (R=Gd) fluctuation was obtained. [1] T. Katsufuji et al., Phys. Rev. B 64, 054415 (2001). [2] T. Katsufuji et al., Phys. Rev. B 69 064422 (2004).