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Magnetic Properties of Divalent Europium Perovskite Oxide Thin Films

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Eu^{2+}-containing perovskite oxides such as $EuTiO_3$ and $EuZrO_3$ have arrested considerable attention because of their multiferroic as well as magnetodielectric properties[1),2)]; the former has been anticipated for strain-induced $EuTiO_3$. We have shown both theoretically and experimentally that lattice volume expansion or amorphization of $EuTiO_3$ renders the compound ferromagnetic although the stable phase of $EuTiO_3$ is antiferromagnetic.[3)-5)] In the present talk, we report on our recent studies of magnetic properties of Eu^{2+}-containing perovskite oxide thin films; experimental results about magnetic properties of thin films of $Eu(Ti,Nb)O_3$ are mentioned. Also, we describe theoretical demonstration that cubic $EuZrO_3$ and $EuHfO_3$ show ferromagnetism although the stable phase of these compounds, which is not cubic but orthorhombic, is antiferromagnetic as experimentally revealed.

The thin films of $Eu(Ti,Nb)O_3$ were prepared by using a pulsed laser deposition method. Structural characterization was performed by X-ray diffraction analysis and atomic force microscopy. Magnetic properties of the resultant thin films were measured by using SQUID.

Figure 1 shows the magnetization as a function of magnetic field for $Eu(Ti,Nb)O_3$ thin films measured at 2 K. The thin films were grown on $LaAlO_3$ substrates. It is clear that thin films of $EuTiO_3$ doped with more than 10 % of Nb exhibit ferromagnetic behavior whereas the $EuTiO_3$ thin film doped with 1 % Nb is antiferromagnetic. The temperature dependence of magnetization for these thin films manifests that the Curie temperature is almost independent of the Nb content. We speculate that magnetic polaron or RKKY interaction is responsible for the ferromagnetism.

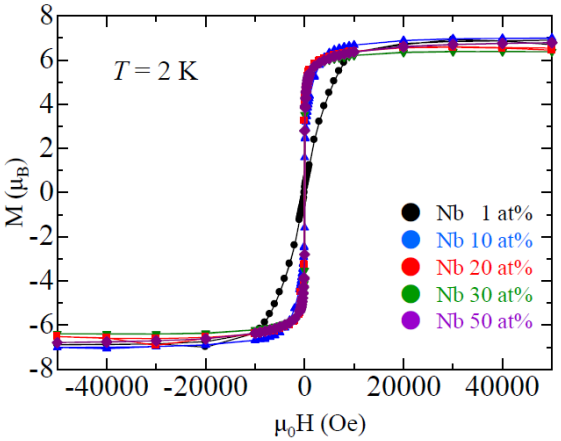

Fig.1 Magnetic field dependence of magnetization for $Eu(Ti,Nb)O_3$ thin films at 2 K. An increase in the Nb content converts $EuTiO_3$ from antiferromagnetic to ferromagnetic.

References

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