 MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2014B0285 実験課題名 Title of experiment Anomalous Magnetic Transition of Magnetoelectric oxide LnCrTiO ₅ (Ln=Nd, Gd) 実験責任者名 Name of principal investigator Yasui, Yukio 所属 Affiliation Meiji University	装置責任者 Name of responsible person Ishigaki, Toru 装置名 Name of Instrument/(BL No.) iMATERIA 実施日 Date of Experiment 2016/03/03 ~ 2016/03/04 2016/05/08 ~ 2016/05/09

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
 Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.
NdCrTiO ₅ Nd _{0.5} Pr _{0.5} CrTiO ₅

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。) Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.
<p>We have investigated the magnetic and dielectric properties of LnCrTiO₅ (Ln=Pr, Nd, Sm, Eu, and Gd). For Ln=Nd, and Gd, the systems exhibit a magnetic field induced ferroelectric transition at an antiferromagnetic transition temperature. For Ln=Sm, and Eu, the systems exhibit an antiferromagnetic transition without magnetic field induced ferroelectric transition. For Ln=Pr, the system does not have any transition. In order to understand the mechanism of magnetic field induced ferroelectric transition and the reason why varies in magnetic behavior between LnCrTiO₅ systems, it is important to clarify the detailed magnetic structure of LnCrTiO₅ systems. Because Sm, Eu and Gd atoms have large absorption of neutron beam, neutron diffraction measurements of these systems are considered to be difficult using samples of natural isotopes. We found that Nd_{0.5}Pr_{0.5}CrTiO₅ exhibit an antiferromagnetic transition at $T_N=14$ K without magnetic field induced ferroelectric transition. Then, the neutron diffraction measurements have been carried out on powder samples of NdCrTiO₅ and Nd_{0.5}Pr_{0.5}CrTiO₅ by using neutron diffractometer (iMateria) in order to study of detailed magnetic structures.</p>

2. 実験方法及び結果(つづき) Experimental method and results (continued)

Examples of neutron diffraction profiles of NdCrTiO_5 and $\text{Nd}_{0.5}\text{Pr}_{0.5}\text{CrTiO}_5$ taken at various temperatures, are shown in Figs. 1 and 2, respectively. We can see the growth of intensities of the magnetic reflections for both systems. Figure 3 shows the magnetic ordering pattern which can reproduce the observed magnetic scattering intensities of NdCrTiO_5 taken at 3.7 K. The obtained magnetic structure is almost consistent with the reported structure in Ref. 1. The Cr^{3+} -moments align parallel to the c axis (collinear). The Nd^{3+} -moments align along the direction which deviates from the b axis towards the a axis by the angle $\sim 15^\circ$. On the other hand, the observed magnetic intensities of the magnetic reflection of $\text{Nd}_{0.5}\text{Pr}_{0.5}\text{CrTiO}_5$ are weaker than those of NdCrTiO_5 . Especially, the magnetic reflections at the d -position pointed by arrows in Fig. 1 disappear by the Pr-substitution for Nd sites. Considering difference of the magnetic form factors of Nd^{3+} , Pr^{3+} , and Cr^{3+} moments, $\text{Nd}_{0.5}\text{Pr}_{0.5}\text{CrTiO}_5$ seems to exhibit the antiferromagnetic ordering of Cr^{3+} -moments only. We are analyzing the detailed magnetic structure of $\text{Nd}_{0.5}\text{Pr}_{0.5}\text{CrTiO}_5$.

[1] G. Buisson, J. Phys. Chem. Solids **31** (1970) 1171

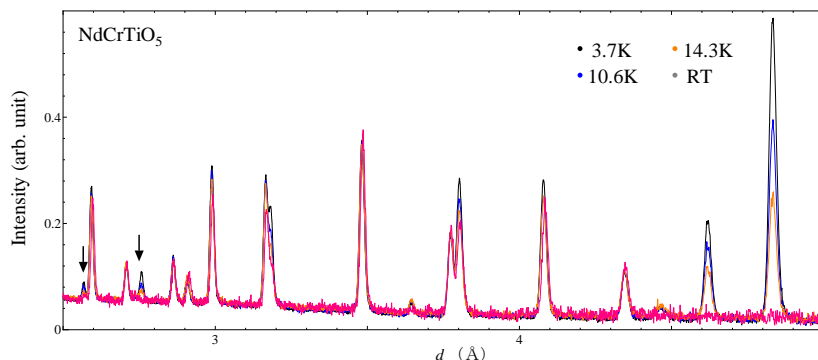


Fig. 1: Profiles of the neutron diffraction of NdCrTiO_5 taken at various temperatures.

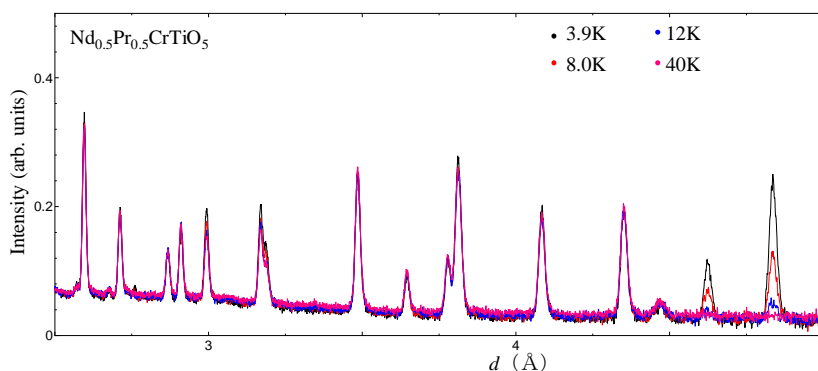


Fig. 2: Profiles of the neutron diffraction of $\text{Nd}_{0.5}\text{Pr}_{0.5}\text{CrTiO}_5$ taken at various temperatures.

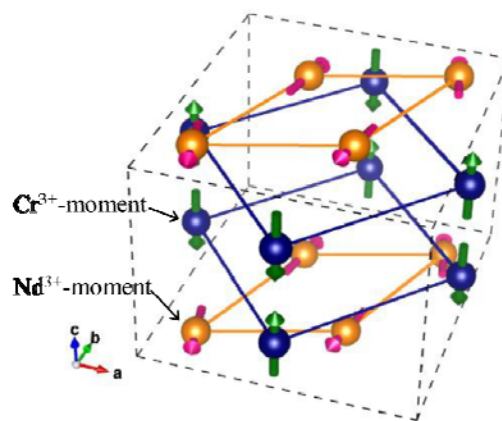


Fig. 3: The magnetic ordering pattern which can reproduce the observed magnetic scattering intensities of NdCrTiO_5 taken at 3.7 K. The obtained magnetic structure is almost consistent with the reported structure in Ref. 1.