実験報告書様式(一般利用課題・成果公開利用)

(※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。)

CROSS TOKAI **Experimental Report** J-PARC	承認日 Date of Approval 2014/10/22 承認者 Approver TAKEDA Masayasu 提出日 Date of Report 2014/10/22
課題番号 Project No. 2014A0320 実験課題名 Title of experiment Magnetic property at interface in manganite superlattice 実験責任者名 Name of principal investigator Kubota Masato 所属 Affiliation; JAEA	装置責任者 Name of Instrument scientist ; Takeda Masayasu 装置名 Name of Instrument/ (BL No.) BL17 実施日 Date of Experiment 6月13日 22:00 - 6月18日 9:00; 6月13日 21:00 - 6月20日 10:00

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.

LaMnO3/SrMnO3

Thin film 10mm*5mm*40nm

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.

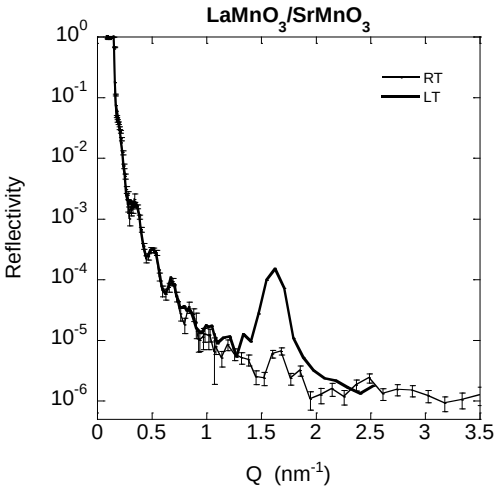
Our group extensively investigated physical properties of $(LaMnO_3)m/(SrMnO_3)n$ (LmSn) superlattices grown on lattice-matched $La_{0.3}Sr_{0.7}Al_{0.65}Ta_{0.35}O_{0.3}$ (LSAT) substrates, especially in terms of the influence of the number of m ($LaMnO_3$ layers) and n ($SrMnO_3$ layers) on the electronic and magnetic properties.

LmSn superlattices on the LSAT substrate exhibit a ferromagnetic insulating behavior for $2<n<m$. The insulating behavior suggests that the fabrication of the superlattices is well controlled at interfaces without a structural imperfection which would cause a charge transfer at interfaces. Consequently, it is surprisingly found that a large magnetoresistance effect occurs in the L2S2 superlattice, which is in contrast with the metallic ferromagnetism in bulk mixed valence $La_{1-x}Sr_xMnO_3$ manganite.

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

As a nondestructive technique, neutron reflectivity brings significant information on the magnetism at interfaces even in thin films. Besides, the magnet with high field and the spin polarization apparatus are available at BL17 SHARAKU installed at MLF, which are useful for revealing the magnetism at in the superlattices.

We mounted the L5S5 thin film onto a sample holder and put it into cryostat, combined with an electromagnet of 1 T. The thickness of the sample is approximately 40nm. The ferromagnetic transition temperature T_c is 160 K. By using neutron beam with the wave length of $2.4 < \lambda < 8.4$Å, the reflectivity data were obtained between $0.09 < Q < 0.35$ (nm^{-1}). Polarized neutrons were injected into the samples and reflectivity data for up and down spins were obtained without spin polarization analyses.



The figure below corresponds to the comparison of reflectivity data at 300K(RT) and 2.3 K(LT) with unpolarized neutron beam. There is a large difference in the reflectivity around Q=1.6 (nm^{-1}) between the both temperatures. This originates from the appearance of a ferromagnetic component within the superlattice. The interval of fringes which is clearly observed in the lower Q-range below 1 nm^{-1} reflects the thickness of the thin film.

At the present time, the analyses of the observed neutron reflectivity data have been proceeded, where we especially focus on whether ferromagnetic component gradually weakens or canted structure appears.

(Neutron beam supply were interrupted for about 36 hours because of emergency.)