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Magnetic structures of layered perovskite $SrIrO_3/SrTiO_3$ superlattice thin films studied by resonant x-ray diffraction

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1 Introduction

Ir oxides (5*d*-electron systems), by strong spin-orbit interaction, are expected to have metal-insulator transition which is different from the 3*d* electron system. In bulk samples of $Sr_{m+1}Ir_mO_{3m+1}$, it changes from Mott insulators to semimetals as m increases [1].

$(SrIrO_3)_m/SrTiO_3$ superlatice (SL) thin films are composed of a band insulator $SrTiO_3$ (STO) and a semimetal $SrIrO_3$ (SIO). One can control the electronic and magnetic structures by changing the value of m. The resonant x-ray diffraction (RXD) technique uses resonant effect at the x-ray absorption edge (at the L_2- and L_3-edges) to selectively enhance the signal of interest, and has become a powerful tool for investigating ordering phenomena. In the present work, we have obtained the information about the magnetic structure in SIO/STO SL thin films.

2 Experiment

Thin films of SIO/STO SL were fabricated by the pulsed laser deposition (PLD) method. The resonant x-ray diffraction measurements were performed at BL-3A of KEK-PF. RXD Measurements were performed between 10 K and 300 K. We used Ir L_2- and L_3-edge (12.845 keV and 11.228 keV, respectively). We also performed x-ray absorption spectroscopy (XAS) measurements at both edges. XAS spectra were measured by fluorescence mode.

3 Results & Discussion

Figure 1 (a) shows $(SIO)_1/(STO)_1$ superlattice thin film at resonant x-ray diffraction peaks at the L_3-edge at Q = (1/2 1/2 5). The peak of Q = (1/2 1/2 5) is of magnetic origin and disappears at T_N = 130K. This result is in good agreement with magnetization measurements.

Figure 1 (b) and (c) show the Ir $L_{3,2}$-edge RXD and XAS spectra for $(SIO)_1/(STO)_1$ SL. We obtained the RXD enhancement only at the L_3-edge as shown in Fig. 1(b) and (c).

From these results, we conclude that the magnetic structure is similar to that of Sr_2IrO_4 [2] and that $(SrIrO_3)_1/(SrTiO_3)_1$ superlattice thin film has in-plane magnetization due to spin canting.

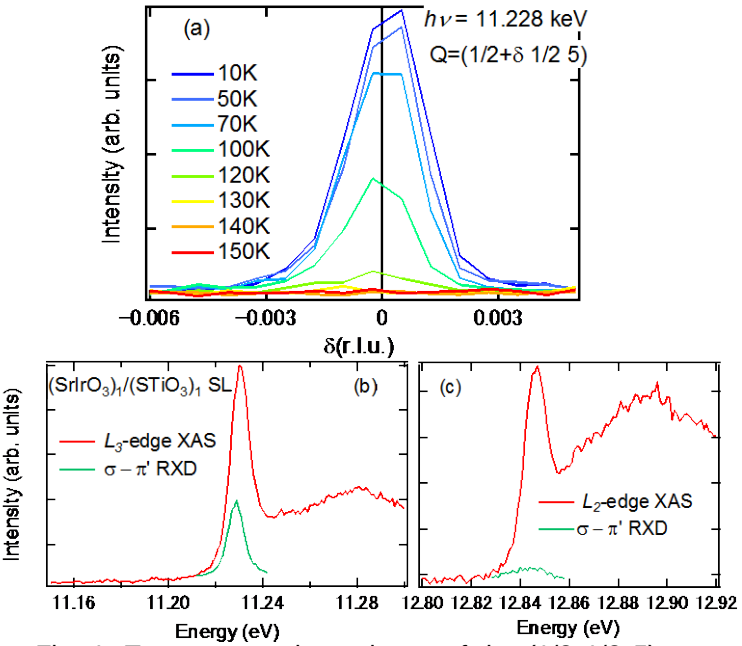

Fig. 1: Temperature dependence of the (1/2 1/2 5) peak at the L_3-edge (a). Photon-energy dependence of the RXD and XAS at Ir L_3 (b) and L_2 (c) edges.

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References

[1] S. J. Moon *et al.*, PRL **101**, 226402 (2008).
[2] B. J. Kim *et al.*, Science **323**, 1329 (2009).

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