4C, 16A2/2001S2002

Application of RXS interference technique to $La_{0.5}Sr_{1.5}MnO_4$

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Introduction

The interference technique, which is the new technique of the resonant X-ray scattering (RXS) [1, 2], has two features: i) one can observe a ferro-type orbital ordering whose reflections coincide with the fundamental Bragg reflections; ii) the energy scheme of virtual states related to the resonance process can be obtained. The former feature has directed the application of the interference technique to ferro-type orbital ordering systems. However, the latter feature is much attractive than the former one. Then, we have applied the interference technique to $La_{0.5}Sr_{1.5}MnO_4$, which is the first application of RXS interference technique to a system having an antiferro-type orbital ordering.

Experimental

The experiments were carried out at BL-4C and BL-16A2 of Photon Factory. The incident X-ray energy was tuned to the Mn *K*-absorption edge and polarization analysis of the scattered beam was made using a Cu (220) reflection. The single crystal sample of $La_{0.5}Sr_{1.5}MnO_4$ was mounted on the cold head of a closed-cycle helium refrigerator.

Results

We have successfully observed the interference signal on the super-lattice reflection for the first time. Figure 1 shows RXS profiles of the (3/4, 5/4, 0) super-lattice reflection. Interference term intensity [$I(\Delta=+12)$- $I(\Delta=-12)$]/ [$I(\Delta=+12)$+ $I(\Delta=-12)$] is also presented. Remarkable difference between the profiles means the coincidence of orbital ordering with the super-structure of crystal lattice. Figure 2 summarizes the azimuthal angle dependence of the peak value of the interference term. Results seems satisfactory for an analysis of the energy scheme of virtual states related to the resonance process. The precise analysis with reliable structure data will be reported elsewhere.

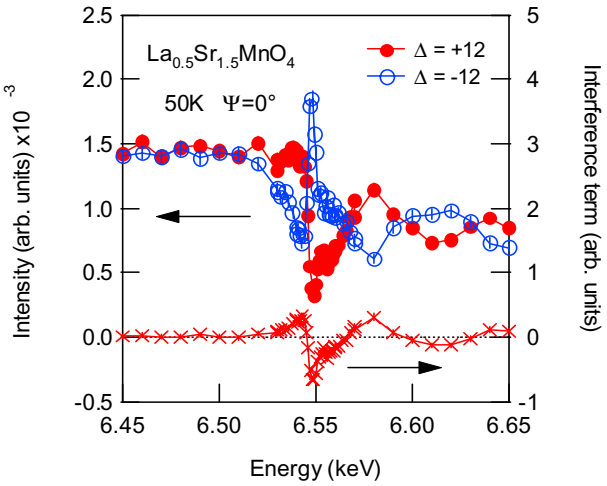

Fig. 1 RXS profiles of the (3/4, 5/4, 0) super-lattice reflection. Interference term intensity (x) is also presented.

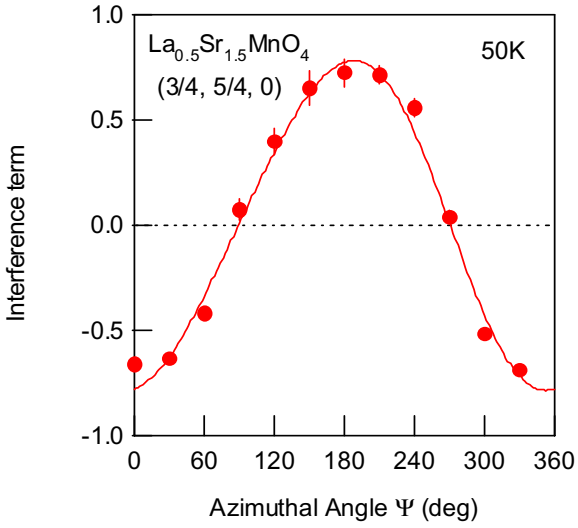

Fig. 2 The azimuthal angle dependence of the peak value of the interference term. The solid curve is the guide for eye.

References

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