# Lattice effects on the charge-spin ordering in layered cobaltates R1.5Sr0.5CoO4

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Layered transition metal oxides have been much attention due to their wide variety of magnetic, electrical and structural properties. In some of the doped transition metal compounds, there is a real space ordering due to the charge carriers in a certain carrier concentration, resulting in an orbital ordering (OO) and sometimes a charge ordering (CO). In a recent neutron scattering study, Zaliznyak el al. investigated a short ranged checkerboard charge order of Co2+/Co3+ ( ξ co=23 Å) and magnetic order at L=odd in the half-doped cobaltate La1.5Sr0.5CoO4 (LSCO:rA=1.19 Å) [1]. More recently, we performed neutron scattering experiments on La1.5Ca0.5CoO4 (LCCO: rA=1.15 Å) [2]. Comparing the results between LSCO and LCCO systems, we found that long-ranged checkerbord charge order ( ξ co(Ca)=115 Å) and new type of magnetic reflections at L=half-integer were observed in LCCO system. Our purpose of this study is to clarify the relationship between A site radius, rA, and charge-spin ordering. Thus, we studied about charge and magneic orderings in Nd1.5Sr0.5CoO4(NSCO: rA=1.16 Å) system.

Single crystal of Nd1.5Sr0.5CoO4 was grown by the TSFZ method, of which volume was about 1.0 cc. It was mounted in a refrigerator with the b-axis vertical, allowing to observe the (h,0,L) reciprocal lattice plane. To index the superlattice peaks, we use a unit cell with dimensions $\sqrt{2}a \times \sqrt{2}a \times c$. The neutron scattering experiments were carried out on the 3-axis spectrometer AKANE(T1-2).

Figure 1-(a) shows structural scatterings due to checkerboard charge ordering of R1.5Sr0.5CoO4 (R=La, Nd) in (1, 0, L). We observed the scatterings with L=integer in Nd system, while those of intensity in La system was very small. This result indicate that A site radius, which corresponds to bandwidth, is coupled with the charge order in layered cobaltates.

Magnetic scatterings at q=(0.5, 0, L) in Nd1.5Sr0.5CoO4 is shown in Fig.1-(b). We observed scatterings with L=odd, and this result is same as that of LSCO system. Contrary to the case of charge ordering, magnetic ordering is hardly coupled with A site radius.

Reference

[1] I. A. Zaliznyak et al.: PRL 85 (2000) 4353.
[2] K. Horigane et al.: JPSJ 76 (2007) 114715.

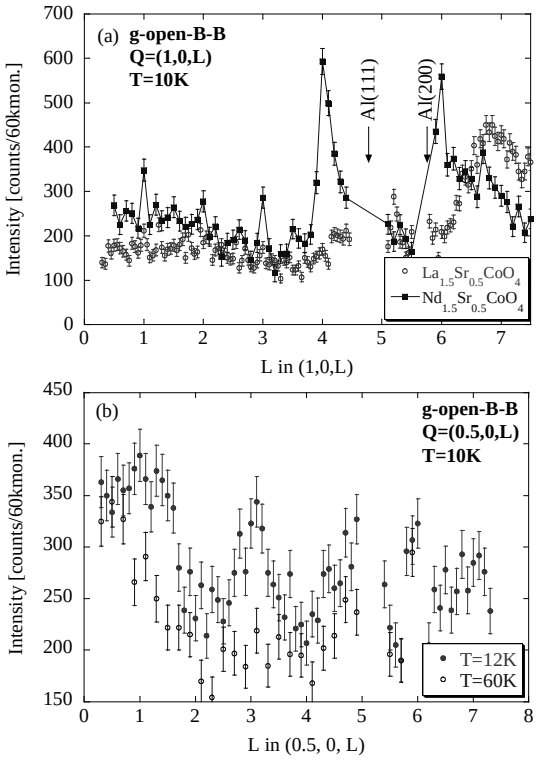


Fig. 1. (a)Structural scattering due to checkerboard charge order at (1, 0, L) in R1.5Sr0.5CoO4. The arrows indicate aluminum scattering. (b)Magnetic peaks at (0.5, 0, L) in Nd1.5Sr0.5CoO4.