Charge and spin ordering in La1.85Ca0.15CoO4.17

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In the neutron scattering experiments of layered cobaltate, we studied the hole-doping dependence of the charge and magnetic orderings[1]. Charge order peaks were insensitive to x, while the magnetic diffraction pattern changed dramatically below and above x=0.5. The type-1 reflections arised below x=0.5, whereas it switches to the type-2 reflections avobe x=0.5. From these results, we found that the type-1 and 2 stacking domains were changed by Ca doncentration or Co-valence. However, it is not straightforward to understand the origin of magnetic structure by Ca doping. In order to understand the essence for magnetic domains in this system, we examined the charge and magnetic ordering in excess oxygen system La1.85Ca0.15CoO4.17, of which cobalt valence is about Co2.5+.

Single crystal of La1.85Sr0.15CoO4.17 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 TOPAN(6G). The incident neutron energy was fixed to be Ei=30.5meV, typecally with a sequence of collimation of blank-30′-60′-blank.

Figure 1-(a) shows the charge order spectrum of (1,0,L). An integer-peak structure was clearly observed, and it is consistent with the checkerboard-type charge order in La1.5Ca0.5CoO4. If the Ca concentration is essential for magnetic domains, it is expected that magnetic peaks due to type-1 stacking are only observed. Figure 1-(b) shows the magnetic scattering in La1.85Ca0.15CoO4.17. We observed the strong intensity at L=half-integer. This result indicates that type-1 stacking domain is dominant in a lower doping range, suggesting that the magnetic domains are changed by Ca concentration around x=0.5. To understand the relationship, we should study other cobaltates which are substituted at A-site with various rare-earth and alkaline earth metals.

Reference

[1] K. Horigane et al.: JPSJ 76 (2007) 114715.

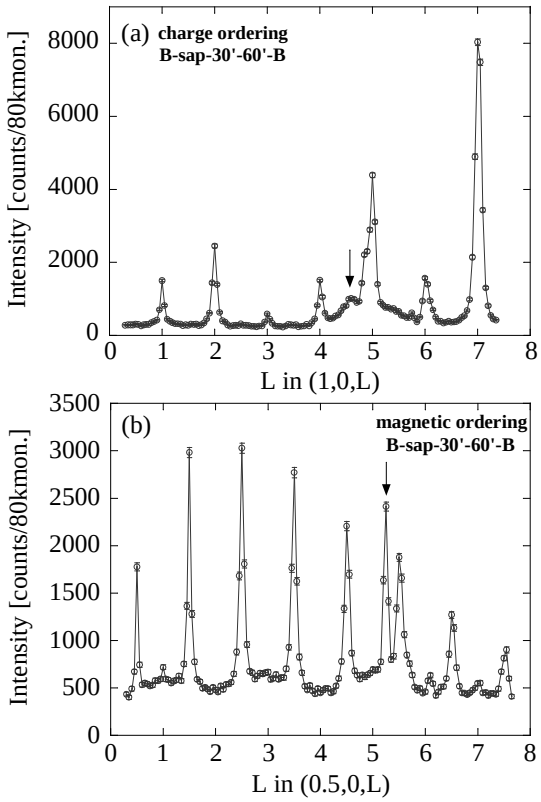

Fig. 1. (a)Structural scattering due to checkerboard charge order at (1, 0, L) in La1.85Ca0.15CoO4.17. The arrow indicate aluminum scattering. (b)Magnetic peaks at (0.5, 0, L) in La1.85Ca0.15CoO4.17.