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Author(s)	Goka, Hideto; Fujita, Masaki; Kubo, Takuyuu; Yamada, Kazuyoshi
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(II) Effect of Crystal Structure on the Competitive Relation between the Magnetic Order and Superconductivity in $La_{1.875}Ba_{0.125-x}Sr_xCuO_4$

H. Goka, M. Fujita, T. Kubo and K. Yamada

We performed neutron scattering, μSR and magnetization measurements on $La_{1.875}Ba_{0.125-x}Sr_xCuO_4$ to investigate an interplay among the superconductivity, magnetic/charge order and crystal structure. The obtained phase diagram clearly demonstrates an intimate relation among these physical properties.

Keywords: 1/8-problem/crystal structure/magnetic order/stripe model/high-T_c superconductor

In $La_{2-x}Ba_xCuO_4$ the high-T_c superconductivity is strongly suppressed with x around 1/8[1]. This 1/8-problem is considered to be closely connected with the mechanism of high-T_c superconductivity, particularly with the role of magnetic order for the suppression of superconductivity. Inspite of a large number of experimental studies on the 1/8-problem, few systematic work has been done for the effect of crystal structure on both the magnetic order and superconductivity. Then we utilized neutron scattering, μSR and magnetic susceptibility measurements on $La_{1.875}Ba_{0.125-x}Sr_xCuO_4$(LBSCO) single crystals to elucidate the effect of crystal structure on the 1/8-problem. The LBSCO is one of the ideal system to study this problem since one can control the crystal structure with keeping the carrier concentration constant.

As shown in Fig. 1, we obtained a phase diagram of LBSCO which clearly demonstrates a role of crystal structure on the competitive relation between the superconducting transition and magnetic ordering. In the low temperature tetragonal(LTT) or *Pccn* orthorhombic phase in the region x<0.07, the superconductivity (magnetic ordering) is substantially suppressed (stabilized). While in the low temperature orthorhombic (LTO) phase the supeconductivity is more stable even with the 1/8-doping.

One of possible models to explain the present results is so-called stripe model [2]. In this model, the LTT structure is favorable for the pinning of dynamical hole stripes. In fact, as shown in Fig.2, we observed nonmagnetic superlattice peaks in the LTT/*Pccn* phase which reflects the stripe ordering of holes. Futher study on the spin/charge fluctuation will reveal the detailed nature of dynamical stripe correlations and the relation with the superconductivity.

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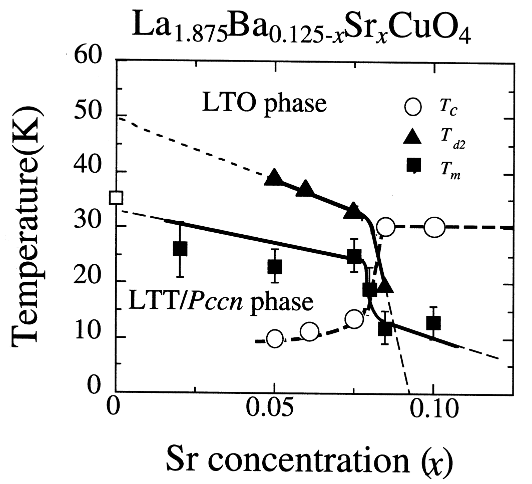

Figure 1. Phase diagram of LBSCO. Circles, triangles and squares denote the T_c, LTO-LTT(or *Pccn*) structural transition temperature T_{d2} by neutron scattering and the onset temperature for magnetic order T_m by μSR experiments, respectively. T_m for x=0 is quoted from [3]. Both solid and broken lines are guides to the eye.

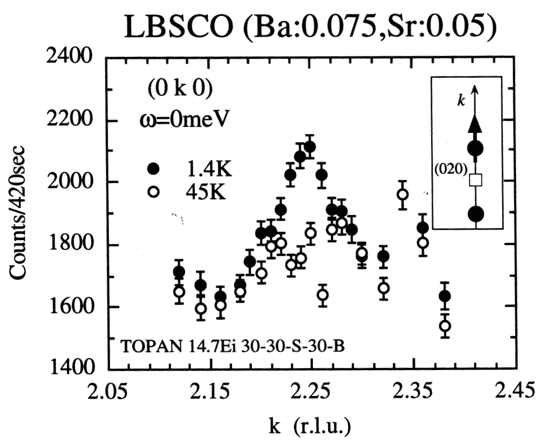

Figure 2. Superlattice peak at (0,2.25,0) observed by neutron scattering measurement. Inset shows the scan-trajectory.

References

[1] A. R. Moodenbaugh et al. Phys. Rev. B **38** 4596 (1988)
[2] J. M. Tranquada et al. Nature(London) **375** 561 (1995)
[3] K. Kumagai et al. J. Supercond. **7** 63 (1994)