Spin fluctuations in the heavily overdoped regime of the Bi-2201 cuprates

T. Adachi[A], Y. Komiyama[A,B], T. Taniguchi[C], S. Asai[D], T. Masuda[D], M. Fujita[C]

[A]*Dept. of Eng. & Appl. Sci., Sophia Univ.,* [B]*RIKEN Nishina Center,* [C]*IMR, Tohoku Univ.,* [D]*ISSP-NSL, Univ. of Tokyo*

It has formerly been proposed that ferromagnetic order/fluctuations develop and compete with the high-T_c superconductivity in the non-superconducting heavily overdoped (HOD) regime of the hole-doped cuprates [1]. To clarify the magnetic states in the HOD regime, we formerly performed neutron-scattering experiments in 5% Fe-substituted Bi-2201 cuprates at the Oak Ridge National Lab. in USA and JRR-3 in Japan and found incommensurate magnetic peaks at low temperatures, suggesting the formation of an Fe-induced incommensurate antiferromagnetic (AF) order [2]. On the other hand, whether ferromagnetic fluctuations exist was unclear yet. To clarify the details of the magnetic states in the HOD regime, we performed neutron-scattering experiments using 9% Fe-substituted Bi-2201 cuprate $Bi_{1.74}Pb_{0.38}Sr_{1.88}Cu_{1-y}Fe_yO_{6+\delta}$ with $y = 0.09$ in the HOD regime at C1-1 in JRR-3.

Alignment of the HOD crystal of $Bi_{1.74}Pb_{0.38}Sr_{1.88}Cu_{1-y}Fe_yO_{6+\delta}$ with $y = 0.09$ was carried out at T1-2 in February 2024, and neutron-scattering experiments were carried out at C1-1 in March 2024. The measurements were carried out using the advanced neutron triaxial spectrometer HODACA, which was newly developed at C1-1.

At first, the crystal axes were aligned at the Bragg reflections. As shown in Fig. 1, it was found that there were mainly two domains, and the orthorhombic $(100)_{ortho}$ and $(010)_{ortho}$ were aligned with respect to the domain with the strongest intensity.

A search for incommensurate magnetic peaks was then carried out around $(100)_{ortho}$ and $(010)_{ortho}$, where incommensurate magnetic peaks were observed at $y = 0.05$ from elastic scattering at the base temperature. However, no clear peaks were observed. Moreover, increasing temperature resulted in the absence of peaks. As no elastic peaks were observed, next we performed inelastic measurements at 30 K and ΔE = 0.4 - 0.5 meV. However, no significant peak structures were observed. Based on the above, it was concluded that the incommensurate AF peaks could not be observed in the sample used.

The absence of incommensurate peaks in the present measurements may be due to the multiple domain structure as shown in Fig. 1. Bragg peaks. That is, the intensity of a main peak around c2 = 90 deg is weak to be 200 cps.

In summary, the expected incommensurate AF peaks were not observed in the present experiments. The reason may be due to the multiple domain structure of the present crystal.

[1] A. Kopp *et al*., PNAS **104**, 6123 (2007).
[2] Y. Komiyama *et al*., in preparation.

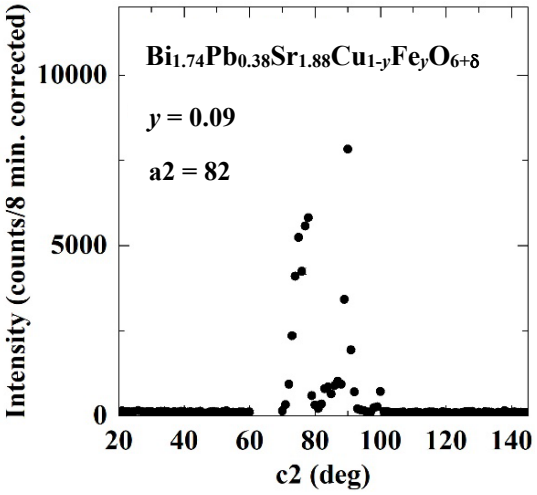

Fig. 1. Peak profile around the Bragg refletion of $(010)_{ortho}$ of 9% Fe-substituted $Bi_{1.74}Pb_{0.38}Sr_{1.88}Cu_{1-y}Fe_yO_{6+\delta}$ with $y = 0.09$ in the HOD regime.