Fe-doping dependence of magnetic correlations in Bi2201

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To explain the origin of high-T_c superconductivity, it is important to investigate spin correlations in a wide carrier-concentration range for high-T_c cuprates systematically. Although no magnetic cross section has been experimentally reported yet in one of the most typical cuprate superconductors Bi2201, we succeeded in finding magnetic incommensurate peaks at quasi-elastic channel by using a Fe and Pb co-doped single crystal on AKANE last year [1]. The most striking feature of the magnetic scattering is the anomalously large incommensurability $\delta = 0.20$. Since δ in Sr-doped La214 system saturates in $0.13 \sim 1/8$, it should be examined first whether the large δ in Fe-doped Bi2201 come from the underlying Cu-spin modulation or merely the Fe-Fe magnetic interaction between localized spins. So, we searched the Fe-doping dependence of the magnetic incommensurate peaks using as-grown single crystals of $Bi_{1.75}Pb_{0.35}Sr_{1.90}Cu_{1-y}Fe_yO_{6+\delta}$ with y =0.03, 0.06, and 0.12. To compare the scattering intensity each other, samples with nearly the same sample volume were prepared for current studies.

Neutron scattering experiments were carried out on triple-axis spectrometers AKANE and TOPAN. Figure 1 shows difference plots of **Q** spectra between 3 K and 70 K about $(1,0,0)$ antiferromagnetic zone center. While the magnetic intensity successively increases upon Fe doping, the incommensurate-peak structure is unchanged within the statistics. In fact, the spectra are well reproduced by using the same incommensurability and peak width, already extracted from $y = 0.09$ [1]. This result could be explained by supposing small magnetized clusters around Fe, which grow in number with increasing Fe spins. Hence, the magnetic modulations with large δ detected by Fe doping may come from underlying modulations of Cu spins. The large δ of the current sample in the ocerdoped phase follows a relation $\delta = p$, where p is the effective hole concentration and estimated to $\sim$0.22 from ARPES measurements for $y = 0.09$ [2]. This strongly suggests a different type of spin correlations in Bi2201 from the dominant spin-stripe correlations in Sr-doped La214.

References

[1] H. Hiraka and K. Yamada, Activity Report on Neutron Scattering Research: Experimental Reports **15** (2008), Report Number 398.

[2] T. Sato, private communications.

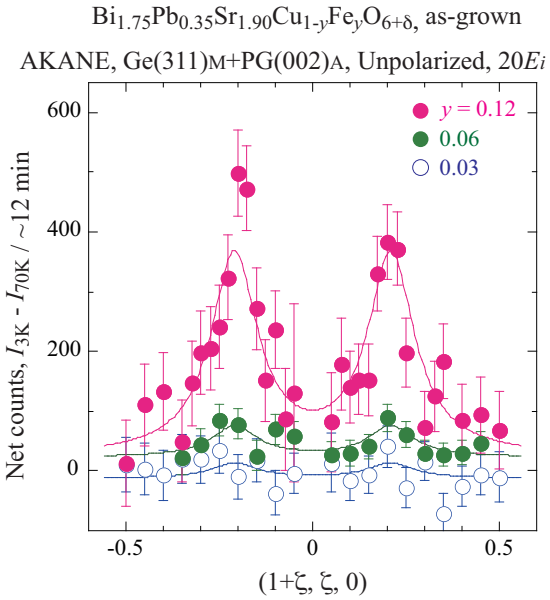

Fig. 1. Difference plots of Q spectra of Fe-doped samples for Fe-doped Bi2201 with $y = 0.03, 0.06$, and 0.12. The curved lines are fits to a pair of Lorentzians by holding the peak position and the peak width fixed.