Pressure induced superconductivity in SrFe2As2

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In 2008, a group in Japan reported high-Tc superconductivity in the Fe-based layered material LaFeFAsO [1]. Since then, a boom of the superconductivity research has been continuing all over the world to date. Soon after the discovery, it was found that the superconducting phase is situated in vicinity of the antiferromagnetically ordered phase, which suggests a close relation between the superconductivity and antiferromagnetic fluctuation, as has been suggested in the cuprate superconductors. For such a case, it is crucial to know if the superconducting phase can coexist with the antiferromagnetic phase or not. To date, however, this is not clear, since most of the phase diagram studies have been carried out in the carrier doped systems, where chemical inhomogeneity is inevitable. We therefore perform neutron diffraction study under hydrostatic pressure, where such chemical inhomogeneity is absent in principle.

The neutron diffraction experiment has been performed using single crystals of SrFe2As2 grown by the self-flux method [2]. The diffraction experiment has been performed using the triple-axis spectrometer ISSP-GPTAS, operated in the double-axis mode. The palm cubic anvil cell was used to generate a hydrostatic pressure up to 7 GPa; to maintain good hydrostaticity and to reduce the background, we have employed deuterated glycerol as a pressure medium.

Shown in Fig. 1 is the resulting pressure dependence of the ordered magnetic-moment size. This has been obtained by using the integrated intensity of the 103 reflections, normalized to that of the nuclear Bragg intensity at the 206 position. It can be clearly seen that the long-range ordered moment disappears around 5 GPa, where the coexistence of the antiferromagnetic and superconducting domains is suggested in the NMR study [3]. Our result clearly excludes the possibility of coexisting long-range antiferromagnetic order of the stripe type and the superconducting phase. By combining the NMR result, it may be inferred that the different type of the long-range antiferromagnetic order establishes at higher temperature, or the antiferromagnetic order becomes short-ranged. Further study is in progress to clarify this issue.

[1] Y. Kamihara et al., J. Am. Chem. Soc. 130 (2008) 3296.
[2] R. Morinaga et al., Jpn. J. Appl. Phys. 48 (2009) 013004.
[3] K. Kitagawa et al., Phys. Rev. Lett. 103 (2009) 257002.

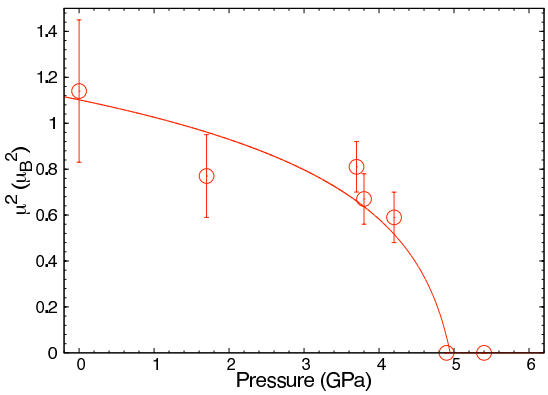

Fig. 1. Pressure dependence of the ordered moment size determined using the integrated intensity of the 103 reflection.