

Superconductivity and magnetism in $\text{Ba}(\text{Fe}_{1-x}\text{Co}_x)_2\text{As}_2$ near the phase boundary

M. Hiraishi¹, R. Kadono^{1,2}, M. Miyazaki¹, A. Koda^{1,2}, K. M. Kojima^{1,2},
S. Ibuka^{3,4}, Y. Nambu^{3,4}, and T. J. Sato^{3,4}

¹Department of Materials Structure Science, The Graduate University for Advanced Studies (SOKENDAI)

²Institute of Materials Structure Science, High Energy Accelerator Research Organization (KEK-IMSS)

³Neutron Science Laboratory, Institute for Solid State Physics, University of Tokyo (ISSP)

⁴Japan Science and Technology Agency-Transformative Research-Project on Iron-Pnictides (JST-TRIP)

BaFe_2As_2 (Ba-122) is known to exhibit superconductivity upon introduction of additional carriers to the pristine metallic compounds by partial substitution of Ba with K (hole doping) or Fe with Co (electron doping) [1]. We have revealed that Co substitution in $\text{CaFe}_{1-x}\text{Co}_x\text{AsF}$ (belonging to a class of so called “1111” iron arsenides common to LaFeAsO) induces development of superconducting domains over the magnetic background (“insular superconductivity”) [2]. In order to investigate the effect of Co substitution in Ba-122 series, we have carried out μSR experiment on single crystal sample of $\text{Ba}(\text{Fe}_{1-x}\text{Co}_x)_2\text{As}_2$ near the phase boundary with $x = 0.06$ ($T_c = 23$ K), $x = 0.065$ ($T_c = 21$ K), and $x = 0.08$ ($T_c = 23.3$ K).

As shown in Fig. 1 (a), it is found in zero field μSR spectra of $x = 0.06$ that a part of the asymmetry exhibits rapid depolarization with reduced temperature below 100 K, indicating development of magnetic domain. Thus the sample with $x = 0.06$ exhibits a microscopic phase separation into magnetic and paramagnetic state. The same behavior was observed in $x = 0.065$. The volume fraction of the magnetic phase reaches ~ 50 % and ~ 30 % at the lowest temperature, respectively. However, as shown in Fig. 1 (b), it is revealed that $x = 0.08$ remains a paramagnetic state at least until 5 K. Thus, the Co doping dependence of volume fraction of magnetic phase in Ba-122 series is different from that in $\text{CaFe}_{1-x}\text{Co}_x\text{AsF}$ which magnetic phase exists even in $x = 0.15$ (in volume fraction, ~ 30 %).

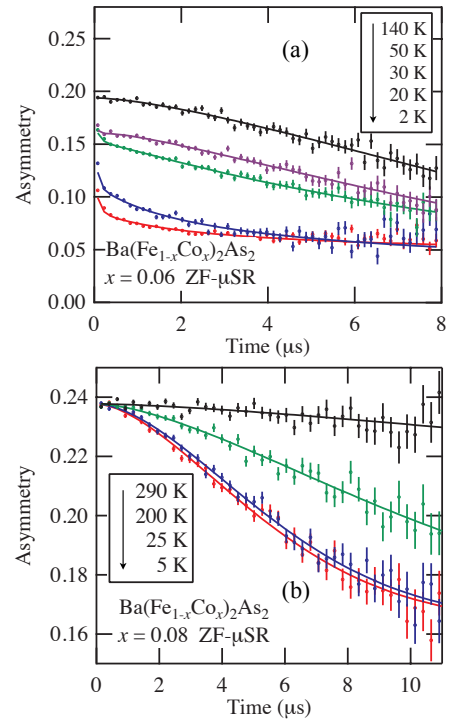


Fig. 1: Zero field μSR time spectra of $\text{Ba}(\text{Fe}_{1-x}\text{Co}_x)_2\text{As}_2$.

[1] A. S. Sefat *et al.*, Phys. Rev. Lett. **101**, (2008) 117004.

[2] S. Takeshita, *et al.*, Phys. Rev. Lett. **103** (2009) 027002