

 MLF Experimental Report	提出日 Date of Report 2017. 10. 10
課題番号 Project No. 2106B0121 挨拶 実験課題名 Title of experiment μ SR study of the Fe-substitution effects on the possible ferromagnetic state in the non-superconducting heavily overdoped high- T_c cuprates 実験責任者名 Name of principal investigator Tadashi Adachi 所属 Affiliation Department of Engineering and Applied Sciences, Sophia University	装置責任者 Name of responsible person Yasuhiro Miyake 装置名 Name of Instrument/(BL No.) S1 実施日 Date of Experiment 2017. 2. 5 - 8

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
 Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form. Bi-based high- T_c cuprates, $\text{Bi}_{1.76}\text{Pb}_{0.35}\text{Sr}_{1.89}\text{CuO}_{6+\delta}$, Single crystals Electron-doped high- T_c cuprates, $\text{Pr}_{1.3-x}\text{La}_{0.7}\text{Ce}_x\text{CuO}_{4+\delta}$ ($x = 0.10$), Single crystals

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。) Experimental method and results. If you failed to conduct experiment as planned, please describe reasons. Zero-field and longitudinal-field μ SR measurements have been performed using MiniCryo at temperatures between 4.2 K and 200 K and in magnetic fields up to 150 G for non-superconducting heavily overdoped $\text{Bi}_{1.76}\text{Pb}_{0.35}\text{Sr}_{1.89}\text{CuO}_{6+\delta}$ single crystals. Measurements have been performed in the double-pulsed mode, using a fly-past chamber. In zero field, the overall behavior of the spectra was Gaussian-like more or less. It was found that the muon-spin depolarization became fast gradually with decreasing temperature below ~ 200 K, suggesting the development of the spin correlation. From the analysis of the spectra, it was found that the depolarization rate of muon spins increased with decreasing temperature and tended to be saturated below ~ 50 K. Combining with our former results, moreover, it was found that the enhancement of the depolarization rate became significant with increasing the hole concentration from the superconducting overdoped to non-superconducting heavily overdoped regime. These results suggest that ferromagnetic fluctuations

2. 実験方法及び結果(つづき) Experimental method and results (continued)

reside in the overdoped and heavily overdoped regime of Bi-2201 cuprates. Accordingly, ferromagnetic fluctuations may be the cause of the suppression of superconductivity in the heavily overdoped cuprates.

Zero-field and longitudinal-field μ SR measurements have been performed using MiniCryo at temperatures between 4.7 K and 200 K and in magnetic fields up to 500 G for the over-reduced single crystals of the electron-doped high- T_c cuprates $\text{Pr}_{1.3-x}\text{La}_{0.7}\text{Ce}_x\text{CuO}_{4+\delta}$ ($x = 0.10$). Measurements have been performed in the double-pulsed mode, using a fly-past chamber.

In zero field, it was found that the depolarization of muon spins became fast gradually with decreasing temperature and rather fast Gaussian-like spectra were observed at low temperatures. The Gaussian-like behavior was mainly due to the growing effects of the Pr^{3+} moments. From the analysis of the spectra, it was found that the depolarization rate of muon spins increased with decreasing temperature at low temperatures, suggesting the enhancement of the Cu-spin correlation. Since the value of T_c of the over-reduced crystal was as high as ~ 27 K, it was concluded that the Cu-spin correlation was in intimate relation with the superconductivity in the electron-doped cuprates.