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Possible Existence of the Stripe Correlations in Electron-Doped Superconducting Cuprates $Eu_{1.85}Ce_{0.15}Cu_{1-y}Ni_yO_{4+\alpha-\delta}$ Studied by Muon-Spin-Relaxation

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Abstract. Partially Ni-substituted electron-doped superconducting cuprates of $Eu_{1.85}Ce_{0.15}Cu_{1-y}Ni_yO_{4+\alpha-\delta}$ (ECCNO) with y = 0, 0.01, 0.02 and 0.05 have been studied by muon-spin-relaxation (μSR) measurements, in order to elucidate whether or not the dynamical stripe correlations of spins and charges exist in electron-doped cuprates. It has been found that the development of the Cu-spin correlation is induced at low temperatures through the Ni substitution and that, for y = 0.02, a muon-spin precession due to a long-range magnetic order has been observed at 10 K. These results suggest a possibility that the stripe model can globally explain the high-T_c superconductivity in both hole- and electron-doped cuprates.

Introduction

The electron-hole doping symmetry in high-T_c cuprate superconductors has attracted great research interest in relation to the mechanism of the high-T_c superconductivity. Some properties in both systems have been found to be similar. Phase diagrams of the hole- and electron-doped systems are similar to each other, leading to the view of hole-electron doping symmetry. On the other hand, some properties have been found to be different from each other. From inelastic neutron-scattering measurements, an incommensurate Cu-spin correlation corresponding to the so-called dynamically fluctuating stripes of spins and holes [1] has been found in the hole-doped system [2], while a commensurate Cu-spin correlation has been observed in the electron-doped system [3]. From the viewpoint of impurity effects on the superconductivity, it has been found that, for the hole-doped cuprates, the superconductivity is suppressed by non-magnetic impurities such as Zn more markedly than by magnetic impurities such as Ni [4], which is contrary to the result in the electron-doped cuprates [5].

To understand the impurity effects on the Cu-spin dynamics, formerly, we performed zero-field (ZF) muon-spin-relaxation (μSR) measurements in the hole-doped cuprates $La_{2-x}Sr_xCu_{1-y}Zn_yO_4$ [6,7] and in the electron-doped cuprates $Pr_{1-x}LaCe_xCu_{1-y}Zn_yO_4$ [8]. It has been found that, in $La_{2-x}Sr_xCu_{1-y}Zn_yO_4$, Zn tends to induce the slowing down of the Cu-spin fluctuations in the entire superconducting regime, which can be attributed to the pinning and stabilization of the dynamically fluctuating stripes. In the electron-doped cuprates, in contrast, the spectra have been found to be independent of the Zn concentration. That is, no Zn-induced slowing down of Cu-spin fluctuations was observed in the electron-doped system.