Re-examination of the Phase Diagram of $Bi_2Sr_2CaCu_2O_{8+\delta}$ Studied by ARPES

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In high-T_c cuprate superconductors, the phase diagram plotted as a function of temperature and hole concentration has been elucidated as the universal phase diagram. The phase diagram has been known as a dome-like shape centered at the hole concentration of 16% which was determined in the previous report [1]. In contrast to the empirical and universal phase diagram, recent angle-resolved photoemission spectroscopy (ARPES) study has shown that the electronic structure of the cuprates behaves differently in the superconducting and normal states [2], even though the samples are expected to be the same hole concentration. Therefore, we expect that the phase diagram of the high-T_c cuprate superconductors might be deviated from the universal one and the optimally doped hole concentration should be re-examined.

In this study, we have performed an ARPES measurement to investigate the electric structure of the Bi-based high-T_c cuprate superconductors $Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi2212), which has two CuO_2 planes in the unit cell, with three compositions: $Bi_{2.1}Sr_{1.9}CaCu_2O_{8+\delta}$, $Bi_{2.3}Sr_{1.7}CaCu_2O_{8+\delta}$, $Bi_{2.1-x}Pb_xSr_2CaCu_2O_{8+\delta}$ (x = 0.66). Figure 1 shows the Fermi surface taken at $h\nu$ = 28 eV and T = 30 K in the superconducting state of $Bi_{2.1}Sr_{1.9}CaCu_2O_{8+\delta}$. The Fermi surfaces are clearly observed in wide momentum space. We have analyzed the ARPES spectra around the nodal region for each sample and determined the Fermi momentum points for each Fermi surface by fitting of momentum-distribution curves (MDCs) with a Lorentzian as shown by red dots (Fig. 1). As a result, we have found that three samples with different compositions show that the distance between two nodal points has a different value. This implies that these samples show a different hole concentration even though the sample has been expected to be optimal doping.

In this poster presentation, we will discuss a possible interpretation to understand the data obtained from the present ARPES study and show an expected phase diagram of Bi2212.

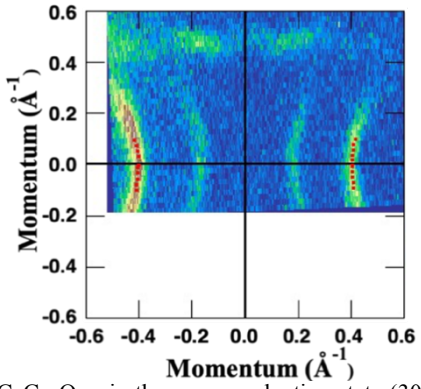

FIGURE 1. Fermi surfaces of $Bi_{2.1}Sr_{1.9}CaCu_2O_{8+\delta}$ in the superconducting state (30 K). Red dots are the Fermi momentum estimated from MDC near the Fermi level.

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