Doping dependence of the energy gap in the triple-layer cuprate Bi2223

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The energy gap seen in the superconducting (SC) and normal states gives an important piece of evidence for the mechanism of high SC transition temperature in cuprate superconductors. Bi-based high-T_c cuprate superconductors can be classified by the number of the neighboring CuO_2 planes (n): single-layer (n = 1) $Bi_2Sr_2CuO_{4+\delta}$ (Bi2201), double-layer (n = 2) $Bi_2Sr_2CaCu_2O_{8+\delta}$ (Bi2212), triple-layer (n = 3) $Bi_2Sr_2Ca_2Cu_3O_{10+\delta}$ (Bi2223). In going from n = 1 to 3, the maximum T_c increases from 35 K (Bi2201), 95 K (Bi2212) to 110 K (Bi2223), which is the highest T_c among the Bi family of cuprates [1]. However, the microscopic origin of this trend has not been clear yet.

For optimally doped Bi2223, previous angle-resolved photoemission spectroscopy (ARPES) studies have revealed its electronic structure [2-5]. However, it has been known that the sample fabrication with different doping is very difficult and the doping dependence of the electronic structure has not been investigated so far. Recently, high quality underdoped and overdoped single crystals of Bi2223 have been successfully synthesized [6,7]. We have performed a high-resolution ARPES study using synchrotron radiation, and revealed the doping-dependent electronic structure of Bi2223. In this presentation, we will show the electronic structure of underdoped, optimally doped, and overdoped Bi2223 and discuss the evolusiotn of the energy gap and the origin of the high T_c in Bi2223.

References

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