PC7-1-INV

ARPES study of high-temperature cuprate superconductor Bi2212 across critical dopings

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In the hole-doped cuprate high-temperature superconductors, the special doping $p = 0.19$ with various anomalies has attracted considerable research interest, with close connection to the pseudogap and strange metal [1]. In this talk, we present systematic angle-resolved photoemission (ARPES) studies across $p = 0.19$ in Bi2212. The results provide important insights into the nature of this special doping and the phenomenology of the cuprates [2, 3]. Further, we plan to discuss significant superconducting fluctuations on a single coherent, hole-like Fermi surface in heavily overdoped regime [4].

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Keywords: cuprate, ARPES, pseudogap, strange metal

PC7-2-INV

Superconductivity in a unique type of copper oxides

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The mechanism of superconductivity of cuprates remains one of the biggest challenges in condensed matter physics. High-Tc cuprates crystallize into layered perovskite structure featured with copper-oxygen octahedral coordination. Due to the strong Jahn Teller effect plus Coulomb interactions the octahedron in high Tc cuprates is elongated, placing the $3dx^2$-y^2 orbital level at top, almost degenerate with the O2p orbital, wherein the doped holes reside. This situation is considered to be unique of the cuprates that sustains d- wave paring symmetry and high Tc.

Here we present the high pressure synthesis of Ba_2CuO_{4-y} superconductor. Interestingly the cuprate possesses extraordinarily compressed octahedron along the *c*-axis direction. In the compressed octahedron the $3dz^2$ orbital level would be lifted above $3dx^2$-y^2 orbital level. The compound shows bulk superconductivity with critical temperature (Tc) above 70 K confirmed by Meissner effect, □SR measurements. The Tc is more than 30 K higher than that for the isostructural hole doped La_2CuO_4. The present work sheds renewed light on comprehensive understanding of the pairing and Tc determining mechanism of cuprate superconductors.

Acknowledgments: We thank all collaborators who contributed to the work.
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Keywords: Copper Oxide Superconductor, Compressed Local Coordination, Orbital Order

PC7-3

Electron-doping Effect and the Electronic State in the Undoped (Ce-free) Superconductor T'-$La_{1.8}Eu_{0.2}CuO_{4-\delta}$

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In undoped (Ce-free) RE_2CuO_4 (RE = rare earth) with the Nd_2CuO_4-type (T'-type) structure, the superconductivity has been observed without carrier doping by removing excess oxygen [1]. To clarify the electronic states of the undoped superconductor, it is necessary to investigate the doped carrier-concentration dependence of T_c in RE_2CuO_4 with a single kind of blocking layer. It has been reported so far that T_c decreases through the hole doping in Sr- and Ca-substituted T'-$La_{1.8}Eu_{0.2}CuO_{4-\delta}$ (T'-LECO) [2, 3]. Accordingly, we have synthesized samples of T'-$La_{1.8}Eu_{0.2}CuO_{4-y}F_y$ (T'-LECOF) and investigated the electron-doping effect on T_c.

T'-LECOF samples were obtained by the fluorination of T'-LECO samples prepared by the low-temperature synthesis method [4] using NH_4F. Superconducting samples of T'-LECOF were obtained by the reduction annealing in vacuum. From the powder X-ray diffraction and EPMA measurements, it has been found that the obtained samples are confirmed to be of the single phase and that the content of F is confirmed to be almost the same as the nominal one. The magnetic susceptibility measurements have revealed that T_c increases with increasing y, exhibits the maximum value of ~ 23K at $y = 0.025$ and decreases. The dome-like dependence of T_c on the doped carrier concentration shown in the figure is explained in terms of the pairing mediated by spin fluctuations based on the d-p model calculation [5].

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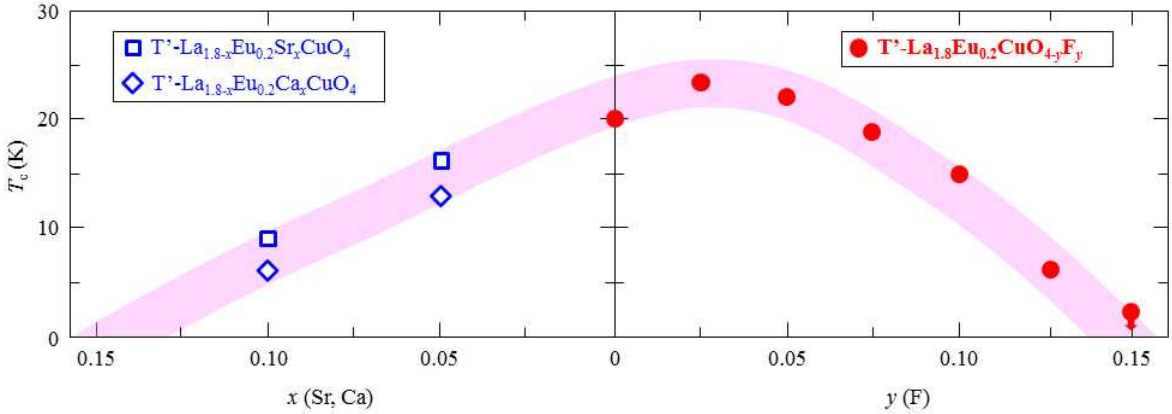

Fig. Dependence of T_c on the doped carrier concentration for T'-$La_{1.8-x}Eu_{0.2}M_xCuO_{4-y}F_y$ (M = Sr, Ca).

Keywords: Undoped superconductor, Cuprate, Low-temperature synthesis, Strongly correlated electron system

PC7-4

Rectification by Superconducting Diodes Made of REBCO Films

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A superconducting diode with an asymmetric I_c has been proposed as a novel rectifying element operating at cryogenic conditions [1]. It has an opposite current-voltage properties compared with the semiconductor diode. In the cryogenic applications, the superconducting diode has a potential to be used as an efficient rectifiers or current limiters. In our previous study, we fabricated the tailored REBCO films to achieve a large rectification rate and developed an prototype element made of the REBCO film [2]. In this study, the rectification properties of the superconducting diodes were investigated at various magnetic fields and temperatures in order to optimize the operating conditions.
$BaHfO_3$-doped $SmBa_2Cu_3O_y$films were fabricated on $LaAlO_3$substrates with a thicknesses of 1000 nm using a pulsed laser deposition method. The films were processed into micro bridges with a width of 100 μm. Current-voltage characteristics including the reverse current were measured at 0-9 T and 40-90 K by the four-probe method. An asymmetricity *Asym.*was defined as a ratio between a differential and an average amplitude of $I_c$for the different current direction.
Figure 1(a) shows *I-V*characteristics in the REBCO film at 65 K and 0.3 T along the in-plane direction. It is apparent that the $I_c$is about twice as different depending on the current direction. *Asym.*was plotted for the temperature and the magnetic field as shown in Fig. 1(b). The optimal temperature for the *Asym.*was about 65 K which corresponds to the temperature of the sub-cooled liquid nitrogen. Therefore, we conclude that the superconducting diode made of the REBCO film is expected to be used in the liquid nitrogen. On site, we will discuss an origin of the asymmetric $I_c$to optimize the diode with the larger rectification rate.

This research was partly supported by JST-ALCA, JST-A-STEP, KAKENHI (19K22154), REFEC, and NU-AIST alliance project.

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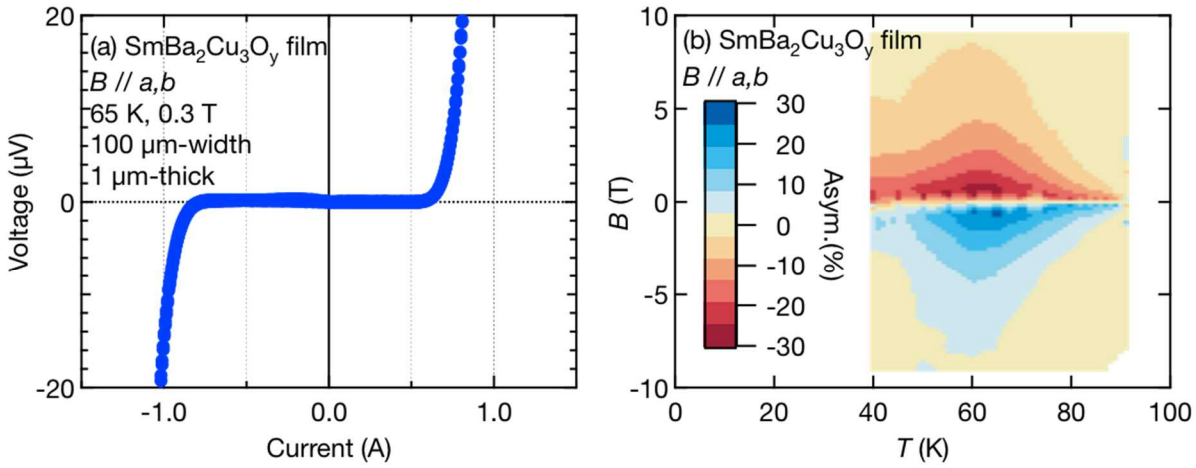

Fig. 1 (a) Asymmetric current-voltage characteristics in $SmBa_2Cu_3O_y$ films at 65 K and 0.3 T. (b) Temperature and field mapping of the asymmetricity of the critical current.

Keywords: REBCO film, Superconducting diode, Critical current