

Superconducting coherence along c-axis in the stripe phase of high-Tc cuprates

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K. Tanaka, Y. Sakai, T. Miyake, S. Miyazaki, S. Miyasaka and S. Tajima,
Department of Physics, Osaka University, 1-1 Machikaneyama, Toyonaka, Osaka 560-0043, Japan

M. Tonouchi
Institute of Laser Engineering, Osaka University, 2-6 Yamadaoka, Suita, Osaka 565-0871, Japan

T. Sasagawa
Materials and Structures Laboratory, Tokyo Institute of Technology, 4259 Nagatsuta, Midori-ku, Yokohama
Kanagawa 226-8503, Japan

Recently, a two-dimensional superconducting state has been reported from transport studies in the stripe-ordered $\text{La}_{2-x}\text{Ba}_x\text{CuO}_4$ with $x = 1/8$ [1]. This is consistent with the results of c-axis ($E//c$) infrared optical studies for $\text{La}_{2-x}\text{Ba}_x\text{CuO}_4$ and $\text{La}_{2-x-y}\text{Nd}_y\text{Sr}_x\text{CuO}_4$, that the Josephson plasma edge originating from the Josephson coupling of the CuO_2 planes disappears in the stripe phase [2]. These results indicate the disappearance of the superconducting coherence along c-axis and the decoupling of the CuO_2 planes. To clarify the universality of this phenomena, we performed terahertz time-domain spectroscopy (THz-TDS) measurement, in which one can obtain lower frequency information than the conventional Fourier transform type spectrometer, on static stripe-ordered $\text{La}_{1.84-y}\text{Eu}_y\text{Sr}_{0.16}\text{CuO}_4$ ($y = 0, 0.1, 0.2$) and $\text{La}_{2-x-y}\text{Nd}_y\text{Sr}_x\text{CuO}_4$ ($x=0.125, 0.16, y=0.1\sim 0.5$), where the stability of the stripe phase can be controlled by y . We found that the Josephson plasma edge shows systematic shift to the lower frequency with increasing y and survives in the extremely low frequency region in the stripe-ordered phase. By comparing the superfluid density along c-axis and in-plane, we conclude that the system is not going toward two-dimensional superconducting state with stabilizing the stripe order.

[1] Q. Li, M. Hucker, G.D. Gu, A.M. Tsvelik, and J.M. Tranquada, Phys. Rev. Lett. 99, 067001 (2007).

[2] A.A. Schafgans, C.C. Homes, G. D. Gu, Seiki Komiya, Yoichi Ando, and D.N. Basov, Phys. Rev. B 82, 100505(R) (2010).

Primary author: TANAKA, Kiyohisa (Osaka University)

Presenter: TANAKA, Kiyohisa (Osaka University)

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