BL-28A/2012G075, 2012S2-001

Superconducting gap in the iron-based superconductor $BaFe_2(As_{1-x}P_x)_2$

Jian XU[1*], K. Okazaki[1], H. Suzuki[1], M. Horio[1], L. Liu[1], S. Ideta[1], T. Yoshida[2], M. Hashimoto[3], D. H. Lu[3], Z.-X. Shen[3], K. Ono[4], H. Kumigashira[4], M. Nakajima[5], K. Kihou[5], C. H. Lee[5], A. Iyo[5], H. Eisaki[5], S. Uchida[1], and A. Fujimori[1]

[1]University of Tokyo, Hongo, Tokyo 113-0033, Japan
[2]Kyoto University, Kyoto, 606-8501, Japan
[3]Stanford University, Stanford, CA 94305-4045, America
[4]KEK, Photon Factory, Tsukuba, Ibaraki 305-0801, Japan
[5]National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Ibaraki, 305-8568, Japan

1 Introduction

The iron-based superconductor $BaFe_2(As_{1-x}P_x)_2$ has attracted much attention since the presence of superconducting gap nodes was suggested from penetration depth and thermal conductivity measurements [1]. In order to investigate the superconducting gap, we have studied $BaFe_2(As_{1-x}P_x)_2$ with x = 0.34 (T_c = 24 K) by angle-resolved photoemission spectroscopy (ARPES). Different doping concentrations (x = 0.3, 0.38 and 0.45) also have been studied by ARPES measurement for systematic research on $BaFe_2(As_{1-x}P_x)_2$.

2 Experiment condition

High-quality single crystals of $BaFe_2(As_{0.66}P_{0.34})_2$ were grown using the self-flux method. Experiments were carried out at BL-28A of Photo Factory using Scienta SES-2002 analyzer and linearly polarized light, with the photon energy of $h\nu$ = 40 eV, and the energy resolution of 9-10 meV. The crystals were cleaved *in situ* at T = 9 K, in an ultra-high vacuum of ~ 1.5×10^{-8} Pa.

3 Result

Figure 1(a) shows the electron Fermi surfaces (FSs) of $BaFe_2(As_{0.66}P_{0.34})_2$. The Fermi-surface angle θ is defined as shown in Fig. 1(a), in which θ = 0 along X-Γ direction. Symmetrized energy distribution curves blow (T = 10 K, blue solid line) and above (T = 30 K, red dashed line) the T_c along the inner and outer FSs are shown in panels (b) and (c), respectively. Nearly isotropic gaps both on the inner and outer FSs are opened for this doping concentration.

Optimally doped sample (x = 0.3, T_c = 30 K) measured at BL-28A using circularly polarized light with the photon energy of $h\nu$ = 40 eV, and at BL5-4 of Stanford Synchrotron Radiation Laboratory (SSRL) using linearly polarized light with $h\nu$ = 28 eV show that anisotropic gaps open on electron FSs. While anisotropy turn to insignificant in this slightly overdoped composition x = 0.34 and previous x = 0.38 one (BL-28A, circularly polarized light, $h\nu$ = 40 eV).

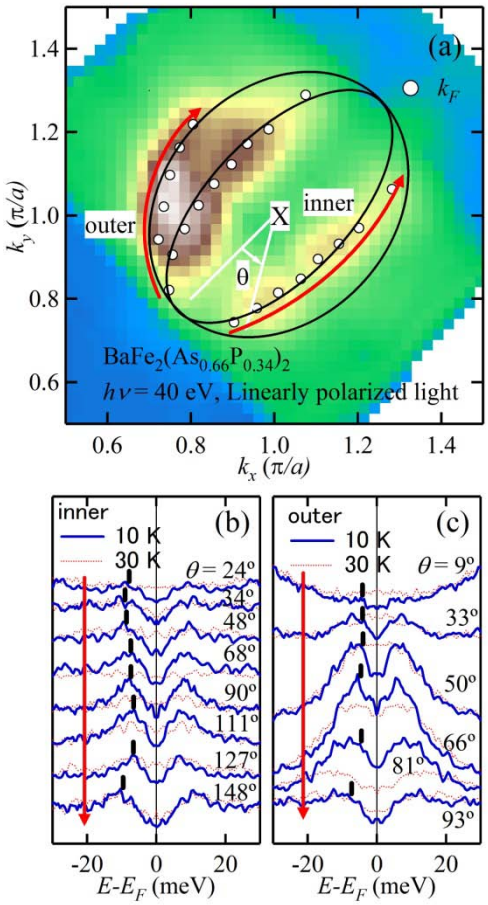

Fig. 1: (a) Electron Fermi surfaces around the X point ($h\nu$ = 40 eV) of $BaFe_2(As_{0.66}P_{0.34})_2$ (T_c = 24 K). (b), (c) Symmetrized energy distribution curves at k_F points on the inner and outer FSs.

Reference:
[1] K. Hashimoto. *et al.*, Phys. Rev. B **81**, 220501 (2010)

* xujian@wyvern.phys.s.u-tokyo.ac.jp