

Superconducting gap in the iron-based superconductor $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$

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1 Introduction:

The iron-based superconductor $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ 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 anisotropy, we have studied $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ with $x = 0.38$ ($T_c = 24$ K) by angle-resolved photoemission spectroscopy (ARPES). Different doping concentrations ($x = 0.3$, and 0.34) have also been studied by ARPES measurement for systematic research on $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$.

2 Experiment condition:

High-quality single crystals of $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ were grown using the self-flux method. Experiments were carried out at BL-28A of Photon Factory using a 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 $\sim 2 \times 10^{-8}$ Pa.

3 Result:

Figure 1(a) shows the electron Fermi surfaces (FSs) of $\text{BaFe}_2(\text{As}_{0.62}\text{P}_{0.38})_2$. The Fermi-surface angle θ is defined as shown in Fig. 1(a), in which $\theta = 0$ along the X - Γ direction. Energy distribution curves (EDCs) and symmetrized EDCs below ($T = 10$ K, blue line) and above ($T = 30$ K, red line) the T_c along the inner and outer FSs are shown in panels (b)-(d) and (e)-(g), respectively. Nearly isotropic gaps both on the inner and outer FSs are opened for this doping concentration as shown by dash line in panels (e)-(g). This is contrasted with the previous results on optimally doped samples ($x = 0.3$, $T_c = 30$ K) measured using circularly polarized light with the photon energy of $h\nu = 40$ eV [2], which showed that anisotropic gaps open on the inner electron FS.

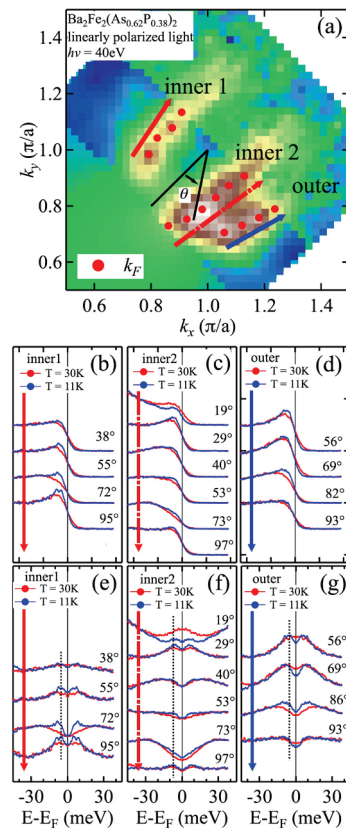


Fig. 1: (a), Electron Fermi surfaces (FSs) around the X point ($h\nu = 40$ eV) of $\text{BaFe}_2(\text{As}_{0.62}\text{P}_{0.38})_2$ ($T_c = 24$ K). (b)-(d) and (e)-(g): Energy distribution curves (EDCs) and symmetrized EDCs at k_F points on the inner and outer FSs respectively.

Reference:

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

[2] T. Yoshida *et al.*, Sci. Rep. **4**, 7292-1-6 (2014)

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