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Unusual electronic structure and pairing in the $K_xFe_{2-y}Se_2$ and $BaFe_2(As_{1-x}P_x)_2$ superconductors

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In this talk, we present the angle resolved photoemission study of the unusual electronic structure and pairing behavior in two rather unique iron based superconductors: $K_xFe_{2-y}Se_2$ and $BaFe_2(As_{1-x}P_x)_2$ For $K_xFe_{2-y}Se_2$, large electron Fermi surfaces are observed around the zone corners with an almost isotropic superconducting gap of 10.3 meV, while there is no hole Fermi surface near the zone center, which demonstrate the inter-band scattering or Fermi surface nesting is not a necessary ingredient for the unconventional superconductivity in iron-based superconductors. Moreover, two insulating and one semiconducting parental phases of $K_xFe_{2-y}Se_2$ were identified. The two insulating phases exhibit Mott-insulator-like signatures, and one of the insulating phases is mesoscopically phase-separated from the superconducting/semiconducting phase in the superconductor/semiconductor [2]. For $BaFe_2(As_{1-x}P_x)_2$, which is a prototypical iron-based superconductor with nodal gap behaviors, we have determined the systematic change of its low energy electronic structures as a function of the Phosphor concentration. We found the so-called iso-valent doping actually introduce significant amount of holes into the system. The chemical pressure effect is largely a doping effect in addition to the non-rigid band behavior [3]. Moreover, we report the direct observation of a circular line node on the largest hole Fermi surface around the Z point at the Brillouin zone boundary. We found that the nodes are due to the strong three dimensional character of this Fermi surface (large kz dispersion, strong mixing of d_{3z2-r2} orbitals), instead of d-wave pairing or other scenarios involving the electron pockets [4].

[1] Y. Zhang et al. Nature. Materials 10, 273 (2011).
[2] F. Chen et al. arXiv:1106.3026v1[cond-mat.supr-con] (2011).
[3] Z. R. Ye et al. arXiv:1105.5242v1[cond-mat.supr-con] (2011).
[4] Y. Zhang et al. arXiv:1109.0229v1[cond-mat.supr-con] (2011).