

Phosphor induced heavy hole-doping in $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ superconductor

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$\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ is a rather unique iron pnictides as its superconductivity is introduced by the isovalent doping of P for As. With angle resolved photoemission spectroscopy, we found that the phosphor substitution could induce significant amount of holes into the hole Fermi surfaces around the zone center, which overturn the previous common belief of “iso-valent” doping, and explains why the phase diagram of $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ is similar to the hole-doped case of $\text{Ba}_{1-x}\text{K}_x\text{Fe}_2\text{As}_2$. More importantly, our results indicate that the drastic pressure effects in iron based superconductors are most likely due to similar electronic structure changes. Moreover, we found that d_{xy} bands are always present even at optimal P doping, unlike predicted before.