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Magnetic penetration depth of oxy-ferropnictide superconductors

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The determination of the symmetry of the superconducting order parameter is an important first step toward uncovering the mechanism of superconductivity in any material. In this regard, measurements of the magnetic penetration depth λ have played an important role. Although not a true bulk probe, like specific heat, penetration depth measurements in the Meissner state probe a few thousand Angstroms below the crystal surface and so should be reasonably representative of the bulk. In this talk I will present data for the in-plane magnetic penetration depth of three different families oxy-ferropnictide superconductors, measured on single crystals using a sensitive radio frequency tunnel diode oscillator technique. Our results for samples of $SmFeAsO_{1-x}F_y$ ($x \simeq y \simeq 0.2$) with $T_c \simeq 45\,\mathrm{K}$ show that $\lambda(T)$ has an exponential temperature dependence suggesting that the Fermi surface is fully gapped. However, data for $Ba(Fe_{1-x}Co_x)_2As_2$ ($T_c \simeq$22 K) show power-law behavior, $\Delta\lambda(T) \sim T^{1.7}$, at low temperature, possibly suggestive of line-nodes. Finally, data for LaFePO ($T_c \simeq 6$K), also show a power-law behavior for $\lambda(T)$, but in this case the temperature dependence is almost perfectly linear down to $T \simeq 100$mK. The results suggest that the gap symmetry may not be universal in all the oxy-ferropnictide superconductors.