Iron-pnitides and -chalcogenides at high magnetic fields

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In this presentation, starting with an overview of the current research status on the upper critical fields H_{c2} of various pnictides ranging from '1111' to '122' system, I will discuss the pairing strength, band effect, and pair breaking mechanism relevant for each system. In particular, I'll highlight the nearly isotropic H_{c2} behaviors observed in the '122' system with various dopants and doping levels, including our recent one [1], and offer an explanation based on the interplay between the two-band orbital and the Pauli paramagnetic effects with temperatures. As a unique case of dominant Pauli paramagnetic effect, I'll focus on our recent results of the $H_{c2}(T)$ of a $FeTe_{0.6}Se_{0.4}$ single crystal obtained from the resisitivity measurements in static magnetic fields up to 45 T [2]. In this representative '11' system, the observations of strong bending in the $H_{c2}^{ab}(T)$ curves and nearly isotropic $H_{c2}^{ab}(0) \approx H_{c2}^{c}(0) \approx 48$ T support the presence of strong Pauli paramagnetic effect. The Werthamer-Helfand-Hohenberg formula considering the Pauli limiting and the spin-orbit scattering together can effectively describe both $H_{c2}^{ab}(T)$ and $H_{c2}^{c}(T)$ curves. The enhancement in quasi-particle density of states or increased scattering resulting from Te(Se) vacancy or excess Fe is likely to be a main origin for the manifesting Pauli paramagnetic effect in this '11' system. Finally, I'll present successful growth story of a large '111' single crystal and its anisotropic $H_{c2}(T)$ behaviors.

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[1] Seunghyun Khim et al., Nearly isotropic upper critical fields in a $SrFe_{1.85}Co_{0.15}As_2$ single crystal, arXiv:1001.4310; Physica C, in press.
[2] Seunghyun Khim et al., Evidence for dominant Pauli paramagnetic effect in the upper critical fields of a $FeTe_{0.6}Se_{0.4}$ superconductor, arXiv:1001.4017 (submitted)