

Upper Critical Field, Second Magnetization Peak and Irreversibility Line in $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ Single Crystals

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The upper critical field H_{c2} of optimal ($x = 0.31$, $T_c \sim 29$ K) and slightly overdoped ($x = 0.38$, $T_c \sim 26$ K) $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ single crystals were extracted from the temperature dependences of in-plane resistivity ρ_{ab} and magnetization with varying magnetic fields under both $H \parallel c$ and $H \perp c$ configurations. A nearly linear temperature dependence of H_{c2} is observed, and the anisotropic ratio defined as $\gamma = H_{c2}^{\perp c} / H_{c2}^{\parallel c}$ turns out to be ~ 2.3 . In the case of $H \parallel c$, the second magnetization peak H_{sp} is observed in the magnetic hysteresis loops (MHLs). The irreversibility line $H_{irr}(\text{T})$ was determined by measuring temperature dependence of magnetization at different magnetic fields and MHLs at different temperatures. The vortex phase diagram of $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ single crystals was subsequently established. The H_{c2} , H_{sp} and $H_{irr}(\text{T})$ of $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ single crystals were analysed by comparing with those observed in optimal doped $\text{Ba}_{1-x}\text{K}_x\text{Fe}_2\text{As}_2$ and $\text{BaFe}_{2-x}\text{Co}_x\text{As}_2$ single crystals. The origin of the second magnetization peak and mechanism of vortex pinning in $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ single crystals are further discussed.