Anisotropic H_{c2} Measurement on the $(Ca_{0.855}La_{0.145})_{10}(Pt_3As_8)(Fe_2As_2)_5$ High-Temperature Superconductor

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Introduction

Since 2008, FeAs- and FeSe-based superconductors have attracted a lot of research interest, partly due to their high temperature superconducting transition temperature, high upper critical field, and small anisotropy, which could make these superconductors of practical use. Recently a compound $Ca_{10}(Pt_3As_8)(Fe_2As_2)_5$ (10-3-8 phase) was characterized [1]. It has the layered –Ca-Pt_3As_8-FeAs-Ca-stacking arrangement. This compound can be tuned to superconductivity below 11 K with Pt substitution on the Fe sites; superconductivity can also be induced up to 26 K with La doping on the Ca sites. The most prominent difference compared to other pnictides lies in the structural and electronic characters of the metallic intermediary platinum arsenide layers rather than the insulating intermediary layers [1].

Results and Discussion

To study the anisotropy of H_{c2}, the magnetic field dependence of rf contactless penetration depth of the $(Ca_{0.855}La_{0.145})_{10}(Pt_3As_8)(Fe_2As_2)_5$ superconductor was measured for magnetic field applied both **H||ab** and **H||c** in pulsed magnet systems. The shapes of the $H_{c2}(T)$ curves for **H||ab** and **H||c** show the different temperature dependence. A conventional linear field dependence of H_{c2} is observed close to the T_c, with clearly different slopes for the two field orientations. Toward higher field, H^{ab}_{c} presents a tendency to saturate, whereas the curve for H^{c}_{c} shows a steep increase. The anisotropy coefficient γ_H is plotted in the inset of the figure. One can see that the value of γ_H is ~12 near T_c and then decreases considerably with decreasing temperature. This temperature dependence of γ_H is similar to other Fe-based superconductors.

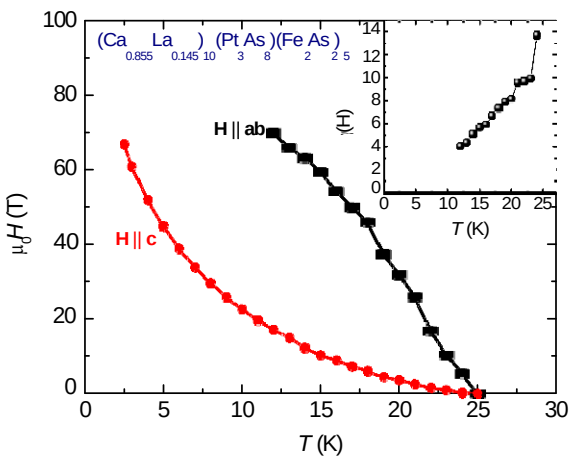

Fig. Anisotropic H_{c2}(T) for $(Ca_{0.855}La_{0.145})_{10}(Pt_3As_8)(Fe_2As_2)_5$ single crystals. Inset shows the temperature dependence of the H_{c2} anisotropy.

Conclusions

We have determined the $H_{c2}(T)$ of the $(Ca_{0.855}La_{0.145})_{10}(Pt_3As_8)(Fe_2As_2)_5$ superconductor by measuring the rf contactless penetration depth up to 65 T in pulsed magnetic fields. It was found that this superconductor shows very high $H_{c2}(0)$ values and relatively weak anisotropy of superconductivity at low temperatures. The $H_{c2}(T)$ curve for H || ab shows upward curvature, which is a common feature for the multi-gap superconductor.

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References

[1] Ni, N., *et al.*, Proc. Natl. Acad. Sci. (USA) 108, E1019 (2011).