Strong Flux Pinning In Potassium Doped $BaFe_2As_2$ Thin Film

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Introduction

It has been widely known that potassium doped $BaFe_2As_2$(KBa122) has a high critical field(H_{c2}) and high critical current density(J_c), which are the major requirements for the applications. Wang *et al*. reported that KBa122 single crystal has high activation energy of about 10000 K. This activation energy is much higher compared with other superconductors.[1] In this study, we present the higher and less anisotropic activation energy in KBa122 thin film than poly or single crystals. Because the high activation energy refers to the strong flux pinning mechanism, the high value of pinning potential in KBa122 film supports the high critical field(H_{c2}).

Experimental

Transport properties were measured by 4-probe method in an 18/20 T superconducting magnet system (SCM2). Activation energy can be obtained with the R(T) under the field which is modified by Arrhenius relation from vortex dynamics. We fixed magnetic field from the 0.1 T to 14 T and rotated samples' direction.

Results and Discussion

The critical temperatures of our samples exceed 27 K while 17.4 K in the pure single crystal [1]. As the magnetic field increases, the critical temperature decreases and the transition width becomes enlarged. Even in the 14 T, critical temperature remains over 24 K. Moreover the transition width at 0.1 T is about 0.5 K. These results show that the film's quality is quite good. Moreover the activation energy at 0.1 T exceeds 20000 K. This result may place it in the class of the highest value in pnictide superconductors. In addition, the influence of magnetic field on the activation energy is different to a direction of the magnetic field. The slope of the activation energy implies what kinds of vortex behavior dominate.

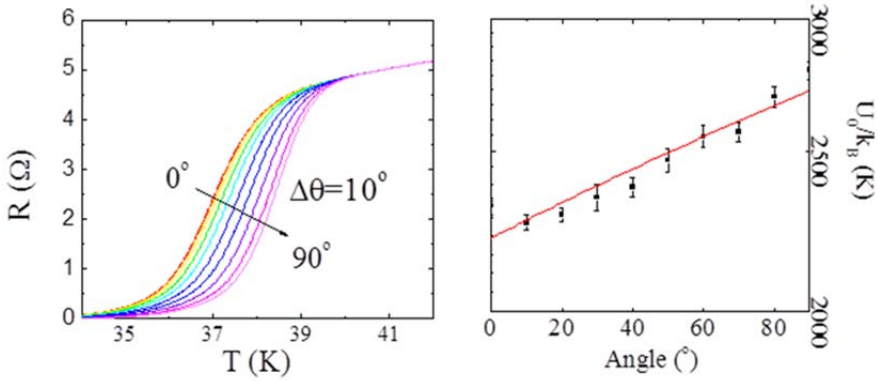

Fig. (Left) R(T) of K-doped $BaFe_2As_2$ thin films at H=14 T, with different field orientations. (Right) Angle dependence of the activation energy at 10 T

Conclusions

XRD images of K-doped $BaFe_2As_2$ film shows that the film is well fabricated parallel to the c-axis. But it is hard to find a pick that represents parallel to the ab-plane. This means the film has a columnar joint. The normalized resistance and RRR represent a quality of the samples. Anomaly of R(T) curve around 140 K may be a crystal transition of pure Ba122 phase [2]. Because of the ex-situ synthesis method, the film may have a pure Ba122 phase. The activation energy of the film is more isotropic than that of the single crystal. The activation energy of film has sample dependence. It is needed to find out the origin of the anisotropic superconducting properties.

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References

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