Characterization of Co-doped BaFe₂As₂ thin film

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Introduction

The discovery of superconductivity in iron pnictides has caused significant interest in the scientific community.[1] After the discovery of BaFe₂As₂ (Ba-122), many studies have come forward about its properties. Ba-122 is structurally simple, it has been found that Co-doped BaFe₂As₂ has a typical Tc of 21.5K [2] and has an expected anisotropy relatively low (γ ~ 2-3).

It is worth wondering whether the property of this material is good enough for applications. The investigation of this material properties here has the purpose to determine Jc by changing the angles between sample and applied magnetic field and temperatures.

Methods

- Deposit 20nm Pd
- Make four electric contacts
- Pattern bridge by laser cut
- Characterization
- SQUID
- Transport
- VSM

The sample was deposited in Wisconsin University by S.Lee and C.B. Eom. The thin film was prepared on a (LaSr)(AlTa)O₃ (LSAT) substrate with 50 unit cell thick BaTiO₃(BTO) layer deposited by PLD using a KrF excimer laser(248nm) [3,4]

Results

To characterize the superconducting transition temperature Tc, resistivity was measured as a function of temperature by the four point method. We can see that the Tc is approximately 20.3K.

As the temperature rises we noted that the moment reaches zero, this tells us that the film has a strong diamagnetic signal.

In this graphs we notice that there is an unusual behavior, the critical current density is higher when the field is perpendicular to the field. This is opposite from what expected by the Ba-122 crystalline structure and found in the single crystals.

In the VSM, Jc has been measured also at lower temperatures. Jc enhances from 1 to 3 order of magnitude decreasing temperature from 14 to 5 K.

Analysis

We determined:

• Tc measured by transport is about 20.3K.
• Jc has an anomalous behavior being larger when the field was perpendicular to the sample. This gives new information for further studies of this superconductor.
• In figure 5 we can see that Jc(H) significantly increases with a decreasing temperature down to 5K.

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References

[1] Norman M R 2008 Physics 1 21