

## Grain 이 Align 된 고온 초전도체의 자기적 특성

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The Magnetic Properties of Grain Aligned High - T<sub>c</sub> Superconductors.

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## 1. Introduction

It is well-known that single crystal high-T<sub>c</sub> superconductor exhibits large magnetic anisotropy. Farrel et al.<sup>1)</sup> studied the magnetic anisotropy in a grain aligned YBCO superconductor, which have similar magnetic properties to single crystal superconductor.

In this paper, magnetic properties of a high T<sub>c</sub> superconductor, which is grain-aligned at room temperature, are studied. Unlike bulk superconductors, depending upon whether the external magnetic field is perpendicular or parallel to the Cu-O plane, prominent magnetic anisotropy is found in this sample. Both the H<sub>c1</sub> and H<sub>c2</sub> are experimentally measured and the penetration depth ( $\lambda$ ) and the coherence length ( $\xi$ ) are derived from these H<sub>c1</sub> and H<sub>c2</sub>.

## 2. Experiments

The samples were prepared by conventional solid-state reaction method. The crystalline grains were permanently aligned by vigorously mixing the powder with an epoxy(Duro TM-51), followed by curing for about an hour in a magnetic field of 11 Tesla at room temperature. Both the superconducting quantum interference device(SQUID) magnetometer by Quantum Design and the vibrating sample magnetometer (VSM) by EG&G are used in our investigation of magnetic properties of Y-Ba-Cu-O and Bi-Pb-Sr-Ca-Cu-O compounds.

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### 3. Results

Fig. 1(a) shows the typical peaks of YBCO powder, obtained from the X-ray diffraction, before the grain alignment. Here the lattice constants are given by  $a=3.82527\text{\AA}$ ,  $b=3.93557\text{\AA}$  and  $c=11.64772\text{\AA}$ . Fig.1(b) shows the X-ray diffraction pattern of the crystalline grain sample aligned along the c-axis. Note here that the peaks appearing in Fig.1(a) vanished, and (0 0 5) and (0 0 6) peaks are distinctive while (0 0 4) peak had grown up a little<sup>2)</sup>. This implies that the crystalline grains are well aligned along the c-axis. We have determined all the macroscopic parameters including the coherence length,  $\xi$ , the penetration depth,  $\lambda$ , and Ginzburg-landau parameter,  $\kappa$ , lower and upper critical field,  $H_{c1}$ ,  $H_{c2}$ , which are tabulated in table I.

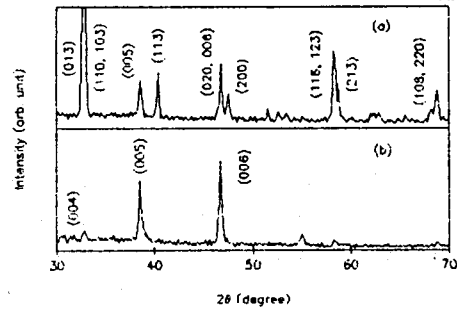
### 4. Conclusions

- i. The magnetic moment of grain aligned samples in the presence of a magnetic field applied perpendicular to the Cu-O plane is approximately ten times the magnetic moment in a field applied parallel to the Cu-O plane.
- ii. The calculated critical current density of aligned samples is increase more than about  $10^4$  times than the unaligned samples.
- iii. We have seen that the magnetic anisotropy play a very important role in the superconducting aligned crystal grains.

Table I. Measured and derived anisotropic parameters of  $Y_1Ba_2Cu_3O_{7-y}$ .

parameter	perpendicular	parallel
$\partial H_{c2} / \partial T$	-1.13 T/K	-2.19 T/K
$H_{c1}$ (79K)	90 Oe	< 67 Oe
$H_{c2}$ (0)	74 T	224 T
$\kappa$	$\kappa_{a-b} = 72$	$\kappa_c = 224$
$\xi$ (0)	$\xi_{a-b} = 21 \text{\AA}$	$\xi_c = 15 \text{\AA}$
$\lambda_{GL}$ (0)	$\lambda_{a-b} = 1516 \text{\AA}$	$\lambda_c = 3392 \text{\AA}$
$H_c$ (0)	0.7 T	0.5 T

Fig. 1. X-ray diffraction pattern of  $Y_1Ba_2Cu_3O_{7-y}$ .



### REFERENCES

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