§13. Basic Study on Oxide Superconductors for Nuclear Fusion Reactor

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1. Introduction

This year we measured the temperature dependences of the magnetization curves of YBCO superconducting tapes and estimated the temperature dependences of the I_c-B characteristics to understand the basic electromagnetic properties of YBCO tapes.

2. Magnetization measurement and I_c estimation

A sample straight YBCO tape with a length of 60mm was inserted into a saddle-shaped pickup coil shown in Fig.1. Magnetic field was applied in perpendicular to the wide surface. Temperature ranged from 31K to 77K. The observed magnetization curves are shown in Fig.2.

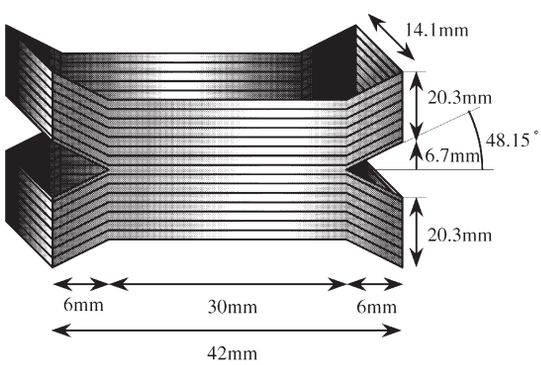

Fig.1 Saddle-shaped pickup coil

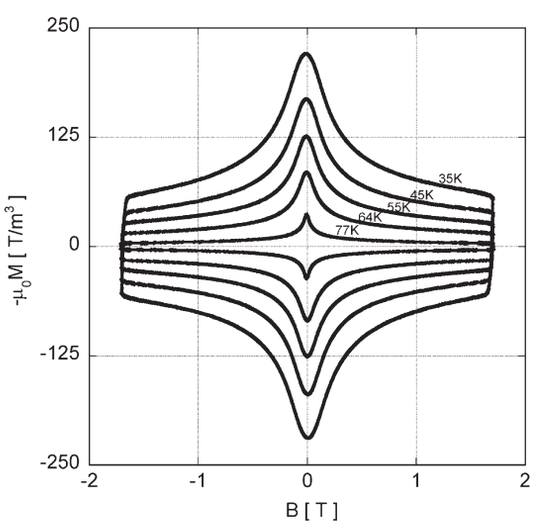

Fig.2 Observed magnetization curves

Next we estimated I_c-B characteristics by using the magnetization curves and the following expression,

$$I_c(B) = 4h \times \{((I_c(B)/2) \times (w/2))/\ wh\}$$
$$= 4h \times (m(B)/wh)$$
$$= 4h \times M(B)$$

where $m(B)$ is the magnetic moment due to the induced shielding current at the applied field, B, w and h is the width and the height of superconducting layer. The estimated I_c-B characteristics are shown in Fig.3 in log scale.

Here we found out that the specific field at the breaking point of I_c-B curves, B_b, and the constant I_c around zero field, I_{c0}, have the same temperature dependence and that the B dependences of I_c are the same for $B > B_b$ regardless of temperature. So we normalized the I_c-B curves by I_{c0}. The obtained result is shown in Fig.4. We can see that the normalized I_c-B curves coincide with each other and the I_c-B characteristics are scaled with temperature.

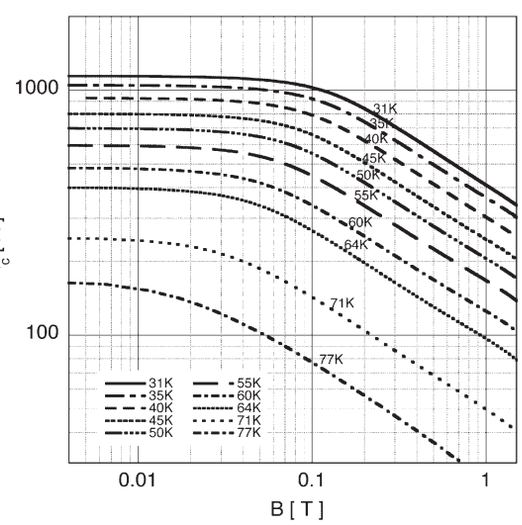

Fig.3 Estimated Ic-B curves by using the observed magnetization curves

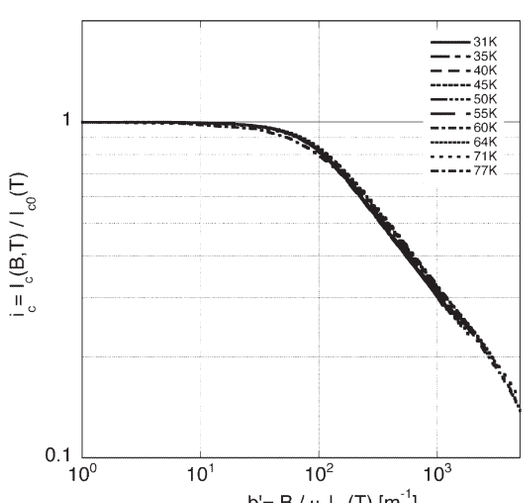

Fig.4 Normalized Ic-B curves by using zero field Ic at the respective temperatures