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

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1. Introduction

Last year we studied the temperature dependences of the ac losses in YBCO superconducting tapes fabricated by IBAD-PLD method to understand the basic electromagnetic properties. This year we investigated the temperature dependences of the ac losses of YBCO superconducting tapes fabricated by TFA-MOD method in a similar way.

2. Magnetization measurement and $I_c$ estimation

First we measured the magnetization curves of sample YBCO tapes in perpendicular magnetic field to the wide surface. The observed results are shown in Fig.1. Sample straight tapes with a length of 60mm were inserted into a saddle-shaped pickup coil. Magnetic field was applied in perpendicular to the wide surface. Temperature ranged from 31 to 77K.

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 screening 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.2 in log scale.

Here we found out that the specific field at the breaking point of $I_c$-$B$ curves, $B_o$, and the constant $I_c$ around zero field, $I_{co}$, have the same temperature dependence and that the $B$ dependences of $I_c$ are the same for $B > B_o$ regardless of temperature. So we normalized the $I_c$-$B$ curves by $I_{co}$. The obtained result is shown in Fig.3. We can see that the normalized $I_c$-$B$ curves coincide with each other and the $I_c$-$B$ characteristics are scaled with temperature. As a result, it was shown that the magnetization and ac losses were scaled with temperature.