## WBP5-2

# Thickening of $YBa_2Cu_3O_y$ coated conductors fabricated by self-heating technique in Pulsed Laser Deposition method and evaluation of the superconducting properties

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$REBa_2Cu_3O_y$ (REBCO) coated conductors (CCs) are expected for high critical currents ($I_c$). In order to improve the $I_c$, it is essential to increase the film thickness while maintaining the high critical current density ($J_c$). However, it has been reported that *a*-axis oriented grains as the film thickness increases are generated and $J_c$ decreases[1]. The occurrence of *a*-axis grains is due to the decrease in surface substrate temperature during the deposition. Thus, many research groups have developed the method of a heating substrate. For example, one of the methods is self-heating (S-H) technique. This technique is a method to heat the substrate by the Joule effect. The system provides rapid thermal response compared with the conventional heating system that heats the substrate with a heater[2].

In this study, we fabricated $YBa_2Cu_3O_y$ (YBCO) CCs on IBAD-MgO substrates which were heated by S-H technique in pulsed laser deposition (PLD) method. A thermocouple temperature ($T_{T.C.}$) was measured by attached thermocouple to substrate. $T_{T.C.}$ was maintained by proportional-integral-derivative (PID) control during the deposition. For comparison, YBCO CCs without PID control are also fabricated. We fabricated a thick film of which thickness was about 0.9 - 8.6 μm was prepared under the conditions of $T_{T.C.}$ = 758 and 783 °C, oxygen partial pressure $P_{O2}$ = 200 mTorr, and laser energy density $D$ = 1.5 J/cm$^2$.

Fig. 1 shows thickness dependence of $I_c$ deposited at different $T_{T.C.}$. It was confirmed that $I_c$ was increased by PID control. $I_c$ reached about 750 A/cm-width (77 K, self-field) and was saturated in the film at $T_{T.C.}$ = 758°C at the thickness of thicker than 4.9 μm. This result might show that dead layer including *a*-axis oriented grains and other phases is formed on the surface of the CCs in thickening. We will report the microstructure of pure YBCO thick CC and superconducting properties of $BaHfO_3$-doped YBCO thick film in magnetic fields.

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[1] L. Zeng et al., J. Appl. Phys. 112 (2012) 053953
[2] G. Majkic et al., IEEE Trans. Appl. Supercond. 25 (2015) 3

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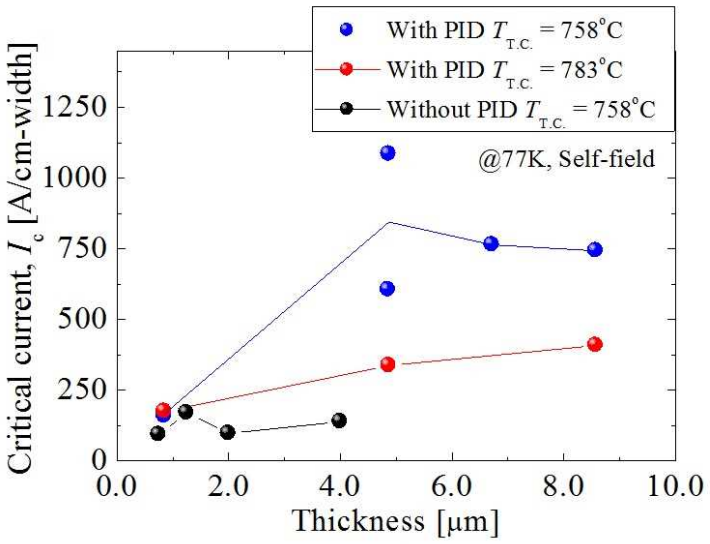


Fig. 1 Thickness dependence of $I_c$ in YBCO CCs deposited at various $T_{T.C.}$s with and without PID control of substrate temperature