WBP5-4

Fabrication of $BaTiO_3/YBa_2Cu_3O_y$ Multi-layered Films for Superconducting Capacitors

*Yoshiyasu Moriguchi[1], Yuji Tuchiya[1], Yusuke Ichino[1], Yutaka Yoshida[1]

Nagoya Univ. Japan[1]

High Q value is necessary for the wireless power transfer. The resistance in the circuit degrades the Q factor, thus it is important to use elements with a low internal resistance such as superconductor [1]. However, the reports on LC resonance using capacitors with superconductor are still few compared with the one with metal electrodes. Therefore, in this study, we fabricated multi-layered films with $BaTiO_3$ (BTO) films epitaxially grown on REBCO films for electrode as superconducting capacitors, and measured their dielectric properties. BTO is known as a material with an extremely high relative permittivity ε_r of more than 10,000, and epitaxially grows on REBCO because of its perovskite structure as same as REBCO [2].

Figure (a) shows the structures of the fabricated multi-layered films. 100 nm BTO films were deposited on a half area of 300 nm thick YBCO films grown on IBAD-MgO substrates by the PLD method. The YBCO and the BTO films are separately coated by two Ag electrodes with 8 mm^2 area using the sputtering. The equivalent circuit of the films are as follows; the capacitors with the YBCO superconducting electrode, the BTO dielectric, and the Ag metal electrode. The crystalline orientation of the film was evaluated by the XRD. The capacitance density C was measured at the room temperature (RT) and at 77 K by the four probe measurements using an LCR meter.

The XRD patterns of the films consisted of BTO (h00) peaks and YBCO (00l) peaks. Figure (b) shows the frequency f dependence of the impedance Z in the films at both the temperatures. Z at each temperature was sufficiently insulative of ~10 MΩ at ~ kHz, and was inverse proportional to f like a capacitance at f = 1~10 kHz. C of the films were 0.45 μF/m^2 at RT and 0.21 μF/m^2 at 77 K, and ε_r was 5.0×10^{-3} and 2.3×10^{-3}, respectively. The series resistance was too small to be measured, therefor we will investigate superconducting properties of the YBCO electrodes by using the magnetization measurement. We will also report on the capacitors using YBCO for both the electrodes.

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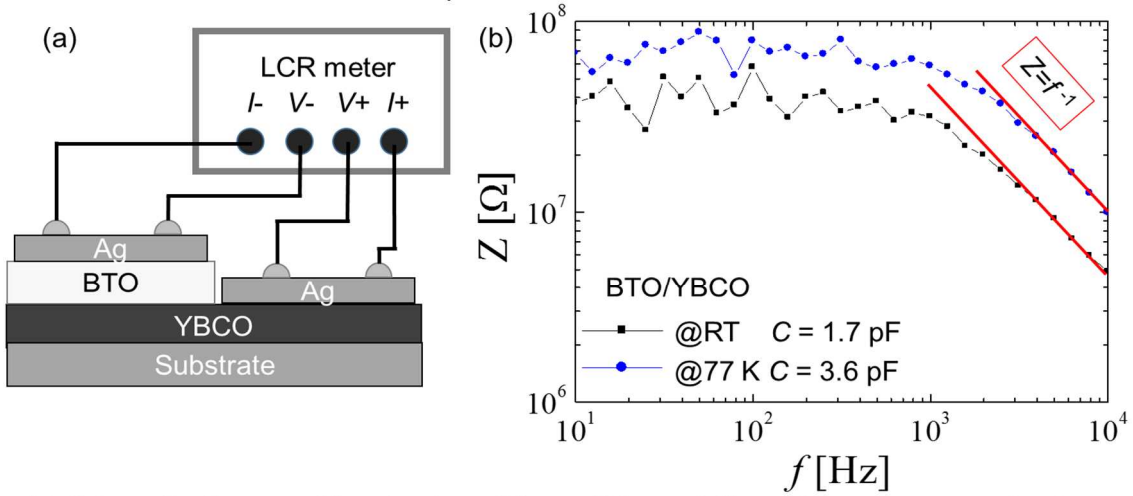

Fig. (a) Schematic diagram of the structure of the multi-layered film and the measurement set up. (b) Frequency dependences of impedance in the BTO/YBCO multi-layered films at RT and 77 K.

Keywords: REBCO, capacitor, BaTiO3, PLD