

Growth of Large-area YBa₂Cu₃O_y films and Application on Superconducting microwave devices

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ABSTRACT

The double-sided high-T_c superconducting (HTS) YBa₂Cu₃O_y (YBCO) films were grown on LaAlO₃ (LAO) substrates by an off-axis magnetron sputtering system with two 2-inch sputtering guns. High-quality YBCO films within a 50 mm diameter area were obtained. The homogeneous YBCO films revealed transition temperature T_c(R=0) of 86 K and a critical current density J_c (zero field) of ~ 1.5 × 10⁶ A/cm² at 77 K. The surface impedance of YBCO films was measured using a probe-coupling type microstripline resonator method. The surface resistance R_s of ~ 4.7 mΩ was obtained at 77 K and 2240 MHz. Furthermore, narrow-band microstrip hairpin-type filters are designed and fabricated. Our 3-pole filter has the insertion loss of 0.28 — 1.35 dB with a bandwidth of 10 MHz at 1.94 GHz, while the 6-pole filter has the insertion loss of 0.223 — 1.7 dB with a bandwidth of 20 MHz at 1.94 GHz. The results are discussed.

Keywords : high-T_c superconducting film ; HTS ; magnetron sputtering ; probe-coupling type microstripline resonator ; microstrip hairpin-type filter

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REFERENCES

- [1] 吳景森、呂台華、洪姮娥，超導體簡介，台灣書店，1998。
- [2] C. J. Gorter and H. B. Casimir, *Physica*, 1(1934a), 306; *Phys. Z.*, 35(1934b), 963; *Z. Techn. Phys.*, 15(1934b), 539.
- [3] F. London and H. London, "The electromagnetic equations of the superconductor", *Proc. Roy. Soc. (London)*, Vol. A-149, pp71-88, 1935.
- [4] Daisuke Okai etc., "New Measurement Technique of the Surface Impedance of Superconductors Using the Probe-Coupling Type Microstripline Resonator", *Microwave Conference*, vol.3 pp880-883, 1999 [5] J. A. G. Maltherbe, *Microwave Transmission Line Filter*, Artech House, Dedham, Mass, 1979.
- [6] L. M. Wang, H. W. Yu, H. C. Yang, and H. E. Horng, *Physica C* 256, 57 (1996).
- [7] G. L. Matthaie etc., "Narrow-band Hairpin-comb Filters For HTS And Other Applications", *IEEE MTT-S International*, vol 2, pp457

