

On the preparation and the characterization of superconducting thin films of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$

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Abstract. The results of our initial efforts to deposit thin films of $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ system on sapphire substrate are described. The deposited films are shiny black in appearance and are of quite uniform chemical composition. The annealed films exhibit zero resistance superconducting transition temperature $T_c(R=0)$ ranging between 23 K and 30 K.

Keywords. High- T_c superconductivity; thin films; resistivity.

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Thin films of high T_c superconducting materials $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ (Wu *et al* 1987) have obviously great potential from the viewpoints of fundamental physics as well as the technology. Extensive efforts are being made at various leading laboratories the world over to grow and characterize thin films of these high T_c superconductors. Many groups have already reported successful preparation of good quality thin films. The critical current density, J_c , has been reported to be in excess of $\sim 10^6$ A/cm² at 4.2 K by the IBM group (Chaudhuri *et al* 1987). The zero resistance superconducting transition temperature T_c for these films is reported to be 90 K and the width of the transition from 10% (92 K) to 90% (91 K) of the resistance ΔT_c is ~ 1 K.

Several techniques have been employed for the growth of thin films of high T_c materials. For instance, the IBM group co-evaporated the metallic constituents by electron beam, the Bell Core group (Wu *et al* 1987) used an excimer pulse laser to evaporate the composite material and the Bell Lab group employed (Kwo *et al* 1987) molecular beam epitaxy to deposit films on a substrate.

We have used the technique of plasma rf sputtering for deposition of thin films of Y-Ba-Cu-O system on sapphire substrates (of random orientation) of 10 mm diameter. The targets used for sputtering had the initial chemical composition close to that of the so-called 1-2-3 phase and exhibited bulk superconductivity (as inferred from their low frequency ac-susceptibility response) above 85 K. Targets of 40 mm diameter weighing between 10 and 15 g were used in the growth of these films. Films of ~ 1 micron thickness were deposited at the rate of 20 Å-40 Å/min. Subsequently they were annealed in oxygen at 850 C for 1 h and cooled slowly. The annealed films were black and shiny and adhered very well to the substrate.