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Laser Ablated High T_c Superconducting Thin $YBa_2Cu_3O_{7-x}$ Films on Substrates Suitable for Microwave Applications

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The development of high temperature superconducting $YBa_2Cu_3O_{7-x}$ thin films on substrates suitable for microwave applications is of great interest for evaluating their applications for space radar, communication, and sensor systems. Thin films of $YBa_2Cu_3O_{7-x}$ have been formed on $SrTiO_3$, ZrO_2, MgO, and $LaAlO_3$ substrates by laser ablation. The wavelength used was 248nm from a KrF excimer laser. During deposition the films were heated to 600° C in a flowing oxygen environment, and required no post annealing. The low substrate temperature during deposition with no post annealing gave films which were smooth, which had their c-axis allighned to the substrates, and which had grains ranging from 0.2 to 0.5 microns in size. The films being c-axis aligned gave excellent surface resistance at 35 GHz which was lower than that of copper at 77 K. At present, $LaAlO_3$ substrates with a dielectric constant of 22, appears suitable as a substrate for microwave and electronic applications. The films have been characterized by resistance-temperature measurements, scanning electron microscopy, and x-ray diffraction. The highest critical transition temperatures(T_c) are above 89K for films on $SrTiO_3$ and $LaAlO_3$, above 88K for ZrO_2, and above 86K for MgO. The critical current density(J_c) of the films on $SrTiO_3$ is above $2x10^6$ amperes/cm^2 at 77K. The T_c and J_c are reported as a function of laser power, composition of the substrate, and temperature of the substrate during deposition.

Resistance versus temperature for a $YBa_2Cu_3O_{7-x}$ film on $LaAlO_3$ is shown in fig. 1. Its transition temperature is 89.6 K.

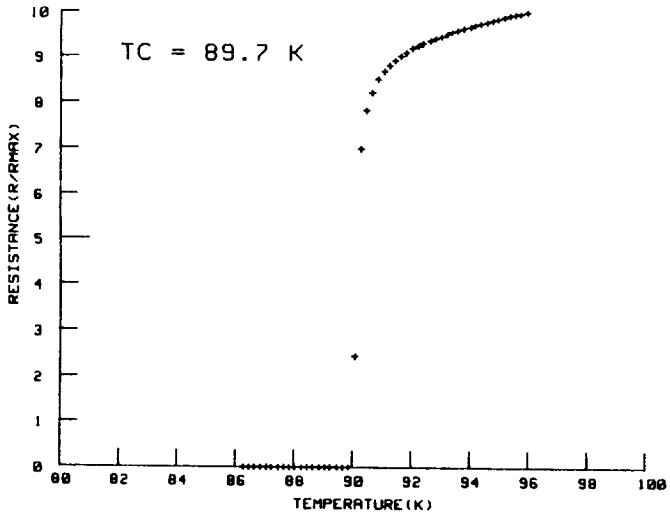

Fig. 1 Laser ablated $YBa_2Cu_3O_{7-x}$ Film on $LaAlO_3$.

Deposition temperature 610°C and oxygen pressure of 170 mtorr.