Pramāṇa – J. Phys., Vol. 30, No. 1, January 1988, pp. L81–L86. © Printed in India.

Critical current in silver clad Y-Ba-Cu-O superconducting wires

R G SHARMA, Y S REDDY, S R JHA and S S DUBEY
National Physical Laboratory, New Delhi 110012, India

MS received 18 November 1987

Abstract. Silver clad wires of high T_c superconductor $Y_1Ba_2Cu_3O_{7-x}$ have been fabricated through the powder metallurgy technique. The reacted wires show a midpoint T_c of 84 K. A critical current density of 26·4 A cm^{-2} (77 K, 0 T) is obtained in these wires. The wires, however, turn complete normal only at a current density of 280 A cm^{-2}. The reasons for low critical current density obtained in these wires are discussed.

Keywords. Silver clad wire; critical current density.

PACS No. 74·60

The discovery of superconductivity in Y-Ba-Cu-O system around 92 K by Wu *et al* (1987) has opened up a new area of research and raised the expectation that the new superconducting devices can now be operated at liquid nitrogen temperature. Therefore, efforts to develop thermally stabilized high T_c superconducting wires are going on an unprecedented scale. So far the superconducting wires have been used most widely in the production of magnetic fields. The stringent requirements of a superconducting material useful for magnet application are that they should carry large currents in high magnetic fields and should be able to be produced in a flexible form such as a wire or a tape. Because of the tremendous commercial potential of these wires we took up a programme of developing these high T_c stabilized wires indigenously. In this brief communication, we report our preliminary results on silver clad $Y_1Ba_2Cu_3O_{7-x}$ wires.

So far, limited results have been published on these high T_c superconducting wires. Cava *et al* (1987) reported a critical current density (J_c) value of $1{\cdot}1 \times 10^3$ A cm^{-2} (77 K, 0 T) in bulk Y-Ba-Cu-O material. High values of $J_c > 10^5$ A cm^{-2} (77 K, 0 T) have been reported by Chaudhari *et al* (1987) in epitaxial film of $Y_1Ba_2Cu_3O_{7-x}$ on $SrTiO_3$ substrate. Similar high values of $J_c = 3 \times 10^6$ A cm^{-2} (4·5 K, 0 T) were inferred from the magnetization experiments by Dinger *et al* (1987) on single crystals of the compound $Y_1Ba_2Cu_3O_{7-x}$ when the applied magnetic field was perpendicular to the Cu-O plane (induced screening current being along the Cu-O plane). These experiments do indicate good potentiality of these materials to carry large J_c if grown in ideal conditions. The J_c results obtained on polycrystalline wires are, however, not so encouraging.

Yamada *et al* (1987) at Toshiba Japan prepared 2 mm diameter wire of the compound $Y_{0{\cdot}4}Ba_{0{\cdot}6}Cu_{1{\cdot}0}O_{3-x}$ in a copper sheeth through powder metallurgy and cold working. The copper sleeve was removed before the wire was finally sintered. The bare wire carries a current density of $7{\cdot}25 \times 10^2$ A cm^{-2} (77 K, 0 T). Almost