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Critical current measurement on Y-Ba-Cu-O

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Abstract. We report critical current measurements on sintered $Y_{0.35}Ba_{0.65}CuO_y$. The sample, in the perovskite phase, shows zero resistance at 87 K. The critical current transition is seen, in zero field and at 77 K, at a current density J_c of 50 A/cm^2.

Keywords. Critical current; current density.

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Superconducting transition occurs in Y-Ba-Cu-O system at temperatures around 90 K (Cava *et al* 1987, Rao *et al* 1987, Murphy *et al* 1987, Hor *et al* 1987, Dhar *et al* 1987). The structure (Cava *et al* 1987, Rao *et al* 1987, Hor *et al* 1987) has been identified as the perovskite $A_3Cu_3O_{6+x}$. We report our measurements on the critical current of sintered $Y_{0.35}Ba_{0.65}CuO_y$ in zero field and at 77 K.

The samples were prepared in bulk (about 15 g) by heating together appropriate amounts of Y_2O_3, $BaCO_3$ and CuO powders at 900 C for a few days. The reacted mixtures were then pelletised. This pellet was annealed at 950 C in a continuous flow of O_2 gas for 18 hr. A portion of this sample (referred to as "single-fired") was retained and the rest was crushed, ground, repelletised and again fired at 950 C in flowing O_2 gas for 18 hr. The sintered samples had an average grain size of 10–15 μm.

The samples were checked for crystal structure using CuK_α X-rays, and peaks showing $\gtrsim 5\%$ intensity agreed with those reported in literature. The doublet at $2\theta = 32{\cdot}6°$ shows the correct intensity ratio (Cava *et al* 1987). The "single-fired" sample showed zero-resistance at 85 K, with a T_c (mid-pt.) of 88 K and a transition width (10–90%) of 2 K. The "double-fired" sample showed zero resistance at 87 K. with a T_c *(mid-pt.)* of 89 K. The width of the transition (10–90%) was 1·5 K.

The critical current measurements were made using fresh silver paint contacts as the contact resistance had to be kept low. Even these contacts showed heating effects at currents > 500 mA. The thinned-down samples were further necked to reduce the critical current. The single-fired sample showed a broad flux-flow transition with a critical current density of only 4 A/cm^2. The double-fired sample showed a sharp flux-flow transition at $I_c = 240$ mA, as shown in figure 1. The neck had an area of $\simeq 5 \times 10^{-3}$cm^2, thus yielding a J_c of $\simeq 50$ A/cm^2. This J_c is at 77 K, or at $T/T_c \simeq 0{\cdot}9$.

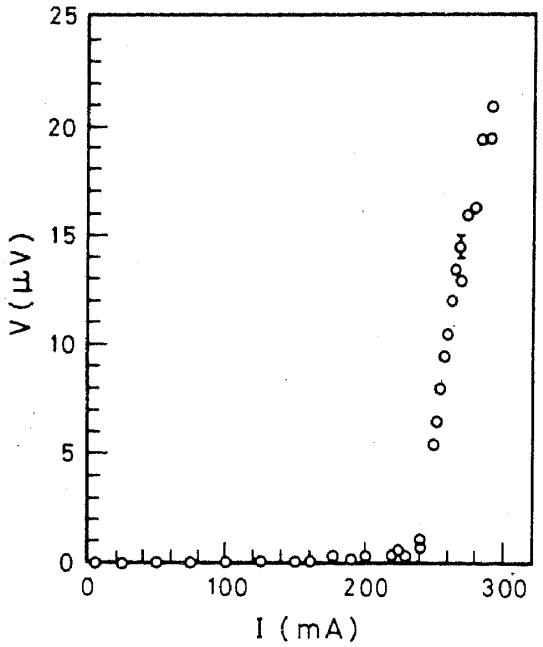

Figure 1. The flux-flow transition yielding the critical current in the "double-fired" sample.

Cava *et al* (1987) have reported a much higher zero-field J_c (> 1100 A/cm^2) at the same temperature, while Somekh *et al* (1987) have reported a J_c of 60 A/cm^2 at 36 K and 180 A/cm^2 at 4 K. Besides these two reports on sintered Y-Ba-Cu-O, Panson *et al* (1987) have reported a zero-field J_c of 10 A/cm^2 in $La_{1.8}Sr_{0.2}CuO_4$ at $T/T_c \simeq 0.9$. Our results compare favourably with those of Somekh *et al* (1987) and Panson *et al* (1987), but are much lower than those of Cava *et al* (1987). Further efforts to improve sample homogeneity and to increase J_c are in progress.

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