Superconductivity in a New YBaCuO Compound at 105 K.

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Abstract. – A superconducting transition has been detected in a \( (Y_{0.8}Ba_{0.2})(CuO_{4-n})_2 \) compound by electrical and magnetic measurements. The resistivity begins to decrease at 173 K and the zero-resistivity state sets in at 105 K.

The experiences of investigation of high-\( T_c \) superconductors [1-7] led us to search the possible highest-\( T_c \) superconductors among Y-Ba-Cu-O compounds. The optimum value of the ionic radii, of the substitution of lanthanides (L) with alkaline earths (AE) and that of the ratio of L + AE to Cu and the redox processes of Cu were taken into account during our experiments [8].

A new kind of Y-Ba-Cu-O system was developed with nominal composition of \( (Y_{0.8}Ba_{0.2})_2(CuO_{4-n})_2 \), which was prepared by solid-state reaction from pure chemicals of \( Y_2O_3 \), BaCO\(_3\) and CuO.

During previous experiments we found that the lower molar ratio of \( (Y + Ba) : Cu \) improves the superconducting parameters, so it was chosen as 1:2 in this case. The pulverized and homogenized mixture was heated gradually over 3 hours to 925 °C, found to be the optimum temperature for the solid-state reaction by thermogravimetry. After 18 hours the sample was quenched within 15 minutes. Powder X-ray patterns (Siemens D-500) on reacted and pulverized mixture show a microcrystalline structure. The powder was then pressed into a pellet on 20 kbar and sintered once more. Photographs taken by a scanning electron microscope (Jeol JXA-50A) show that the pellet consists of a medley of different crystalline shapes.

Samples of dimension \( (0.7 \times 1 \times 8) \text{mm}^3 \) were cut out of the pellet. A circular diamond saw was used and when the temperature rose to somewhat above 100 °C the sample was cooled with water. We mention this detail since it may be relevant to the sample's behaviour. The
Fig. 1. – Dependence on temperature of the resistance of a specimen 0.7 × 1 × 8 mm. $R_{300} = 39.52$ Ω, $\rho_{300} = 350$ m Ω cm.

experiments were done over a 48 h period, a week after the preparation of the sample. About thirty cyclings between room temperature and 77 K left the behaviour unchanged.

The dependence of the resistivity $R$ on temperature $T$ was measured at 10 μA, 100 μA and 1 mA. The data obtained are independent of the current in this range. The smallest measurable voltage signal was 10 nV and so the sensitivity of the measurement of specific resistivity $\rho$ is $8.8 \cdot 10^{-8}$ Ω cm.

The temperature dependence of the resistance is shown in fig. 1. There is a kink in the curve at 173 K, the sharp drop starts at 156 K and the zero-resistance state appears at 105 K. The measurements were repeated 4 days later: the onset temperature of the rapid drop increased to 159 K and zero resistance appeared at 101 K. After 3 weeks the sample showed no superconductivity: the resistance increased monotonously with falling temperature. Details of the sample preparation will be further studied.

Magnetic measurement carried out at 77 K show a partial penetration of the external field into the sample and so it hints at a type-II superconductivity. Placing the sample in a low magnetic field of 762 Oe, about 21 vol.% is in Meissner’s state at this temperature.

REFERENCES