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Superconductivity in a New YBaCuO Compound at 105 K.

I. KIRSCHNER (*), J. BÁNKUTI (*), M. GÁL (**), K. TORKOS (**), K. G. SÓLYMOS (***) and G. HORVÁTH (*)

(*) *Department for Low Temperature Physics, Roland Eötvös University 1088 Budapest, Puskin u. 5-7, Hungary*
(**) *Department of General and Inorganic Chemistry, Roland Eötvös University - 1088 Budapest, Muzeum krt. 6-8, Hungary*
(***) *Department of Petrology and Geochemistry, Roland Eötvös University 1088 Budapest, Muzeum krt. 4/a, Hungary*

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Abstract. – A superconducting transition has been detected in a $(Y_{0.8}Ba_{0.2})(CuO_{4-\delta})_2$ 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 $(Y_{0.8}Ba_{0.2})$ $(CuO_{4-\delta})_2$, 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 $(0.7 \times 1 \times 8)\,mm^3$ 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

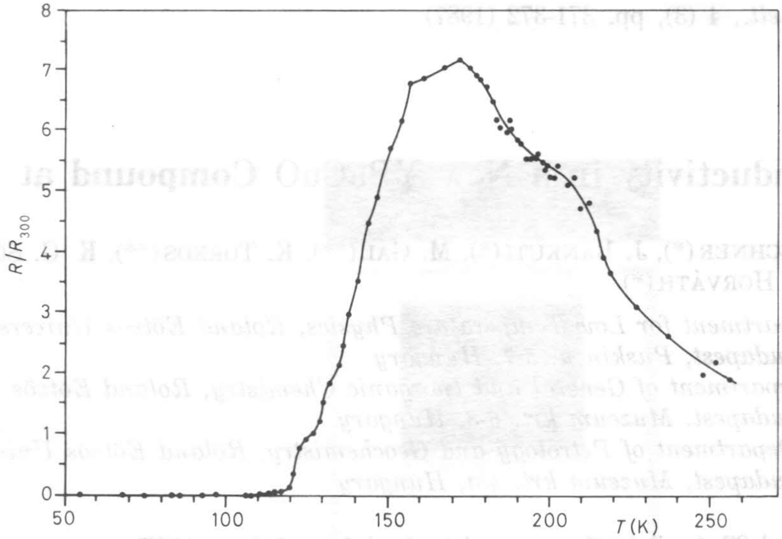

Fig. 1. – Dependence on temperature of the resistance of a specimen $0.7 \times 1 \times 8$ mm. $R_{300} = 39.52\,\Omega$, $\rho_{300} = 350\ \mathrm{m}\,\Omega\,\mathrm{cm}$.

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 $10\ \mu\mathrm{A}$, $100\ \mu\mathrm{A}$ 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 ρ is $8.8 \cdot 10^{-8}\ \Omega\,\mathrm{cm}$.

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.

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