INFLUENCE THE SILVER NITRATE ON THE SUPERCONDUCTING CERAMICS $ErBa_2Cu_3O_{7-\delta}$+nAg

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For the first time, the influence of silver's addition has been studied in the superconductor that contains a rare-earth element such as erbium in particular. The samples of $ErBa_2Cu_3O_{7-\delta}$+nAg ($\delta \cong 0,15$) were fabricated by making use of nitrates. This method enabled us to simplify the technology and to reduce the fabrication time. The X-ray analysis has show that the silver didn't enter into the crystal lattice of the ceramics. In the temperature range of 100-300 K, we have observed that the resistively ρ decreases ten times with increasing concentration of the silver.

High-temperature superconductors have a number of possible applications now. In order to extend the sphere of their application, it is desirable to improve the characteristic parameters of superconductors (such as the density of critical current and the screening properties), to increase electroconductivity, to decrease the influence of heat fluctuation processes, to improve salver mechanical properties and stability against the influence of water and aggressive media.

It was established that the addition of small quantity of impurities made the properties of high-temperature superconducting ceramics worse, as a rule. Few exceptions are silver and gold. Recent investigations [1,2] showed that the impurities of silver made for some increase of the critical current density in the ceramics. The localization of silver impurities between the grains [3] can lead to the increase of critical current because of the improvement of contacts between the grains due to the weak links. Similarly, the resistivity of ceramics can been considerably decreased by introducing of gold [4]. Silver was usually introduced as small-grain powder of oxide reduced by annealing. In papers [5,8] several various dependences for the parameters of ceramics (particularly, the dependence of critical current upon the concentration of silver) were obtained by using different techniques and technologies.

It is of interest to study the influence of the silver nitrate addition and fabrication technology on properties of ceramics, as well as to establish the mechanism and regularities of the influence at various concentrations of silver in order to control the changes of the properties. Formerly, the investigations were mainly made for superconductors containing yttrium. In the present paper, the influence of the silver addition in a superconductor containing a rare-earth element such as erbium, particularly, has been studied for the first time.

The samples of $ErBa_2Cu_3O_{7-\delta}$ ($\delta \cong 0.15$) ceramics were fabricated on the basis of nitrate- was used techniques which made it possible to simplify the technology and to reduce the fabrication time. The samples were exposed several times to milling, pressing and annealing, in order to improve their homogeneity. The density of ready-made samples without silver impurities was about 5g/cm^3. The addition of silver was leading to monotonous increase of the density.

The resistivity of samples was measured by usual four-probe method. Magnetic measurements were carried out using liquid nitrogen in resonance circuit with a coil. The temperature was measured by a thermocouple within accuracy of 0,5 °C. The X-ray diffraction analysis of the samples made it possible to establish that silver was located between the grains and didn't enter into the crystal lattice of high-temperature superconducting ceramics.

The addition of silver nitrate up to 30 per cent of silver didn't influence the critical temperature of transition, practically, causing some decrease with increasing concentration. The beginning of the transition on resistively coincides practically with that evaluated from the measurements of magnetic response. The transition width equals 2 K and does not depend upon the silver content. In the range of 100-300 K, the curves of temperature dependence for ρ have usual character, but the value of ρ decreases more than ten times with adding silver.

The percolation theory applied to the conductivity at the addition of silver (we have neglected the conductivity of ceramics) gives the following relations for resistively:

$$\rho/\rho_0 = (\rho - \rho_c)^{-t} \quad \text{if} \quad \rho > \rho_c$$

$$\rho/\rho_0 = (\rho_c - \rho)^{s} \quad \text{if} \quad \rho < \rho_c$$

Here ρ is the resistivity, ρ_c is its critical value, t and s are critical indices. Selecting the different values of ρ_c, one ought to prefer the value, which enables linear dependencies to be obtained on a logarithm-scale graph. Then the values of t and s can be determined. In this manner, we have estimated the following values: $\rho_c = 0.22 \pm 0.02$; $t = 1.8 \pm 0.2$; $s = 0.8 \pm 0.1$

The values estimated within experimental error coincide with calculated ones. They are close to the values obtained for the $(YBa_2Cu_3O_{7-\delta})_{1-x}Au_x$ system [4] and Ag [6].The application of percolation model is possible in a number of cases when electrical conduction via the granules of ceramics is significant, and the Au grains in spite of small resistively can be treated as an insulator. Thus the addition of silver improves a number of properties of the ceramics (such as critical current and screening). The best results have been attained at the weight concentration of silver about 30 per cent.

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$ErBa_2Cu_3O_{7-\delta}$+nAg İFRATKEÇİRİCİ KERAMİKANIN XASSƏLƏRİNƏ GÜMÜŞ NİTRATININ TƏ'SİRİ

İlk dəfə olaraq tərkibində nadir torpaq elementi (erbium) olan yüksək ifratkeçiriciyə gümüş əlavəsinin tə'siri araşdırılır. $ErBa_2Cu_3O_{7-\delta}$-nümunələri nitratlar tətbiq olunmaqla hazırlanmışdır ki, bu da texnologiyanı sadələşdirməyə və nümunələrin hazırlanmasına sərf olunan vaxtı azaltmağa imkan verir. Rentgen analizi göstərir ki, gümüş yüksək temperaturlu ifrakeçirici keramikanın kristal qəfəsinə girmir. Gümüşün konsentrasiyasının artırılması ilə biz 100-300 K intervalında ρ-nun azalmasını müşahidə edirik.

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ВЛИЯНИЕ АЗОТНОКИСЛОТНОГО СЕРЕБРА НА СВОЙСТВА СВЕРХПРОВОДЯЩЕЙ КЕРАМИКИ $ErBa_2Cu_3O_{7-\delta}$+nAg.

Впервые в сверхпроводнике, содержащем редкоземельный элемент эрбий, было изучено влияние добавок серебра. Образцы $ErBa_2Cu_3O_{7-\delta}$ ($\delta \cong 0,15$) изготавливались на основе применения нитратов. Эта методика позволила упростить технологию и сократить время изготовления образцов. Рентгеноструктурный анализ $ErBa_2Cu_3O_{7-\delta}$ показал, что серебро не входит в кристаллическую решетку сверхтемпературной и сверхпроводниковой керамики. При увеличении концентрации серебра наблюдалось уменьшение удельного сопротивления ρ в интервале 100-300 К на порядок.

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