THE INFLUENCE OF OLIGONAPHTHOQUINONE ON SOME SUPERCONDUCTING PROPERTIES OF ERBIUM CERAMICS $ErBa_2Cu_3O_{7-8}$

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For samples of ceramics $ErBa_2Cu_3O_{7-\delta}$ processed in the melt of oligonaphthoquinone the increase of temperature of superconductive transition at 1.5 K and the increase of critical current on 30% at constant speed of attenuation in superconductive ring is registered

The information about influence of organic compound on the properties of high-temperature superconductors in literature are very few, the studying of this question has the scientific and practical meaning. The big interest presents the studying of the influence of oligonaphthoquinone on the properties of high-temperature superconducting ceramics $ErBa_2Cu_3O_{7-8}$. As it is known, the powders of high-temperature super semiconductors are mainly the powders with bad pressing. These powders are obtained by the methods of ceramic technology and they are the polydisperse ones with particle sizes 10-50 mcm. The universal means of the powder pressing improvement is their plasticization by organic additions. Besides it, the interaction of organic addition with structural superconductor elements can give the additional information about electron processes in the system. The obtaining of superconducting ceramics was carried out with the use of Er_2O_3 , CuO, BaO. The synthesis procedure was carried out on the following technological schemes, given on the fig.1.

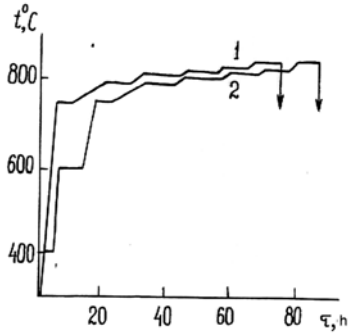

Fig.1. The temperature-time graphic of the samples.

1. The mixture of the powders of initial compound components, well deteriorated and mixed in needed proportion, is annealed on the air at the temperature 800°C during 12 hours. After cooling till room temperature the future superconductor is pressed and formed the needed form. Further it is annealed during 6 hours in oxygen atmosphere and slowly cooled.

2. The scheme of glass-ceramic obtaining, including the low-temperature annealing at 400-500 (with aim of increase of germ number in glass) and at 600-700°C (with aim of finishing of glass crystallization till the synthesis beginning of superconducting phase). The synthesis atmosphere is oxygen. The obtained results show, that the carrying out of the thermoworkings in oxygen atmosphere in temperature interval 800-850°C leads to the saving of the significant quantity of residual glass in the sample and to the slow development of synthesis process of superconducting phase.

The microstructure investigation showed, that in the dependence on the initial state the ceramic has the fine-dyspersated structure and often has large contributions of amorphic phase. In the result the samples with density $4.5 g/cm^3$ has been obtained. By the roentgen-graphical investigation and measurement of magnetic susceptibility on the alternating current it was established, that samples of $ErBa_2Cu_3O_{7-8}$ composition have 85% of superconducting phase, width and beginning of superconducting transition 2K and 92K, correspondingly.

From the tablets of superconducting ceramics by diameter 14mm and width 2 mm, the core by diameter 4 mm was cut. The residuary ring core after cutting was used for the measurement of the critical current on the known method. The temperature of superconducting transfer of initial and treated samples was measured with the help of the registration of real part of magnetic susceptibility χ in alternating magnetic field with the frequency 40 Hz.

The oligonaphthoquinone was heated till the melt obtaining. After it, the samples were put into melt and were held near the hour with the following drying on the air at the room temperature. Thus, the pore infill of the sample by the thin layer of the oligonaphthoquinone took place. In this case many granules and amount of intergranule intervals are covered by thin layer of oligomer. The sample treatment in the melt leads to the linear increase of critic parameters of superconducting ceramics. The increase of the temperature T_c on 1,5K of superconducting transition and increase critic current on 30% at the constant speed of current damping in the ring has been fixed.

The flushing of the oligomer from the sample in the melt, by the way of its holding in pure chloroform leads to the almost total reconstruction of previous values of critic parameters and T_c, which is temperature of superconducting transition decreases on the value ΔT_c=1.5K, that is seen from the fig.2.

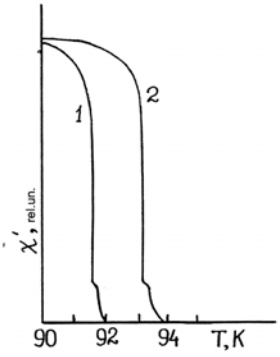

Fig.2. The temperature dependence of real part of magnetic susceptibility.

If till the treatment the full current, captured by superconductor ring was 2,8Å, then after oligonaphthoquinone adsorption it increases till 3.35Å. The dependencies of damping speed of superconducting current in the ring till and before its treatment by oligonaphthoquinone are given on the fig.3.

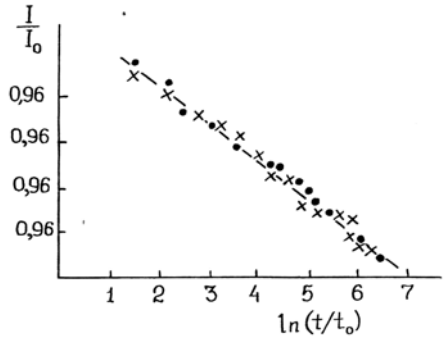

Fig.3. The damping of superconducting current in the ring:
• - till treatment by the oligonaphthoquinone
× – after the treatment by oligonaphthoquinone.

It is seen, that firstly, experiment points in logariphmic scale during 600 seconds, with satisfactory delicacy in logariphmic coordinated lay on the direct line. This allows to estimate the activation energy of pinning whirlwinds, which till our case was 0.22eV. Secondly, the experiment points, obtained till and before ring treatment in oligonaphthoquinone melt, are well laid on the one line, that evidences about the independence of relaxation velocity of superconducting current on the treatment in the ring.

The total understanding of this phenomena is still absent. In the case of the high-temperature superconducting ceramics, presenting by itself the system of superconducting grains, connected by the system of Josefson contacts, influence mechanism can be more significantly complex.

The increase of critic current in ceramics connects with the improvement of the properties of intergranule contacts, i.e. the oligonaphthoquinone probably, either creates the additional current conducting bridges, or improves the currentconducting properties already existed contacts. At the same time the increase of the temperature of the superconducting transfer, probably is connected with influence of oligonaphthoquinone adsorption on the ceramic grains. That's why it can be proposed, that reason of revealed phenomenon in given paper connected with oligonaphthoquinone adsorption from the melt on the surface of superconducting sample has the more complex character.

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OLİQONAFTOXİNONUN $ErBa_2Cu_3O_{7-8}$ KERAMİKASININ BƏZİ İFRATKEÇİRİCİ XASSƏLƏRİNƏ TƏSİRİ

Rentgenoqrafik tədqiqatlar və maqnit qavrayıcılığının ölçülməsi vasitəsiylə göstərilmişdir ki, $ErBa_2Cu_3O_{7-8}$ keramikasının oliqonaftoxinon ərintisində emalı ifratkeçirici keçidin böhranı temperaturunu 1.5K yüksəlməsinə və böhran cərəyanının 30% artmasına gətirir.

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ВЛИЯНИЕ ОЛИГОНАФТОХИНОНА НА НЕКОТОРЫЕ СВЕРХПРОВОДЯЩИЕ СВОЙСТВА ЭРБИЕВОЙ $ErBa_2Cu_3O_{7-8}$ КЕРАМИКИ

Получены сверхпроводящие керамики $ErBa_2Cu_3O_{7-8}$ с использованием окислов Er_2O_3, CuO, BaO. Рентгенографическим исследованием и измерением магнитной восприимчивости установлено, что образцы содержат 85% сверхпроводящей фазы с температурой сверхпроводящего перехода 92К. Показано, что обработка эрбиевых керамик в олигонафтохинонном расплаве приводит к увеличению критической температуры сверхпроводящего перехода на 1.5К и критического тока на 30%.

Received: 16.02.06