

OBTAINING AND RESEARCH OF ELECTRICAL PROPERTIES OF $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$

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The temperature dependences of electrical conductivity, thermoelectromotive force and thermal conductivity of $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$ were carrying out. It was established, that the superconducting transition is not vanished up to 80 at.% of Cd. On the temperature dependences of investigated coefficients are observed the sharp changes of dependence course likely phase transition.

The obtaining new HTSC with higher critical temperature (T_c) of transition in a superconducting (SC) state from not deficient and cheap materials, easily yielding to mechanic processing still remains to one of actual questions of physics of superconductors. There is a large number of the publications, in which one were made partial replacement of atoms Y by atoms Tm, Nd and other elements observing a superconducting (SC) transition at $T_c=91-95K$.

The given work is dedicated to obtaining and research of electrical properties of $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$. Samples $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$ were obtained in two stages: the mixture of oxides CdO, BaO and CuO in the conforming ratio was mixed, was frayed and caked at 800-850°C on air during 20-25 hours. The obtained mixture for the second time was frayed, was extruded in tablets and undergo to an annealing in a flow of oxygen under pressure 1,2-1,5 at. at 900-950°C during 25-30 hours.

$X=0,5$ is maximal and on much more, than sample with $X=0,8$. Notably, that in samples with Cd temperature of SC transition T_0 displaces in the party low T , but also here it is difficult to observe for regularity of change T_0 from X . However, it is seen that at replacement of atoms Y by atoms Cd (up to 80at. %) the temperature of SC transition is saved, and varies within the limits 88-90K. With the purpose of improvement of the obtained results experiments were suggested with some changes. In this case the carbonate of barium - $BaCO_3$ is used in return for of barium oxide - Ba_2O and is made some changes in a temperature regime. A mixture of oxides Cd, CuO and $BaCO_3$ in accordance to a structure $CdBa_2Cu_3O_{7-\delta}$ ($X=1$) was mixed, was frayed in an agate mortar, and was heated up to 920°C within 6 hours. Temperature of heating was rise as contrasted to by previous case, with the purpose of decomposing $BaCO_3$ on Ba and CO_2 . On completion of heating from the obtained material the spacers were pressed in. The spacers were heated up to 920°C and were stand during 15-20 hours, then, with the purpose of a sintering, temperature was increased up to 1000°C, and not for long having stand up to former value 920°C was lowered. Having stand at this temperature during 2 hours, up to the room temperature slowly was cooled.

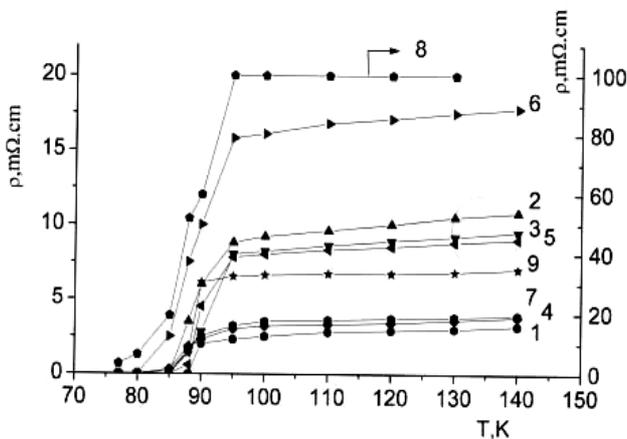


Fig.1. The temperature dependence of specific resistivity for different values X (see to text) of $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$

In a fig. 1 are submitted the temperature dependences of specific resistivity $\rho(T)$ of $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$ at different values X ($X=0-1$; 0,1-2; 0,2-3; 0,3-4; 0,4-5; 0,5-6; 0,6-7; 0,7-8; 0,8-9). As it is seen, up to 80 at.% Cd the superconductivity in them does not vanish. Let's remark, at $X=0,9$ (though the data $\rho(T)$ for specimens with $X > 80$ at. % in figure are not submitted), value ρ increases in 50 times, and course of temperature relation $\rho(T)$ becomes semi conducting. In a sample with $X=1$ the value of ρ increases for 4 order, the semi conducting course $\rho(T)$ becomes sharper, passing through a maximum at 170K, decreases in 6 times, but the SC up to 77K does not observed. From the data introduced in a fig.1, it is seen, that change of values of resistance in a normal condition, in process of increasing X, is not systematical. In particular values ρ for structures $X=0,4$ and 0,7 are close to a sample with $X=0$, or ρ for sample with

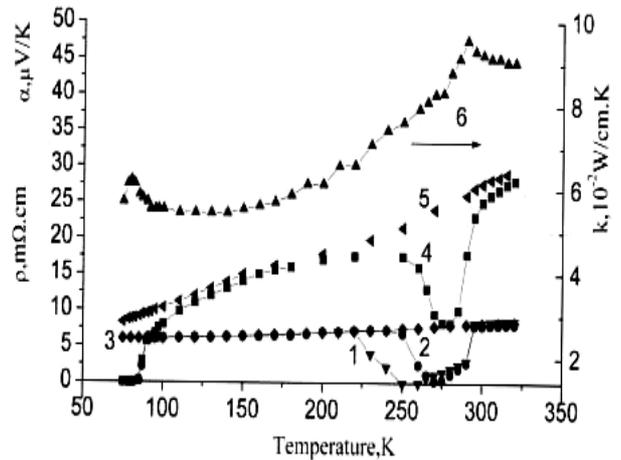


Fig.2. The temperature dependences of specific resistivity (1,2,3), thermo-e.m.f. (4,5) and thermal conductivity (6) of $CdBa_2Cu_3O_{7-\delta}$.

In a fig. 2 the temperature dependences of resistance $\rho(T)$ (1,2,3-after first, second and third measurement respectively), thermoelectromotive force $\alpha(T)$ (4,5 – after second and third measurement respectively) and thermal conductivity k (6,7- after second and third measurement respectively) for $CdBa_2Cu_3O_{7-\delta}$ is submitted. As is seen the value of resistance for the obtained sample is of the same order, as well as in Y-123 ceramics: has a metallicly course,

the value of α and its temperature dependence also corresponds to a metallic course. The superconducting transition was observed at the temperature of $T_c=85K$.

It is necessary to mark some peculiarity on temperature dependences of investigated coefficients in area 250-290K. As it is seen, there is some sharp change of these coefficients similarly to phase transitions. Temperature dependences of thermal conductivity at room temperatures same, as at phase transitions in superconducting state, i.e. the temperature dependences of thermal conductivity passes through a maximum below T_c . Below room temperatures the behavior of all three investigated coefficients resembles phase transition in superconducting state at 90K. The specific

resistivity, decreasing up to zero, further is raised with temperature decreasing. The experiments were conducted repeatedly three times. The two times observed peculiarity on $\alpha(T)$ and $\rho(T)$ in third and fourth time were not watched. The temperature dependence course of thermal conductivity has not changed after the third measurement. Is probably, it was connected to a metastable superconducting phase at these temperatures.

Proceed from the obtained results it is possible to conclude, that at is successful a selected technological regime it is possible to receive samples $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$ with $X<1$ with superconducting properties to a close structure $YBa_2Cu_3O_{7-\delta}$.

[1] Zhao.Y, Sun .S, Zhang Q. J.Appl.Phys.,1998, 64, p.1999.

[2] S.A.Aliev, S.S.Ragimov, V.M.Aliev et.al. J.Rare Earths, 1991, v.3, p.1060.

[3] E.V.Vladimirskaaya, M.V.Yelizarova, N.V.Ageev. FTT, 1998, v.40, №12, p.2145.

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$Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$ ALINMASI VƏ ONUN ELEKTRİK XASSƏLƏRİ

$Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$ nümunələrin elektrikkeçiriciliyi, termoelektrik h.q. və istilikkeçirməsi tədqiq edilmişdir. $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$ -də ifratkeçiricilik 80 at.% Cd-yə qədər yox olmur. Tədqiq edilmiş əmsalların temperatur asılılıqlarında 260-280K oblastında faza keçidlərinə oxşar kəskin dəyişmə müşahidə edilmişdir.

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ПОЛУЧЕНИЕ И ИССЛЕДОВАНИЕ ЭЛЕКТРИЧЕСКИХ СВОЙСТВ $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$

Исследованы температурные зависимости электропроводности, термоэдс и теплопроводности образцов $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$. Получено, что в $Y_{1-x}Cd_xBa_2Cu_3O_{7-\delta}$ сверхпроводимость не исчезает вплоть до 80 ат.% Cd. На температурных зависимостях исследованных коэффициентов образца $CdBa_2Cu_3O_{7-\delta}$ в области 260-280K обнаруживается резкое изменение хода зависимостей, аналогично поведению при фазовых переходах.

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