A new high Tc-Value investigated in the compound $(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$

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Abstract

A ceramic superconductor compounds with the composition $(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$ are prepared by solid state reaction from the principle routs like Y_2O_3,$BaCO_3$ and Ag_2O with high purity 99.99%. Different measurement were made to show the improvement in high phase superconductor such as resistivity measurement , X-ray diffraction(XRD) and scanning electron microscope (SEM). Resistivity measurement consider good tool for determination the critical temperature (Tc) . A better (Tc) value appeared at(x=0.2) , that is related to the amount of (Ag) in the mixture , and nearly equal to (124K) comparable with the pure compound which does not normally exhibited Tc-value greater than (100K) in a YBCO-compound. X-ray exhibited to orthorhombic phase related to high Tc phase .SEM pictures emphasized the presence of high phase through the surface morphology for the samples under study.

Introduction

After the discovery of high Tc superconductor compound with temperature (90k) in the system $YBa_2Cu_3O_{6.5+\delta}$ (1) most scientists condensed their studies on the ability of increasing the value of Tc as a function of different parameters taken into account .these parameters can be classified into two types one of them related to synthesized procedure summarized by flow of oxygen ,forming pressure, sintering temperature and time of sintering (2,3). The other classification related to the variation in the chemical composition as a result of partial substitution by isovalent elements for are earth element (4,5), Barium element (6,7) and for copper atoms in the structure by different elements such as (Co,Ag) (7,8) . In the present paper it was conensed on the YBCO compound substituted by Ag-atoms in Cu atoms with a ratio of (1%) . Those samples under study examined by different measurements to find the effect of substitution on Tc – value and the structure of the compound.

Experimental Procedure

The mixture to make the specimens was prepared by homogeneously mixing and grinding prescribed amounts of powders Y_2O_3,BaO,CuO , Ag_2O, all of which were 99.99% purity , into a gate mortar. Appropriate amounts of these powders were mixed with alumna mortar and pestle for (2 hours) in 2-propanole and dried . The calcinations process performed at ($940C^o$) for (18 hours) in order to remove the Co_2 amount from the mixture as gas and then crushed into fine powder . The calcinations and grinding procedure were repeated three times at least. That make insure the completely evolve of Co_2 – amount from the mixture. The mixture was pressed into pellets with a diameter of about (15mm) under pressure (8ton) and sintered into a tube furnace at ($940C^o$) for (18 hours)with a rate ($60C^o$/h) by flow of oxygen of a bout (1.25 L/min) . Then slowly cooled to ($500C^o$) with a rate ($30C^o$/h)and hold at that temperature (7 hours) before it returned to room temperature.

Result and discussion

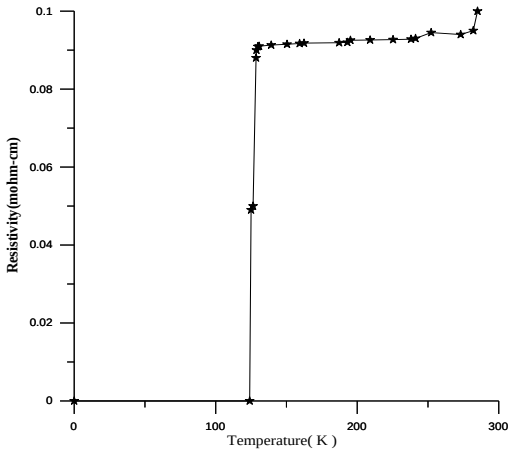
After the successive preparation of superconductor compound like $(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$ we examined it by Meissner effect is used to show a diamagnetic behavior at a certain temperature. Four-probe technique was used in the resistivity measurement to find the critical temperature as shown in figure (1). It is clear that the value of (Tc) nearly approaches to (124k) .through the abrupt variation of resistivity in the temperature range (126-123)K. This result returned to the effect of substitution of Ag with respect to YBCO and considered the best comparable to the YBCO –system. In other words the value of (ΔT =3K) within the temperature range (126-123)K give good indication about the neutrality of superconductor phases in the compound and its stability. The result comparable with $YBa_2Cu_3O_{7+\delta}$ compound . Figure (2) It is clear that the value of (Tc) for $YBa_2Cu_3O_{7+\delta}$ is nearly 117K x-ray diffraction pattern ,as shown in figure (3), taken into account with a presence of computational program to determine the lattice constants and to show the effect of substitution on the structure comparable with the pure system (YBCO-compound). It is found that the structure exhibited an orthorhombic phase with lattice constant (a=b=3.85 A^o and C=21.4A^o) .This result emphasized a high temperature superconducting phase. the creasing in Tc value of $(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$ compound reduced to creasing in a lattice constants of C lattice.

In other words most peaks related to orthorhombic phase with some shifting in the value of (2θ) appeared as result

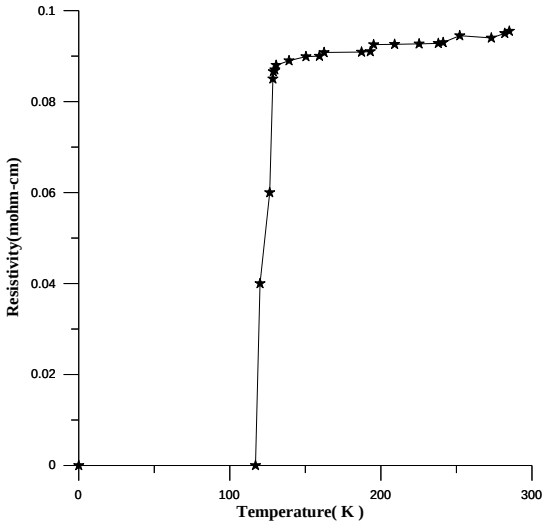
of partial additive of Ag in $YBa_2Cu_3O_{6.85}$. then the effect of Ag on the structure was clear on the modification in the basal plans , especially in c-axis, in comparable with the YBCO-compound which has a lattice constants a= 3.825,b= 3.894 A^o and C=11.702A^o.In figure(4) exhibited the variation in the resistivity as a function of temperature. The Tc value of $YBa_2Cu_3O_{7+\delta}$ compound is equal 117K .and ΔTc = 2.08K ,it was found the resistivity dropped gradually toward zero resistance at certain temperature. These results indicate clearly that zero

resistivity temperature is improve by excess substitution of Ag in ($YBa_2Cu_3O_{6.85}$) .

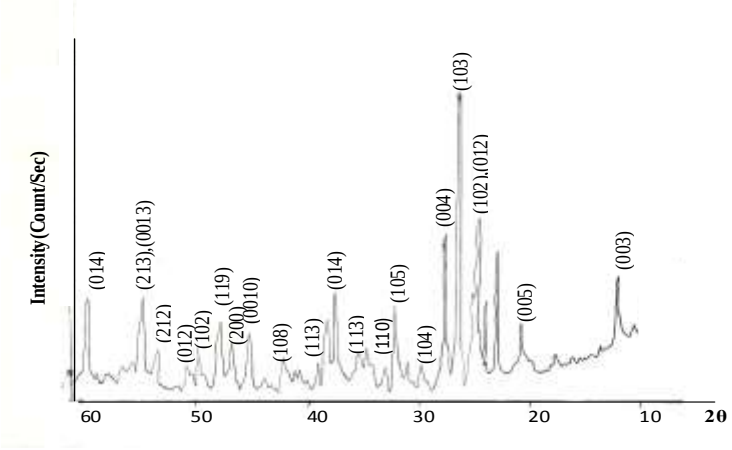
The result of scanning electron microscopy analysis as shown in figure (5) .The size of plates shapes become smaller than those of figure(6) the grain size are elongated platelets and their size is between (21.53,9.23)μm . It was found that the grain growth of plate – like increased rapidly with (Ag) substitution. This agrees with the stability of orthorhombic phase. figure(5) showed structure flak like grains that lead to decrease the weak link between grain, that explain the increase in resistivity of sample. Also similar to that observed in the formation of $YBa_2Cu_3O_{6.5+\delta}$ system by Mattews[10] .



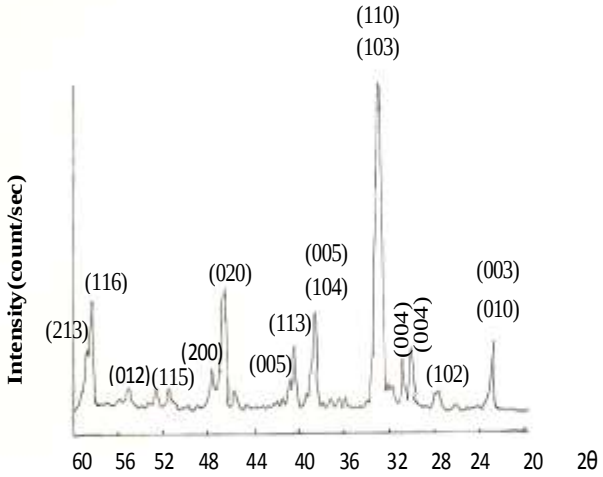
Figure(1) Indicates the resistivity measurements as a function of temperature for the system $(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$



Figure(2) Indicates the resistivity measurements as a function of temperature for the system $(YBa_2Cu_3O_{7+\delta})$



Figure(3) X-ray diffraction patterns of $(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$



Figure(4)X-ray diffrection for the component $YBa_2Cu_3O_{7+\delta}$

Figure(5)Morphology of facture surface of compound $(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$

Figure(6)Morphology of facture surface of compound ($YBa_2Cu_3O_{7+\delta}$)

Conclusion

The study of substitution effect by Ag in the composition $(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$ this work concluded the follwing points:-

1-fine grinding and sieving (using 45μ m sieve) of the material before sintering periods were found to be very effective in producing homogenous samples.

2- sintering process of pellets must be carried out at atemperature of 940C under low blow rate of oxygen the proer flow rate of oxygen is (1.25L/min).

3- the Tc found for the compound $(YBa_2Cu_3O_{6.85})_{0.8}$ $Ag_{0.2}$ is 124K .

4- found the structure exhibited an orthorhombic phase with lattice constant (a=b=3.85 $A^o$and C=21.4A^o).This result emphasized a high temperature superconducting phase.

5-Appearance of texture in (SEM) images for sample under study such as plate-like or needle –like accompanied the formation of superconducting phase.

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اكتشاف درجة حرارة حرجة جديدة للمركب $(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$

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الملخص

تتحول وفق برنامج $YBa_2Cu_3O_{6.5+\delta}$ و$(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$ تم تحضير مركبات سيراميكية مختلفة من نظام محدد فائق التوصيل تفقد مقاومتها عند درجة حرارة ١٢٩كلفن . حضرت المركبات بعد حرق موادها الأولية بدرجة حرارة ٨٥٠ درجة مئوية ولمدة ١٥ ساعة ثم طحنها كمسحوق ناعم متجانس بعد تبريدها لدرجة حرارة الغرفة وكبست على هيئة أقراص سمكها يتراوح بين (١,٥-١,٨) مليمتر وقطرها ١٣ مليمتر بضغط قدره ٠,٦ كيكا باسكال.

تم معامل هذه الأقراص حراريا لمدة ٣٠ ساعة بدرجة تلبيد ٩٤٠ درجة مئوية تم التوصل لها وفق نظام حراري ثابت للعينتين . وضعت العينتين الملبدة في داخل أنبوب من كوارتز وضخ لهما الأوكسجين بمعدل جريان ١,٢٥ لترادقيقة . أظهرت قياسات الأشعة السينية للعينات المحضرة والتي أثبتت توصليتها بتحولها من الطور ألرباعيها الفائقة عند درجة حرارة ١٢٤ كلفن للمركب $YBa_2Cu_3O_{6.5+\delta}$ و١١٧ كلفن للمركب $(YBa_2Cu_3O_{6.85})_{0.8}Ag_{0.2}$

كما أثبتت توصيلتها الفائقة عند درجات الحرارة الحرجة المشار إليها تحولا في الطور من الرباعي الى ألمعيني وقد تأكد من هذا التحول باستخدام المجهر الالكتروني الماسح SEM