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EFFECT OF ADDING SR ON THE COMPOUND AND ELECTRICAL STRUCTURAL PROPERTIES OF ELECTRICAL CONDUCTIVITY THE SYSTEM CU0.5 TI0.5-X AG BA2 SRYCA4CU4 O12-8

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Abstract :*The compound Cu0.5 TI0.5-x Ag Ba2 SryCa4Cu4 O12-8has been studied and prepared in solid state method using annealing at annealing heat 8000c and Hydrostatics pressure 7 ton/cm2, the study shows examine of the crystal structure to remains maintaining the quadric type existing at molecular replacement for the replacement element of Sr in Ba element Cu0.5 TI0.5xBa2-y SryCa4 with different percentages for(y).*

X-ray examination results have shown that the compound remains maintaining the existing quadric characteristic but a simple change occurs by the Scanning electron microscopy and knowing the elements percentages in the compound and the extent of annealing and molecular replacement heat in the elements and assign the quantity and quality concentration percentages for the compound.

Key words: *critical temperature, solid state interaction, density, Crystalline lattice constants, High and low phase and ratios*

INTRODUCTION

The superconductivity phenomenon was discovered in 1911[1] by the Dutch scientist H.Kamarline Onnes, during measuring the electrical resistance for pure **zn** at liquid Helium temperature, and Zn was chosen for it is liquid at room temperature and could obtaining it with very high purity and found the electrical resistance falls and become approximated to zero.

The two distinguished properties for superconductivity is very important whether related with their properties or applications related with their electrical behavior(lose of electrical resistance) and its magnetic behavior(The expel of the magnetic field)which make them of broad scientific and technological applications, amongst their entering in applications of renewal domain where they cause to decrease energy consumption amount to great extent.

For we know that most of waste occurs for power related with electrical resistance of the current also consumption because of the electrical field used to penetrate in the material accordingly, superconductive materials considered important for the perspective technological future free from energy waste depending on this characteristic. And it is one of the essential phenomenon in (solid state physics) is electrical resistance decline phenomenon in and some compounds and the magnetic flux at very low temperature than Zero Kelvin.

The superconductive materials could be divided in to superconductive materials of high critical temperature and low critical temperature, and the superconductivity is called so for their electrical resistance equal to zero at certain temperature whose conductivity ability becomes very high and there are phenomena confirm the high conductive materials.

And with discovering of whose critical temperature exceeding (77k) which is the boiling point of Nitrogen, a new age of conductors that is named(High Temperature Superconductors) while the previous date category named classical super temperature conductors or(low temperature superconductors)[3,2]

PROPERTIES OF HIGH TEMPERATURE SUPERCONDUCTORS HTSC

First: they are oxide compounds suffered from (Oxygen Deficiency compounds)

Second: they all common that they consisted of structural units of Berovskaite structure, we could considered that all the oxides of Berovskaite structure consisted of two metal atoms and oxygen and has the formulateABO_3.

Third: sample preparation

The samples prepared using interaction of solid state technique by two methods of (sintering) and (annealing) and technique of sold state interaction is considered the first super conductive ceramic compounds preparation and methods and it is one of the classical method in which mixture of powders in the form of Oxides and carbonates, where these powders are grinded with alcohol addition to increase the homogeneity and not volatile the material molecules. Then (chaliced) and annealed with in certain conditions including(temperature, time pressure and type of gas contact the sample ….. etc) which assign the sample characteristics.[5].

MATERIALS USED IN SAMPLE PREPARATION

The following materials were used in sample preparation.

1- Chemical materials of purity reached%99.99 including (TI_2o_3),(Cuo), ($Caco_2$),($Sr(No_3)2$ and ($Baco_3$)
2- (C3H3O) for reserve materials when grinding by performing of solid state interaction.

STAGES OF SAMPLE PREPARATION

According to weight ratios of the elements

The weight ratios were calculated of the materials contributed in forming the compound($Cu_{0.5}$ $TI_{0.5xBa2}ca_3$ cu_{4012}-) and the compound (($Cu_{0.5}$ $TI_{0.5-x\ Ag\ Ba2}$ Sr_yCa_4 $O_{12}ð$)) by taking the molecular weights of these materials in appropriated with the element weight in each of the basic material and the compound(the sample) needed to be prepared.

SINTERING OF SAMPLES

The needed for this study samples prepared with certain and appropriated weights according to atomic weights of materials including BaCo3, $Caco_3$,Sr(No3)2, (Cuo, CU, and these compounds were weighted including(Oxides and carbonates) used in preparing the sample according to atomic weights of primary elements as follows:-

Table 1: demonstrated the chemical materials weights used in preparation of different compounds.

Sample	Variables during preparation process	Purpose of preparation
$Cu_{0.5}TI_{0.5}$ Ba_2 Ca_3 Cu_4 O_{12}	Sintering and annealing process	In order to study the effect of preparation methods on temperature and crystal structure and Oxygen rate in the compound
$Cu_{0.5}TI_{0.5-x}Ag_x$ $Ba_2Ca_3Cu_4$ O_{12-6}	Hydrostatic ressure 7 ton/CM^2	In order to study the effect of Partial compensation of the element Ag in the element TI of the compound ,its effect on decisive temperature and crystal structure and Oxygen rate in the compound
$Cu_{0.5}TI_{0.5-x}Ag_xBa_{2-y}$	Partial compensation	In order to study the effect of Partial

$Ca_3Cu_4\ O_{12-6}$	of the element Sr in seat Ba	compensation of the element Sr in the element Ba of the compound ,its effect on decisive temperature and crystal structure and Oxygen rate in the compound

The oxides and carbonates are mixed (TI_2O_3 , $Sr(NO_3)_2$, $CaCO_3$, CuO ,TI_2O_3 showed in the table No.(1) to get the compound ($Cu_{0.5}TI_{0.5-x}Ag_x\ Ba_{2-y}\ Ca_3Cu_4\ O_{12-6}$) subject under study , then these materials are put in grinding pot , grinded well by using grinder manufactured from agate material for half an hour in order to be the mixture homogeneous with addition of Isopropyl during grinding process in order to avoid dropping or loss of parts of the powder during grinding process . Then put in electrical oven in order to get rid of Isopropyl alcohol through sintering process as showed in figures (1 , 2) .

(6) and the following figures showed cooling and heating process in space of air and oxygen .

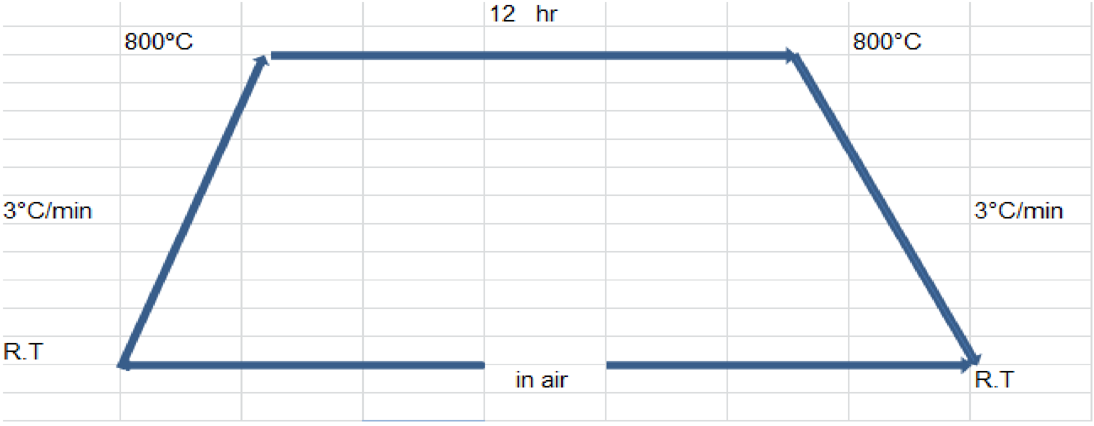


Fig 1: The process of tingling in compound in a saturated atmosphere of oxygen (7) .

SAMPLES ANNEALING

After getting prepared samples in the form of disc from above – mentioned paragraph .Then put in an electrical oven under temperature of (600°C)at rate of (120°C /hr) for (12) hours . Then raise the temperature from (600°C) to (800° C) at the rate of (120°C /hr) for (24)hours in a saturated atmosphere of oxygen. Then reduce the temperature of the pattern from (800° C) to (600°C) at rate of(30°C /hr) for (12) hours . Then reduce the temperature from (600°C) to the temperature of the room at rate of(30°C /hr). The figure No. (2- 3) showed sample annealing of compound (7 , 8) .

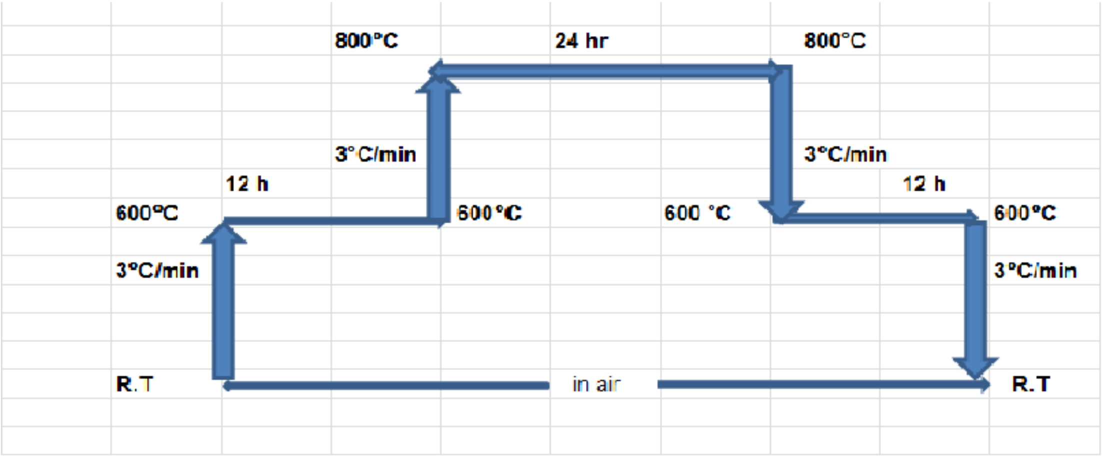


Fig 2 :sample annealing of compound in a saturated atmosphere of oxygen (7)

The purpose of this process is to get the greatest regularity in the crystal structure of the compound to obtain the existing quadruple structure (Tetragonal) .

RESULTS AND DISCUSSION

Results of structural Properties of second system with first sintering .

Figure 3 shows the x-ray diffraction pattern of the second order samples (C-TABSCCO) where the (X=0.05) which was the best and ideal sample and fixed regarding concentration X and (Y= 0.1,0.2.0.3,0.4,0.5)in which we notice differences in intensity of peaks , some rise and others reduce .Also difference in phases rates by which we noticed instability and fluctuations in the proportions of the formed phases as in the figure No (3) .

While compensation at (Y=0) rate with the best and ideal sample of X concentration ,it showed clear regularity in crystalline structure and appearing clear peaks ,and clear of disappear of angle location (20 = 20° C) as in the figure No. (3) .. Through the reflection angles we find Miller coefficient (hkl) by using Bisk language program to get cell unit value if the value was (a=b=3 3.8311°A,C=18.6503°) i.e. (Tetragonal).

While compensating at rate (y=0.1) it shows clearly that crystalline structure and emerging of clear peaks and disappearing of angle location (20 = 20° C) as in the figure No. (3) with the same above-mentioned method , we got Miller coefficient of cell unit value of (a=b=3 3.8268°A, C=18.698°) i.e. (Tetragonal).. Also we noticed at this rare that te compound took the best and ideal regularity from next compensation .

At increasing compensation rate (y=0.2) it was showed from figure (3) clear regularity in crystalline structure but less than before and appearing clear peaks ,and clear of disappear of angle location (20 = 20° C) with the same above-mentioned method we got Miller coefficient of cell unit value of (a=b=3 3.849°A, C=18.6986°) i.e. (Tetragonal).We find at this point of regularity and crystalline structure reducing of the sample that hold concentration (y=0.1) at increasing Sr concentration in Barium (Ba) due to increase in axis c and a .

At increasing compensation rate (y=0.3) it was showed from figure (3) clear regularity in crystalline structure but less than before and appearing clear peaks ,and clear of disappear of angle location (20 = 20° C) with the same above-mentioned method we got Miller coefficient of cell unit value of (a=b= 3.8513°A, C=18.6974°) i.e. (Tetragonal).We find at this point of regularity and crystalline structure reducing of the sample that hold concentration (y=0.1) at increasing Sr concentration in Barium (Ba) due to increase in axis c and a .

While figure (3) shows reducing in intensity in peaks clearly at increasing compensation rate to (4.0) also 0.5 which indicates scarcely and non-regularity due to increasing of compensation rate on the sample which the alloy dimensions were (a=b= 3.8603°A, C=18.6961° A) and alloy dimensions of the last sample was (a=b=3.8551°A, C=18.6872° A) . Accordingly , we conclude that the best regularity crystalline structure at compensation rate (Y = 0.1) .

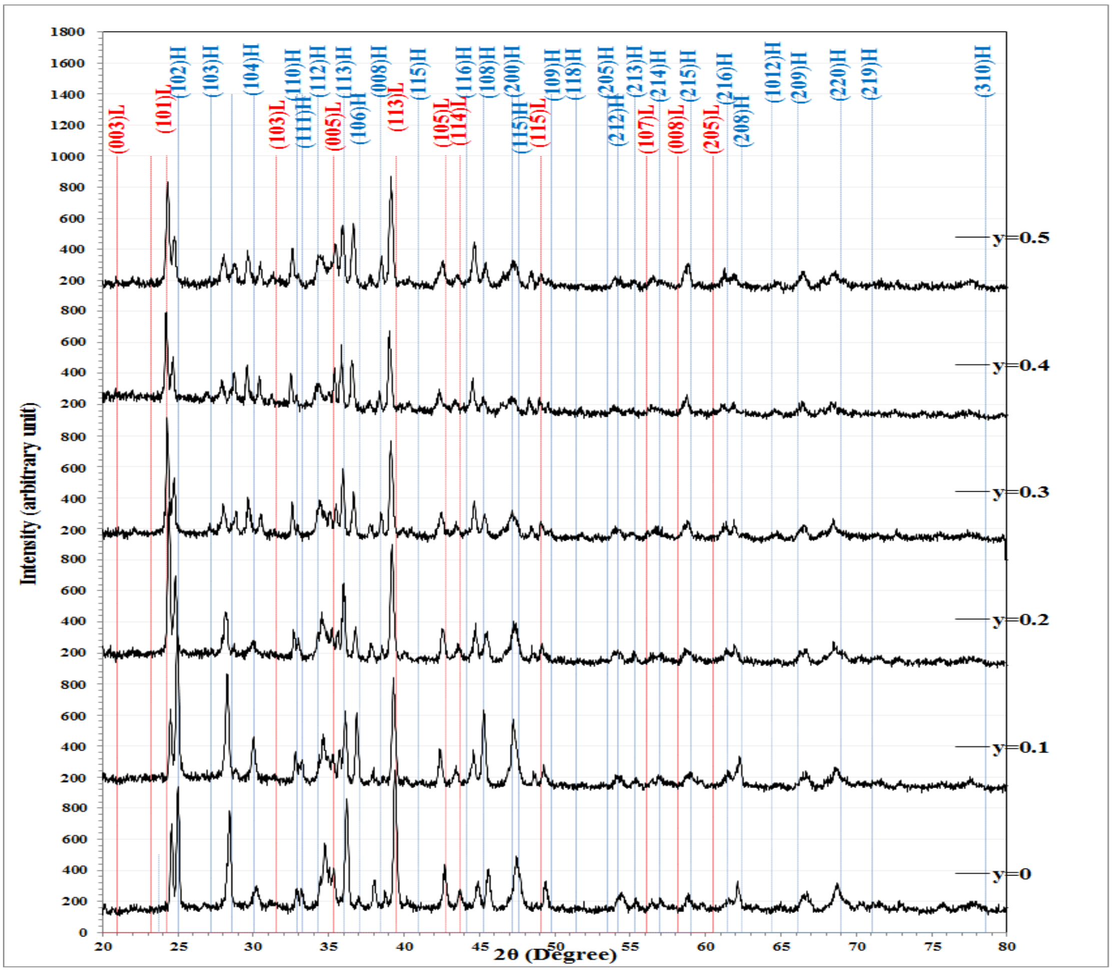


Fig 3: X - ray diffraction diagram of the second system samples of the variable y=Sr of first annealing at (800° C) temperature .

We have noticed that the highest rate of hiogher stage was of the sample (Y = 0.1) . , then reduced from the first system .This reduction of rates imply that the first system is better the second one , but the second one was improved greatly So that it becomes better than the pure sample and maintains the crystalline quaternary structure (Tetragonal) as in the figure (4) .Therefore he sample (y = 0.1) with rising in axis value (c° A) was characterized with increasing in axis (c° A) as in both figures (5 , 6) .

Which reflected on the raise of the rate at first reading . Also raising of intensity as in both figures (7 , 8) which attributed to that the compound has took the ideal structure and the best regularity in higher stage at limited altering rates both of (Sr) and (Ba) .

Also we can interpret the situation on the increase in granular size ,. Also due to required annealing period for stability and getting balanced phases thermodynamically .The samples (Y=0.2.0.3,0.4,0.5) , we noticed remarkable reduction in the rate of higher stage and length of axis (c)and increase in the length of axis (a) .

The reason of this reduction refers to the effect of the locations of some defects, impurities and low phases inside the delayed crystalline structure that hinder process of crystallization and the construction of the crystalline alloy to form the higher phase. Also the reason may be changing and fluctuating in phases rates in the sample and eventually changing structural properties at altering process , changing in length of link (CuO) .

Also axis length (c) which attributed to the change in distribution of oxygen atoms inside the crystalline alloy which affect the result in layer thickness (CuO) which was clear in fluctuating in the rate of higher phase for all vaccination ranges in the second system (C-TABSCCO).

Table 2 : shows rates of phases , rates of alloy , rate (c./a) , density and annealing at above temperature .

Y	x	a (Å)	c (Å)	V (Å^3)	c/a	w (g/mole)	ρ_m (g/cm^3)	HTP Phase%	LTP Phase%
0	0.05	3.8253	18.7200	273.932	4.8937	970.208	5.8804	70.83	29.17
0.1		3.8396	18.8224	277.486	4.9022	965.237	5.7754	74.52	25.48
0.2		3.8265	18.6098	272.482	4.8634	960.266	5.8511	70.91	29.09
0.3		3.8271	18.5929	272.325	4.8582	955.295	5.8242	61.98	38.02
0.4		3.8501	18.5560	275.057	4.8196	950.324	5.7364	60.44	39.56
0.5		3.8411	18.5872	274.238	4.8390	945.353	5.7234	53.75	46.25

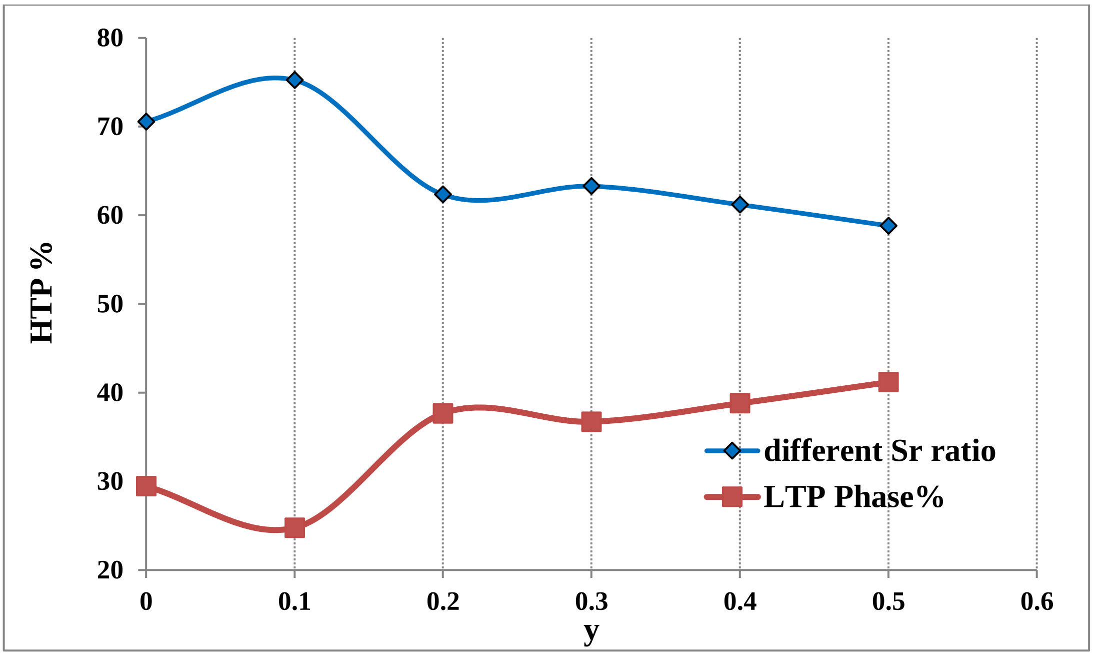


Fig 4: changing of rates of Sr concentration with higher and lower phase of the samples of the second system (C-TABSCCO).

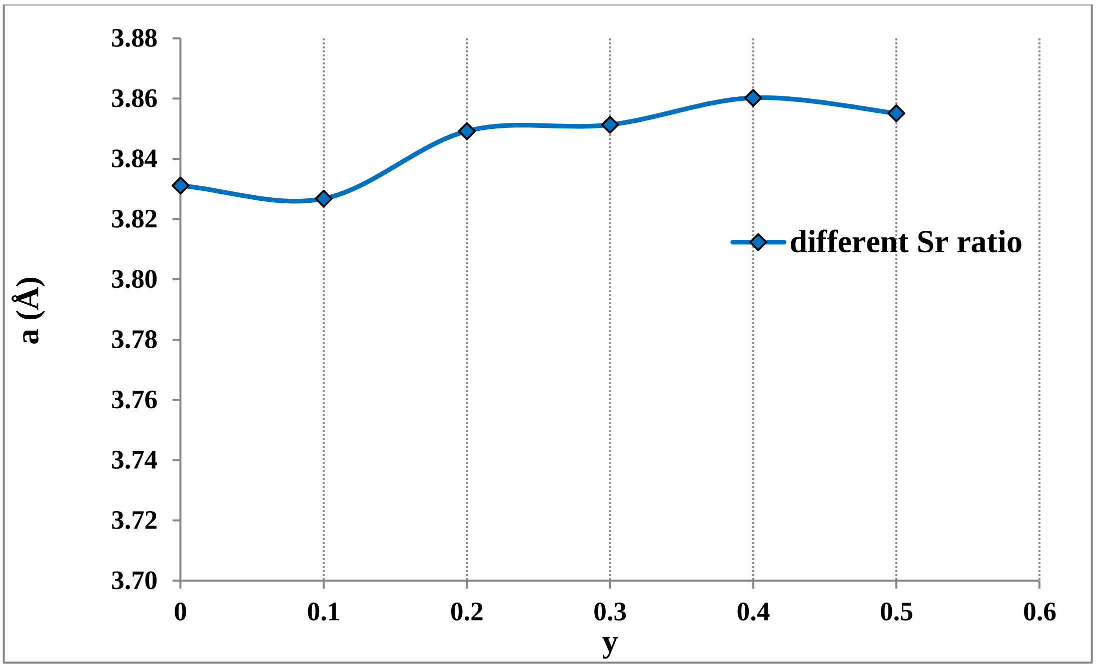


Fig 5: Fixed change of alloy (aA°) as indicator of Sr concentration (sr=y) of the samples of the second system (C-TABSCCO).

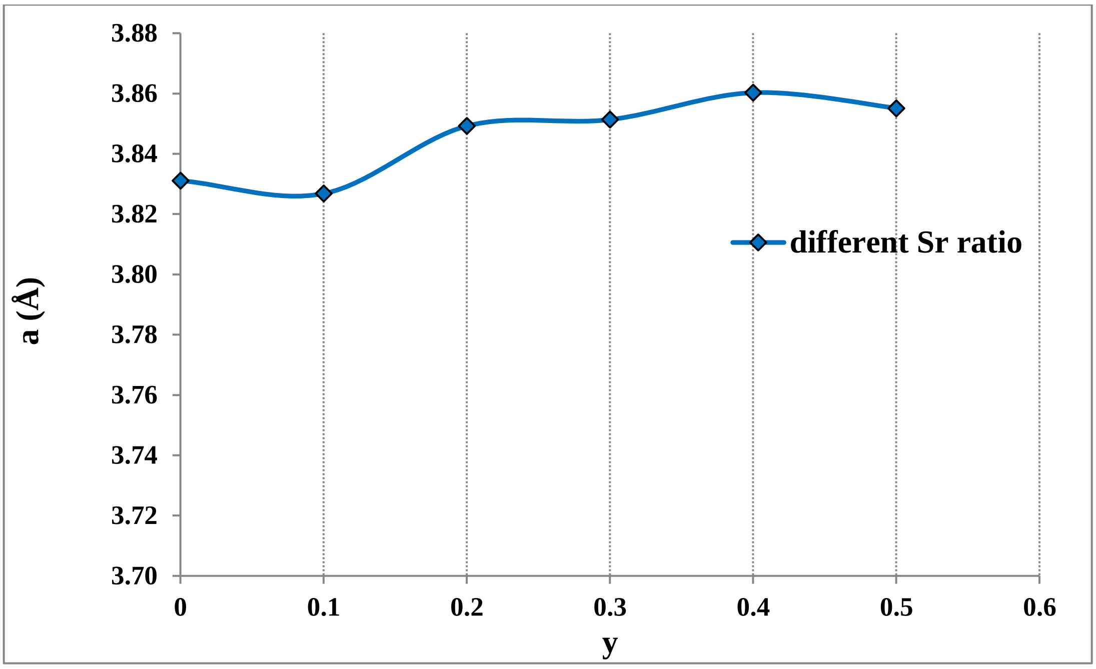


Fig 6: Fixed change of alloy (c A°) as indicator of Sr concentration (sr=y) of the samples of the second system (C-TABSCCO).

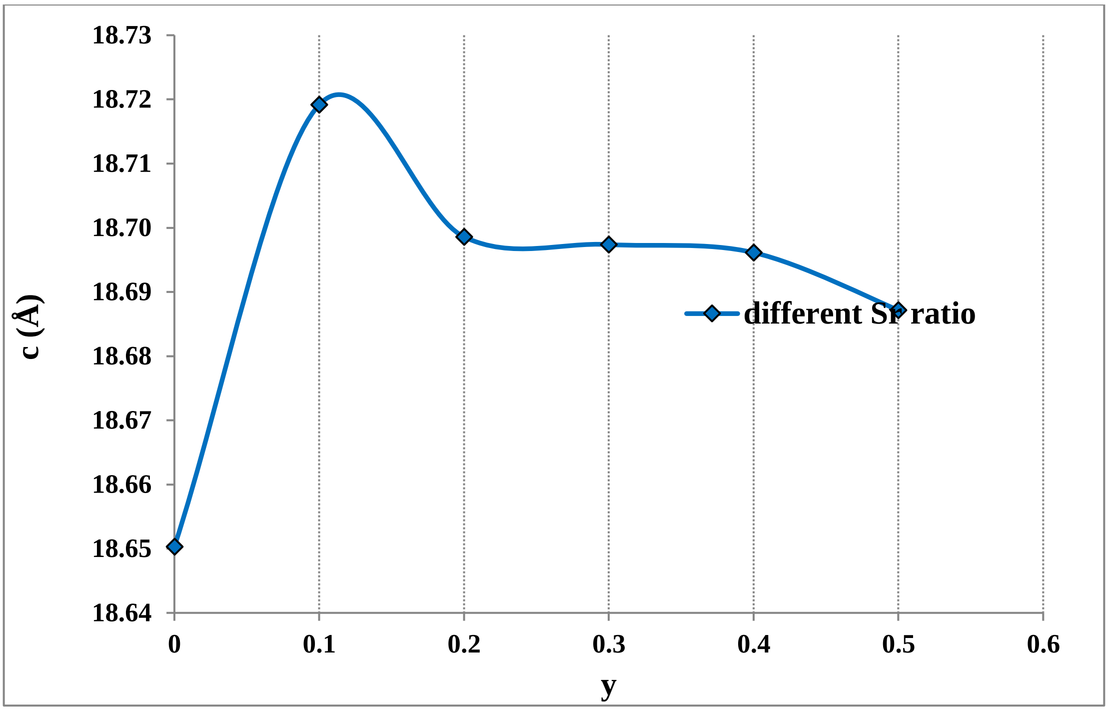


Fig 7: changing the rate (c / a) as indicator of Sr concentration (sr=y) of the samples of the second system (C-TABSCCO).

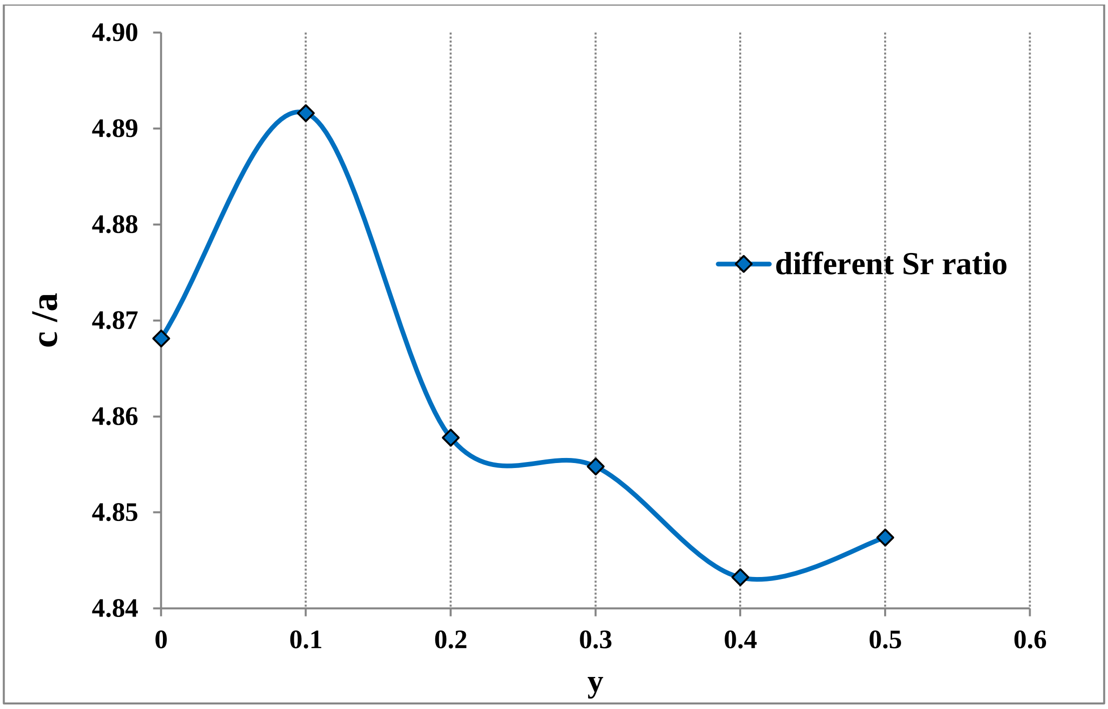
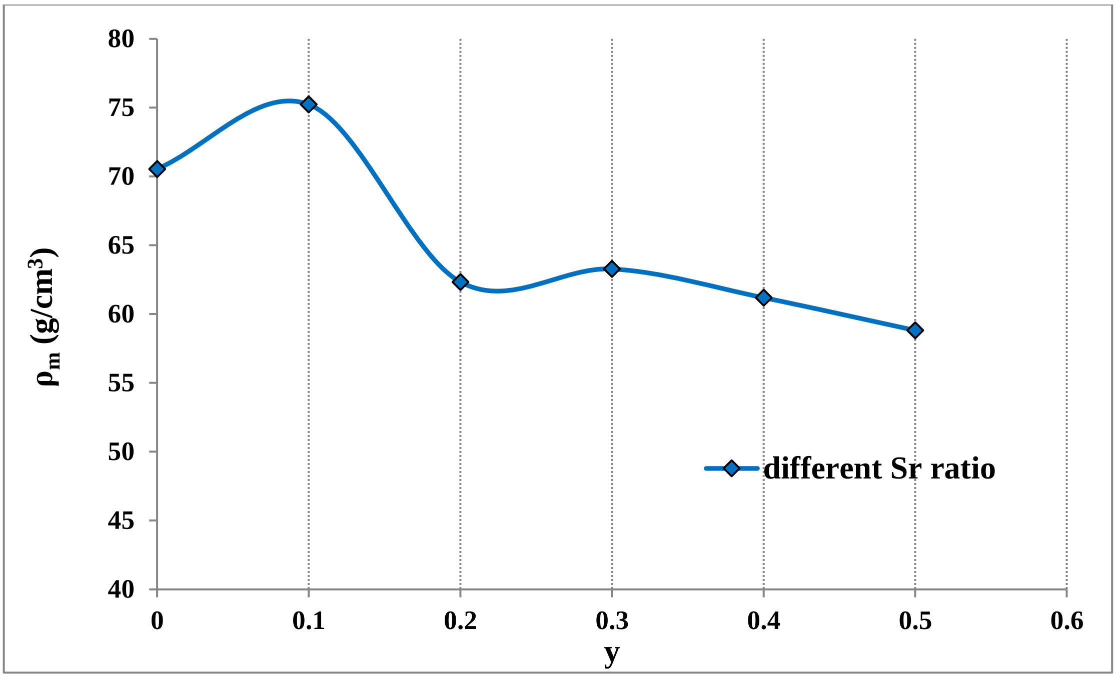


Fig 8:changing of the density of the cell as indicator of(Sr) concentration of the samples of the second system (C-TABSCCO).



Results Of Tests Of Electrical Resistivity And Critical Temperature

Electrical properties of second compound were studied , its abbreviation (CTABSCCO) as explained in (Cu0.5 TI0.5-x Ag Ba2 SryCa4Cu4 O12-8) at partial compensating of the element (Sr) in the element (Ba) of the compound (Cu0.5 TI0.5-x Ag Ba2 SryCa4Cu4 O12-8)with different rates of (y) , the value was (Y=0.2.0.3,0.4,0.5) .The figure No. (9) shows concentrations in one form as whole . Also draw the relation between different critical temperature with different concentrations according to the figure No. (10) .

It was clear from the experimental results of the samples of the second system when the compensation rate was (y = 0.050) , increasing temperature (148K) which equals (y = 0) , and this result could be verified that the compound got great role in regularity of crystalline structure . This rate of compensation led to increasing in critical temperature , also increasing in oxygen rate with concentration increase that led to increasing in critical temperature as explained in table No. (3)

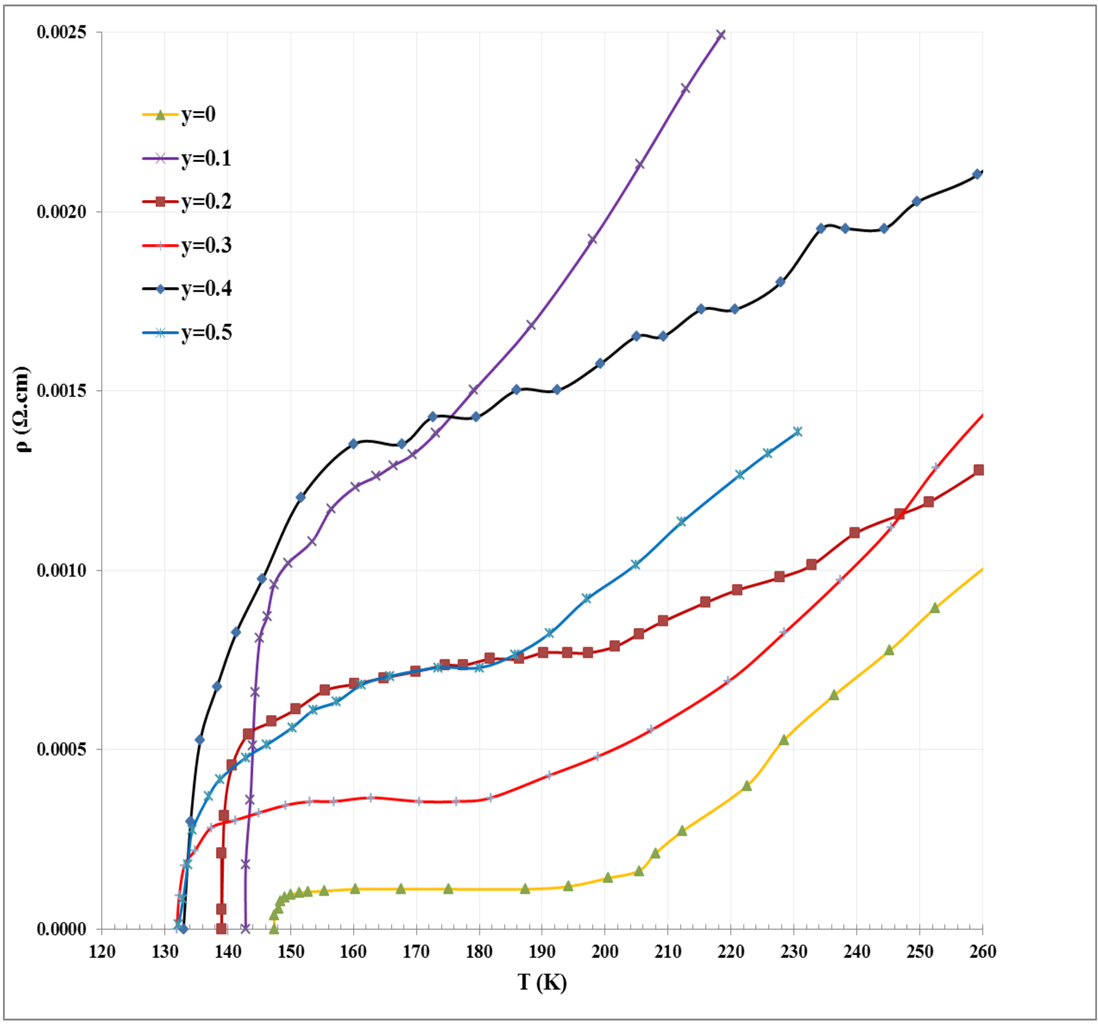


Fig 9: shows the relation between resistivity and critical temperature of the compound (CTABSCCO) when (y) equals (y=0.2.0.3,0.4,0.5).

While we observed a critical temperature drop when the percentage of concentrations of the element increased
(Sr=0.2.0.3,0.4,0.5) which critical temperature of the compound (Tc) has reduced to 136 (Tc = 136 , 137 , 142 ,= 143 , = 147 k) , the reason of critical temperature drop refers to lack of length of axis (c) which leads to reduction in the value of critical temperature (T c) , i.e. increasing in concentration rate of (y) more than (0.1 0 that caused change in alloy constants with crystalline structure. This received value consistent with more research .

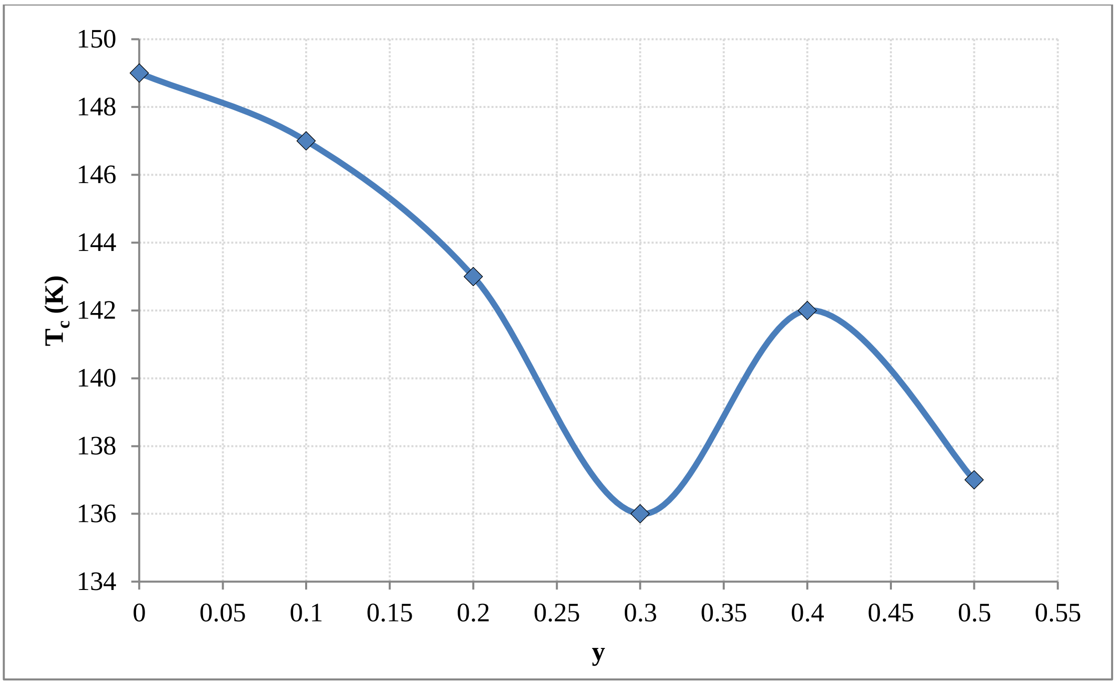


Fig 10: The relation between critical temperature of the compound (CTABSCCO)when(y)equals (y=0.2.0.3,0.4,0.5).

Table 3:shows the relationship between critical temperature and oxygen rate with concentration rate of (y) .

Oxygen Rate	**Critical Temperature**	***Concentration Rate***
10.35	149	0
10.43	147	0.1
109.27	143	0.2
10.19	136	0.3
10.11	142	0.4
10.054	137	0.5

CONCLUSIONS

1. The method of preparation has a very important role in the production of superconducting samples (C-TABSCCO), although the preparation process in the superconducting system Especially in the production of the higher phase (C-T- 1234) will be very difficult which needs great control on all preparation conditions , starting from selecting the materials and vaccination elements till getting samples in their final shapes .
2. The mixing and grinding process and the length of time which included the two mechanisms first : by (Gat Mortar) , second by (Vortex Mixture) had the greatest positive effect in improving superconductivity properties and obtaining high rate of phase (C-T- 1234) through providing homogeneous powders and precise particle size that provides particle affinity and increased contact space between them that provide chemical reaction and good crystalline growth during annealing process .
3. The length of the sintering time is very necessary to insert additional layers of copper oxide layers in the composition of the class of the compound and get the highest proportion of the high phase .
4. Through the analysis of x-ray diffraction, all samples had a quadrilateral crystalline structure (Tetragonal) , and altering (Sr) instead of (Ba) barium will not change of the crystalline

structure of the pure sample . The crystalline structure stay the same for all samples .The samples contain the phases (C0t – 0033 , C-t-1233 , C-T-1212) with the existence of little impurities. The intensity of the higher phase peaks (C-T-1234) of the pure sample is higher than its severity compared to the rest .

5. Analytical results of (XRD) showed that higher phase rate (C-T-1234) and the rest phases . Also alloy transaction (a,b,c) . And the rate of (c/a)and density of cell unit has changed comparing with pure sample which was as a result of replacement of (Sr) .
6. Existing of the phase (C-T-1234) with low rates is necessary in order to push the thermodynamic process and phase transformation in the system (C-TABSCCO) to more stability to form the phase (C-T-1234) with higher rate.
7. Most of the samples were metallic behavior regarding the change in the electrical resistance and reducing temperature before transferring to superconductivity state .
8. Critical temperature increases reaching (High-T_c) by increasing higher phase (C-T-1234) .
9. Superconductivity system especially higher phase (C-T-1234) under study is very sensitive for substitution in copper oxide layers (CuO) which lead to deterioration in the properties of superconductivity and lack of the possibility of some samples showing high accuracy behavior which appeared during replacement of (Sr) instead of (Ba) only at rate of (0.1) within second system in critical temperature and the properties of superconductivity of some samples comparing with the first system and pure sample .

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