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# PREPARATION AND DEVELOPMENT (C-TBSCCO) SYSTEM USED IN THERMAL APPLICATIONS

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***ABSTRACT***

***The superconducting compound samples (Cu0.5Tl0.5-xAgxBa2-ySryca3Cu4O12-8) are prepared in a way of the solid state interaction using sintering and annealing methods under annealing temperature(0C800) and hydrostatic pressure ton/cm27, the result of the testing the crystalline structure that the compound remains Maintaining quaternary type existing in molecular compensation for Ag element in cu-TI element that the compound becomes as the following formula(cuo.5Tl0.5-xAgxBa2ca3Cu4O12-8) with different percentages for(x), the results of the test of the thermal properties has showed that the compound keeps maintain the existing quaternary type for the phase(cu0.5TI0.s.x)-1234 while the alloy constants have changed due to the replacement content, also the results of thermal properties measuring test have showed significant improvement in the thermal conducing values of the support ratios and gradual increase compared with the non- supported basic system by Ag, the improvement of the thermal conductivity resulted in positively and contribution to increase thermal flow(Ɛ). The significant improvement in the diffusion thermal values(ծ ) which represented the real behavior for heat transfer in the system. Via this increase we could find clear decrease in(C th) and this means that the material or the system formed of high thermal conductivity and transfer where the thermal resistance of the basic system is (0.27) while in the0.05% is cm/k.watt0.07419 and this means that the system of high transfer .***

***Keywords: thermal conductivity, solid state interaction, thermal diffusion, thermal flow, Homogeneity in image and particle size***

## INTRODUCTION

The high conductivity phenomenon was discovered in 1911[1] by the Dutch scientist H.Kamarling Onnes, while measuring the electrical resistance of the pure mercury at Liquid helium temperature and he chose the mercury metal being fluid at the room temperature and because we could obtain it with high purity and found the electrical resistance collapse and becomes close to zero.The two most distinguished features of the high conductivity whether related with its properties or its applications concerned its electrical behavior( loss of electrical resistance)( Magnetic field expulsion) which make it of broad scientific and technological application) materials, including entering in the field of the renewal energy applications where it decrease the amount of energy consumption because of the electrical field used to penetrate in the material, accordingly the high conducting materials considered important to be great promising for technological future free from energy waste depended on this property which is one of the important phenomenon in ( solid state physics) which is decrease of the electrical resistance in metals and some compounds and reduce the magnetic flux inside them at a very low temperature close to zero kelvin.

The high conducting materials could be divided in to high conducting materials of high critical temperature degrees and low critical temperature degrees, and it is called super conducting because their resistance for the electricity equal to zero at certain temperature where their ability of conductivity very high and there are phenomena confirmed the superconductivity.

Discovering the compounds whose critical temperature above(77k) which is nitrogen boiling point , and anew age of conductors which is termed the temperature superconductors) while the previous category before this date called them classical superconductors) or( low temperature superconductors[3,2]

The properties of high temperature superconductors HTSC

The most important properties of HTSSC, is mentioned below[4]:-

**First:-** They are(oxygen deficient compounds)

**Seconds:-** They are all common consisted of structural units having pyrophysics compound and all the oxides having pyrophysics compound consisted of metal atoms and oxygen, and formulaABO3.

**Third:-** These materials are considered of superconducting materials type II

**Forth**:- Because cu-o rings are common in most of these materials, it is believed that they form cooper passage.

The practical aspect:

**Sample preparation**

The sample are prepared using solid state interaction techniques with( sintering and annealing ) methods, and solid state interaction is considered first method of preparation super conducting compounds of superconducting, which is one of the classical method in which mixture of powders in a form of Oxides or carbonates, these powders are grind with adding one of Alcohol compounds to increase homogeneity and non-volatile the material molecules, then(Chaliced) and( annealed) within certain conditions including(temperature, time, pressure and type of gas touching the sample , … etc.) which specifying the characteristics of the sample[84]

**Materials used in sample preparation**

**The following materials used in preparation of the samples**

**1-** Chemical materials of (%99.99) purity, which are ($TI_2o_3$), (Cuo),($caco_2$),($Sr(No_3)_2$) and($Baco_3$)

**2-** ($C_3H_3o$) to maintain materials when grinding by performing solid state interaction

**Stages of preparation the samples**

Calculation of Weight ratios of elements, the weight ratios of the materials are calculated which are common in forming the compound($cu_{0.5}TI_{0.5}$,AgxBa$_2$-yca$_3$cu4o$_{12-8}$) and the compound($cu_{0.5}$TI0.$_{5-x}$AgxBa$_2$-yca$_3$cu$_{4o12-6}$)

**Sintering of the samples**

The required samples are prepared for this study by taking certain and suitable weight according to the atom weight of the following materials,Ba2co3,Caco3,sr(No3), Cu o, Cu, these compounds(Oxides or carbonates) used in preparation the sample, and the primary atomic weight of the elements is calculated as illustrated in table(1)

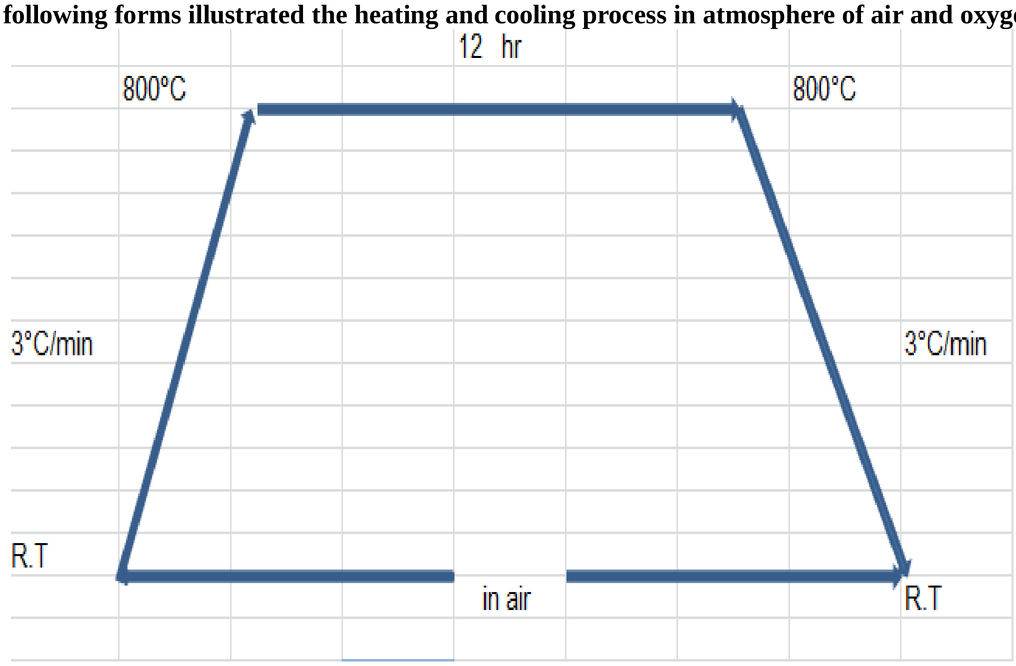
**Table(1) the studies performed of the preformed samples**

| The sample | Changes during the preparation process | The purpose of the preparation |
|---|---|---|
| $cu_{0.5}TI_{0.5}$,AgxBa$_2$-yca $_3$cu4o$_{12-8}$ | Sintering | To study the effect of preparation methods on the critical temperature and |

| | | |
|---|---|---|
| | And annealing process | the crystallized compound and ratio of the oxygen in the compound |
| $cu_{0.5}TI0._{5-x}AgxBa_2\text{-}yca_3cu_{4o12\text{-}6}$ | Pyrophysics pressure7 ton/cm2 | To study the effect of the molecular compensation of Ag element in Cu-TI for the compound and the extent of its effect on the thermal properties |
| $cu_{0.5}TI0._{5-x}AgxBa_2\text{-}yca_3cu_{4o12\text{-}6}$ | Molecular compensation for Sr element in Ba complex | To study the effect of molecular compensation for Sr element in Ba compound and the extent of its effect on thermal properties |

1- Oxides or carbonates weights are mixed for each$TI_{2O3}$, $Sr(No_3)_2$, $caco_3$, $cuoTI_{2o3}$ illustrated in table(1) to obtain $TI_2Sr_2ca_2cu_3o_{10\text{-}6}$ to be studied, then these materials are put in a container and grinding well using grinder makes from agate material for half an hour, so that the mixture becomes homogenous with adding Isopropanol solution during grinding then put in electrical oven in temperature($50^0$C-$60^0$C) to eliminate Isopropanol solution, the sintering process as illustrated in table(1).

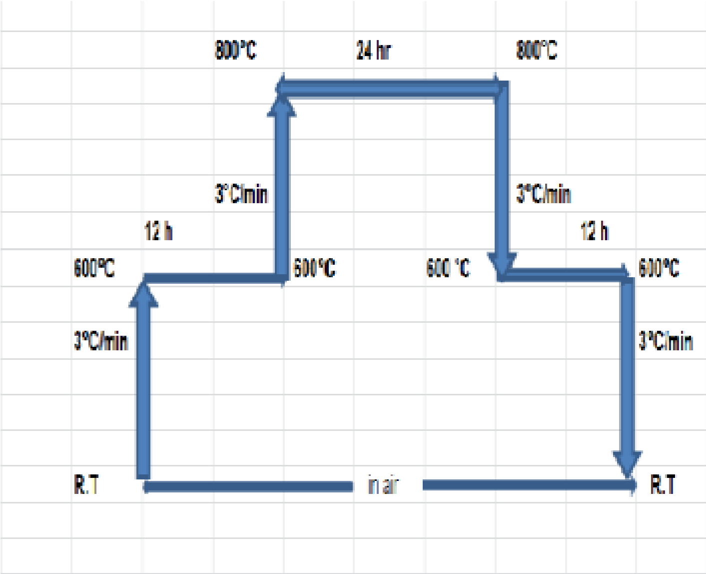
**The following forms illustrated the heating and cooling process in atmosphere of air and oxygen**.




**Figure(1) annealing process of the compound in atmosphere rich of oxygen[53]**

Annealing of samples

After obtain the prepared samples in the form of discs from the previous item, put in electrical oven and increasing its temperature from room temperature to(600°C) of rate($120^0$C/hr) then this sample remains at this temperature for (12) hours after that increase the oven temperature from($600^0$C) to($800^0$C) of rate $120^0$C/hr) and keep at this temperature for(24) hours with atmosphere riches with oxygen then decease the sample temperature from(800°C) of rate($30^0$C/hr) and keeps at temperature also for(12) hours, finally decreasing the temperature from(600°C) to room temperature of rate(30°C/hr) and figure(1), (2) illustrated the sintering and annealing processes of the compound[45,53]




**Figure(2) annealing process of a compound in** atmosphere riches of oxygen[53]

The purpose of this process to obtain most amount of regularity in the crystallized compound of the compound to obtain tetragonal.

Results and discussion

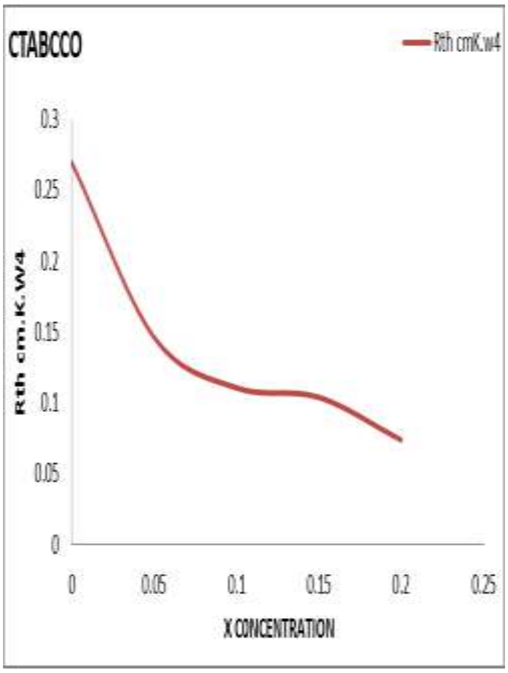
**3-** Temperature transfer in the first system:

Table(2) illustrated brief of results of temperature transfer process of the first system, where figures(7,6,5,4) illustrated thermal conductivity relation , thermal flow, thermal diffusion, thermal capacity, thermal resistance with the added ratios for Ag in this system, the results showed a significant improvement in the temperature conductivity value for the support ratios and gradual increase compared with the non-supported basic system by Ag and the reason ascribed that Ag compounds having high electronic abundance contributed in increasing the elections conveying temperature from and to the basic system and this means increase in the temperature conductivity, and this is clear in the percentages values, and the optimum value of temperature conductivity at2%, improvement of temperature conductivity ascribed positively and contributed in increasing temperature flow( ) which is improved much because of positive relationship between temperature conductivity( λ ) and temperature flow() as illustrated in figure(101-102,4) also the results showed a significant improvement in values of temperature diffusion(ð ) and this represented the real behavior of temperature transfer in the system and it is a constant effect for the materials to know temperature conductivity thus we observe in the figure the significant increase I temperature diffusion for this system.

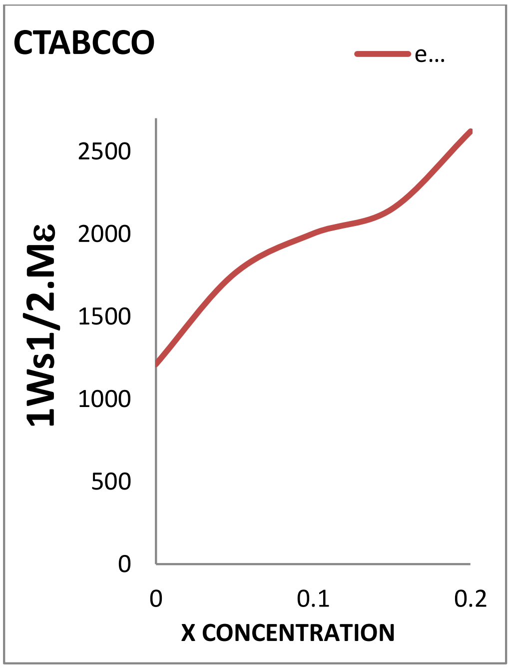
We could find in figure(7) a clear decrease in values of temperature capacity(Cth) and this signifies that this system formed as a result of support byAgno3 transfers the system from semi-conducting material to close conducting materials where the more temperature capacity decreases of the material, the more materials become conducting and this is illustrated by the relation between(Rth) with the support ratios of the first system, figure(3) showed a significant decrease I the system resistance of temperature transfer this means that the relation is reverse between temperature resistance and temperature conductivity where $R_{th}=\frac{dx}{\lambda}$ and this means that the material or the system formed of high temperature conductivity and temperature transfer, where temperature resistance of the basic system is(0.27) whereas in0.59% is0.07419cm/k. watt. and this means that the system of high temperature transfer.

**Table(2) represented measurements for all temperature coefficients as a significance of the first system ratios at(800$^0$C)**

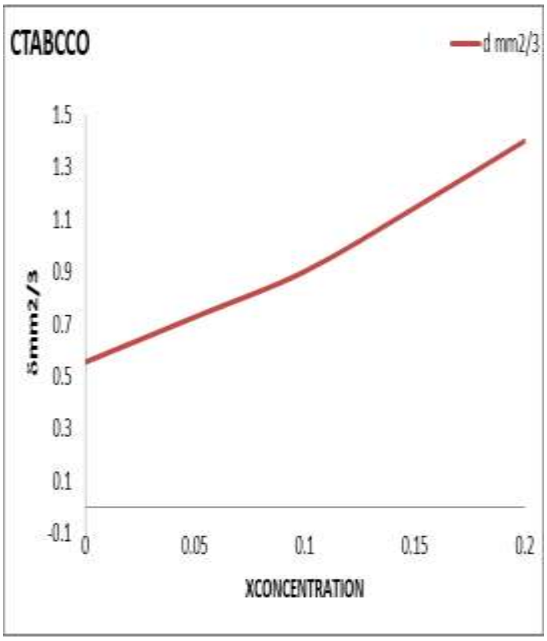
| Sample code | D cm | V $cm^3$ | ρ $g/cm^3$ | λ (w / m. K) | Ɛ $ws^{½}/m^2.K$ | δ $mm^2/s$ | $C_p$ (J/kg.K) | R $cm^2.K.W^{-1}$ |
|---|---|---|---|---|---|---|---|---|
| 0% | 1.898 | 0.6304 | 2.62 | 0.9 | 1208 | 0.555074 | 618.8567 | 0.27 |
| 0.05% | 1.636 | 0.466 | 3.82 | 1.5 | 1758 | 0.728023 | 539.3654 | 0.146667 |
| 0.1% | 1.720 | 0.490 | 3.45 | 1.9 | 2001 | 0.901597 | 610.8325 | 0.111053 |
| 0.15% | 1.766 | 0.602 | 2.94 | 2.3 | 2150 | 1.144402 | 683.5994 | 0.104348 |
| 0.2% | 1.620 | 0.474 | 3.99 | 3.1 | 2621 | 1.398909 | 555.3918 | 0.074194 |



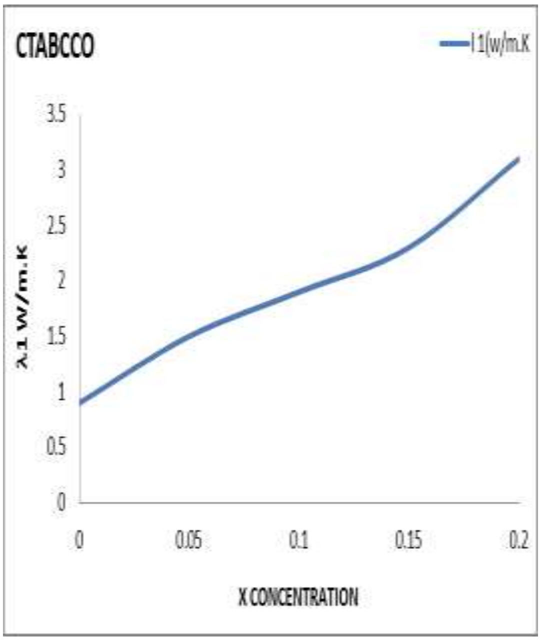

**Figure(3) : relation between thermal Resistance and ratios concentrations (x) system of the first system**



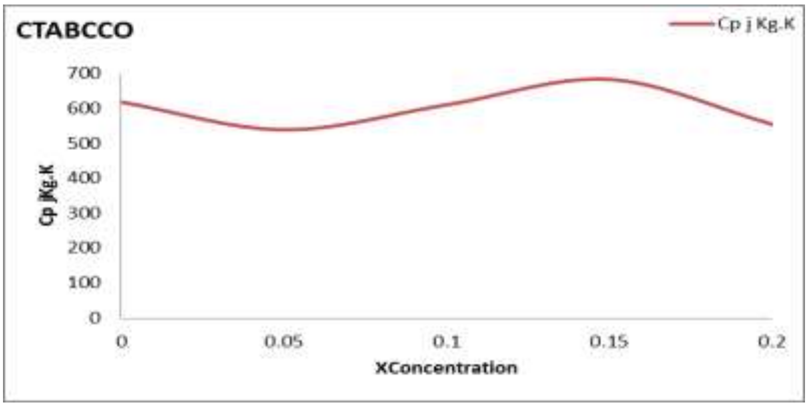

**figure(4) relation between thermal flow and ratios concentrations(x) of the first**




**Figure(5) : relation between thermal diffusion) and ratios concentrations(x) of the first system**



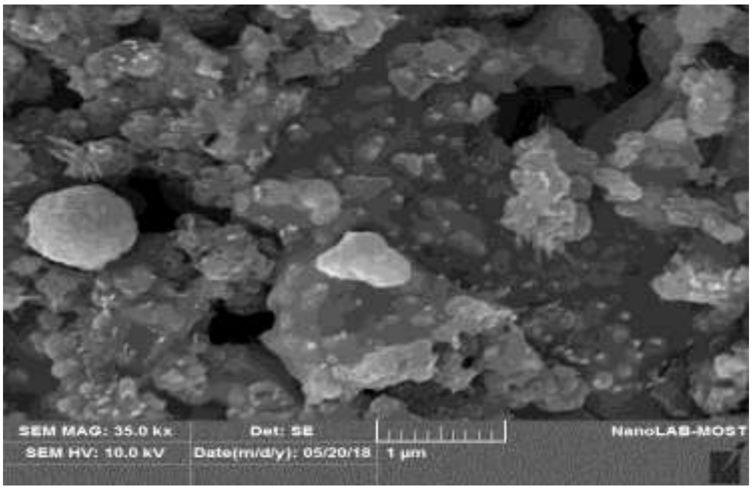

**Figure(6) : relation between thermal conductivity and ratios concentrations(x) of the first system**



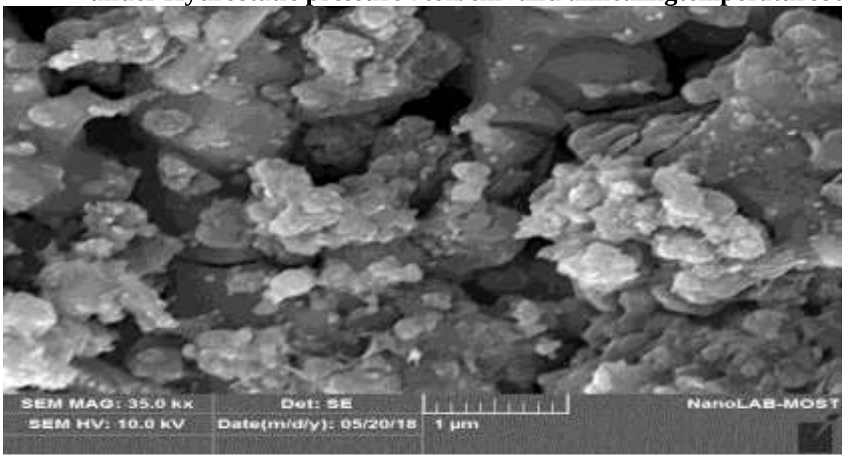

**Figure(7) demonstrated the relation between thermal capacity(Cp) and ratios concentrations(x) of the first system**

**7. Microscopic measurements scanning Electronic Microscopic**

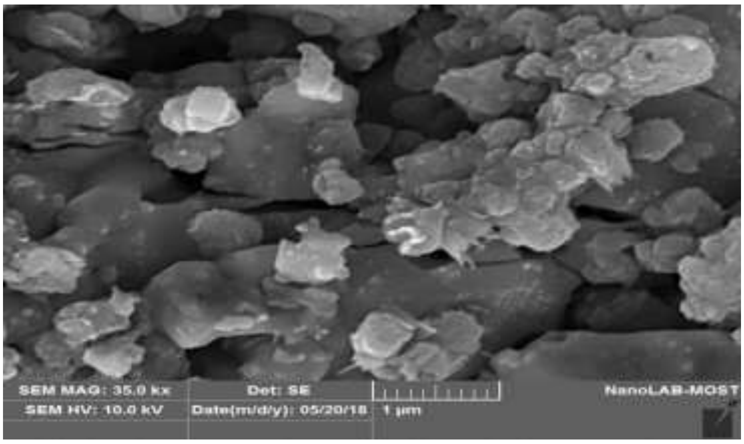
Surface crystalline structure of the samples using scanning Electronic Microscopic characterized by high technology in the process of calculating weight and atomic elements ratios in the compounds and alloys and specifying the compounds types and transfer them by analyzing of results and has the ability to take the microscopic images of a very high zoom for each point on the sample surface. Studying the surface structural properties of the compound($cu_{o.5}$-$TL_{0.5}$-$XAg_xBa_{2-2y}Sr_y$,$Ca_3Cu_2O_{12-8}$) using scanning Electronic Microscopic when y=0,x=0, and the scanning Electronic Microscopic has been studied perfectly of the compound under Hydrostatic pressure7 tons and annealing temperature(800oC), we could observe through studying the scanning Electronic Microscopic at zoom degree(35000X) we could find homogeneity in the In the image and particle size by ruler of particles limits. The dark regions represented ratios of heavy elements increase such that is ascribed to the atomic weight of these elements, also indicted that the mixing process was well to form the compound and scanning Electronic Microscopic of the samples there existed homogeneity in the image and the practices size as demonstrated in the following figures(8,9,10,11,12,13,14)[4][5][6].



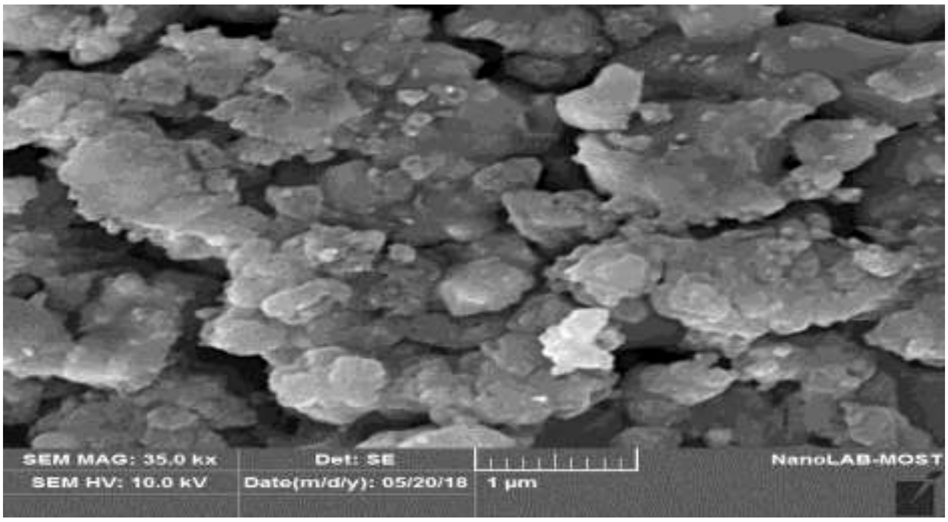

**Figure(8) microscopic examination when x=0,y=0 of the first system($cu_{o.5}$-$TL_{0.5}$-$XAg_xBa_{2-2}ySry,Ca_3Cu_2O_{12-8}$) under Hydrostatic pressure 7ton/$cm^2$ and annealingtemperature800$^{O}$C.**



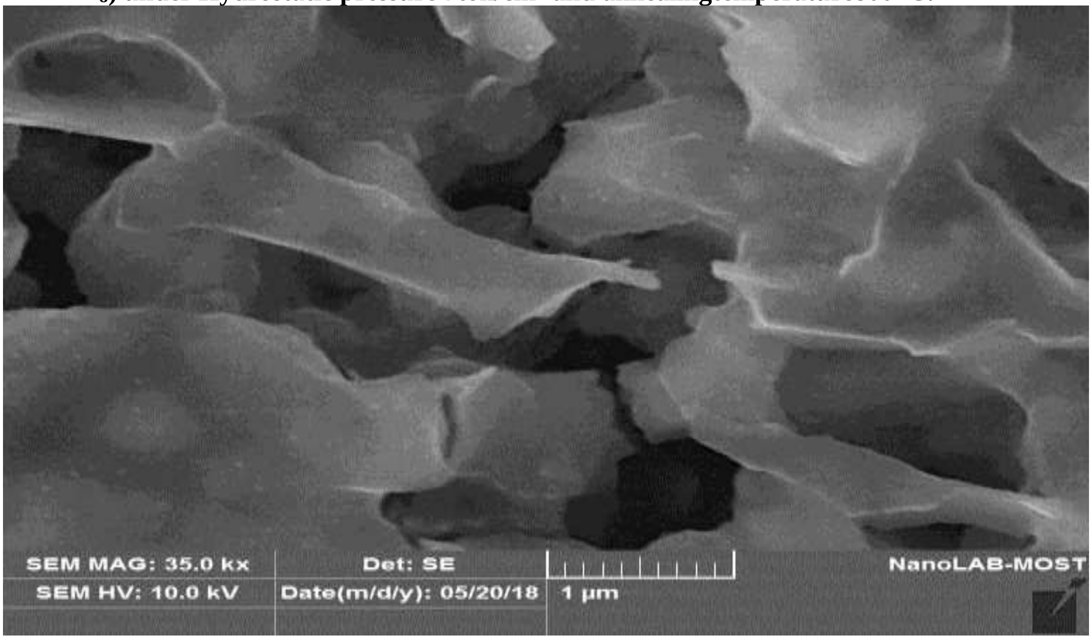

**Figure(9)microscopic examination when y= 0.x=0.05 of the first system($cu_{o.5}$-$TL_{0.5}$-$XAg_xBa_{2-2}ySry,Ca_3Cu_2O_{12-8}$) under Hydrostatic pressure 7ton/$cm^2$ and annealingtemperature800$^{O}$C.**



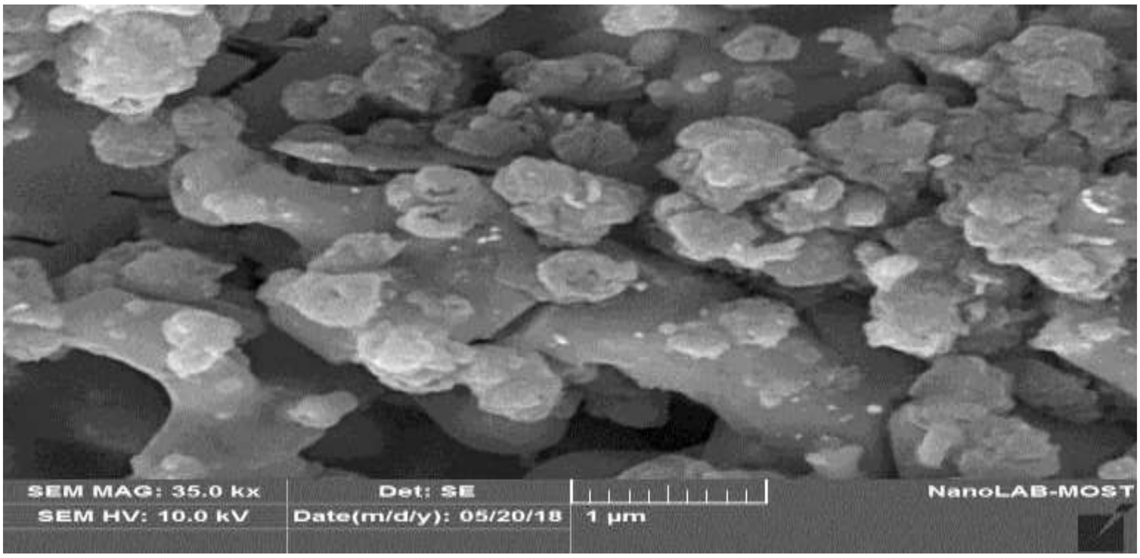

**Figure(10) microscopic examination when y= 0.x=0.1 of the first system($cu_{o.5}$-$TL_{0.5}$-$XAg_xBa_{2-2}ySry,Ca_3Cu_2O_{12-8}$) under Hydrostatic pressure 7ton/$cm^2$ and annealingtemperature800$^{O}$C.**



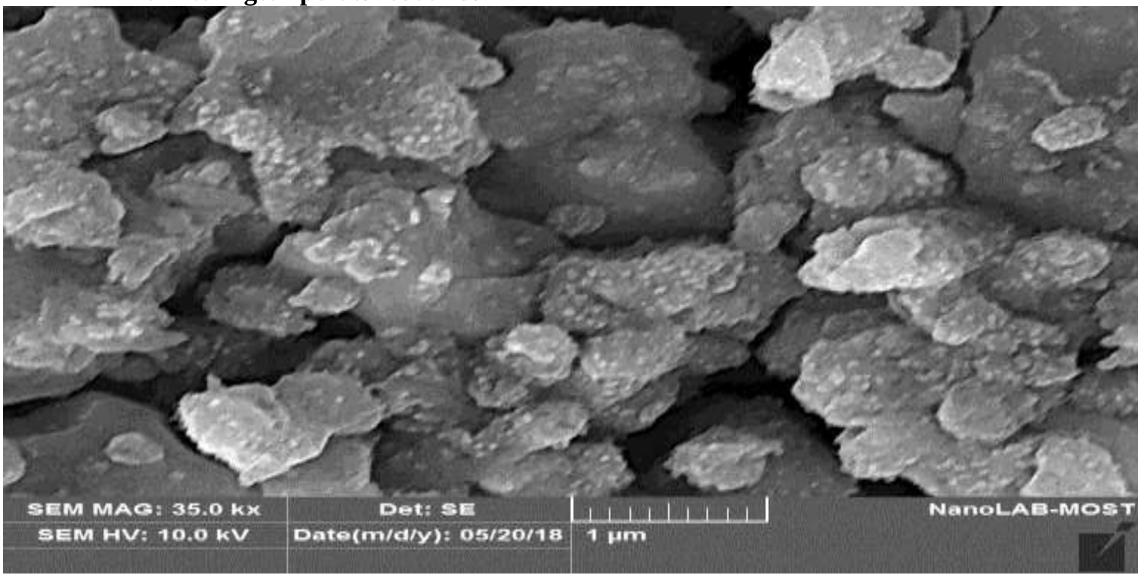

**Figure(11) microscopic examination when y= 0.x=0.15 of the first system($cu_{o.5}$-$TL_{0.5}$-$XAg_xBa_{2-2}ySry$,$Ca_3Cu_2O_{12-8}$) under Hydrostatic pressure 7ton/$cm^2$ and annealingtemperature800$^OC$.**




**Figure(12) microscopic examination when y= 0.x=2 of the first system($cu_{o.5}$-$TL_{0.5}$-$XAg_xBa_{2-2}ySry$,$Ca_3Cu_2O_{12-8}$) under Hydrostatic pressure 7ton/$cm^2$ and annealingtemperature800$^OC$.**




**Figure(13): microscopic examination when y= 0.x=0.25 of the first system($cu_{o.5}$-$TL_{0.5}$-$XAg_xBa_{2-2y}Sr_y$,$Ca_3Cu_2O_{12-8}$) under Hydrostatic pressure 7ton/$cm^2$ and annealingtemperature800$^{O}$C.**




**Figure(14) microscopic examination when y= 0.x=0.3 of the first system($cu_{o.5}$-$TL_{0.5}$-$XAg_xBa_{2-2y}Sr_y$,$Ca_3Cu_2O_{12-8}$) under Hydrostatic pressure 7ton/$cm^2$ and annealingtemperature800$^{O}$C**

## Conclusions

1- Through the sintering and annealing processes to obtain samples of the compound($cu_{o.5}$-$TL_{0.5}$-$XAg_xBa_{2-2y}Sr_y$,$Ca_3Cu_2O_{12-8}$),it has essential and important role in the process of crystal regulation of the compound subsequently obtaining harmonic system and this regularity provide safe paths and transfers of charges carriers of(cooper pairs) in the superconducting materials according we observe increase in temperature.
2- The examining results have showed thermal properties there is an increase in thermal conductivity at ratios x=0.05 and contribution to increase in temperature flow.
3- There is great increase in thermal diffusion of this system and through this increase we could find clear decrease in thermal capacity.
4- The formed system of high thermal conductivity and thermal transfer also low thermal resistance.
5- The results of electronic scanning study of the compound that the surface microscopic structure improve after sintering and annealing and the practices become of clear harmonic characteristics and could distinguishing the interval limits among them easily.

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