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Fabrication and study the effect of the laser on the properties of the compound $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$ superconductor

A. Kareem Dahash Ali
nihadshafeek@yahoo.com
University of Tikrit/College of education for pure science
Nihad Ali Shafeek
nihadshafeek1963@gmail.com
University of Tikrit/College of education/Tuzkurmatu

Abstract

This study included the fabrication of compound ($Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$) in a manner solid state and under hydrostatic pressure (8 ton/cm^2) and temperature annealing(850°C), and determine the effect of the laser on the structural and electrical properties elements in the compound, and various concentrations of x where (x= 0.1,0.2,0.3). Observed by testing the XRD The best ratio of compensation for x is 0.2 as the value of a = b = 5.3899 (A °), c = 36.21 (A °) show that the installation of four-wheel-based type and that the best temperature shift is T_C= 142 K .When you shine a CO_2 laser on the models in order to recognize the effect of the laser on these models showed the study of X-ray diffraction of these samples when preparing models with different concentrations of the values of x, the best ratio of compensation is 0.2 which showed an increase in the values of the dimensions of the unit cell a=b = 5.3929 (A °), c = 36.238 (A°). And the best transition temperature after shedding laser is T_C=144 K.

Keywords: Superconductor,Critical temperature,Laser,Tetragonal

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1. Introduction

The superconducting material is a material that allows electrical current entry into force without resistance, as well as characterized by the complete absence of magnetic flux, when it is cool these materials to a certain temperature called the thermal-class critical (Tc), this feature is important in many applications in the science of electronics and connectivity , and medical equipment. [1] [2].

The superconducting materials can be divided into several sections according to (Tc) own, its structure, and the nature of the superconducting characteristics: conventional superconducting materials such as (Hg), and materials superconducting organic (K_3CO_6), heavy Elvirmionat ($CeCu_2$ Si_2) superior material delivery is based on copper O_3 Ba $Pb_{1-}XBiX$, superior materials based on copper with a high temperature oxide delivery YBCO)) compounds carbide quadrilateral superconducting (Ln Nl_2 B_2 C) and in recent years has been the discovery of a number of superior materials and new plug-and perhaps the most recent is the discovery based on the presence of iron arsenide materials [3].

2. Superconductivity applications

Superconnectors are many benefits and applications in our daily lives, including

1. used in wires of power transmission over long distances and without loss, and about 9% of the generated electric power generating stations dissipated as heat in the regular wires carried by stations to the consumer, as well as use the connecting wires high in the same energy generators to provide the largest portion energy [4].

2.The use of superconductors in electronic computers makes it smaller and more speed as it can slide closer to each other due to generate heat.

3. Use in the medical field in the imaging magnetic resonance imaging machines (MRI), which uses magnetic energy to generate the necessary fields that help doctors to see objects without surgical interference, though the use of superconductors cradles to build a very strong Mganat can supply us with pictures and clear the various changes that occur in cells the body or tissues [5].

4. Use in the manufacture of a link called link Josvensen Josephnson (consisting of two connections of superconducting materials separated by a link buffer is too thin) and use this link in:

a- Detect magnetism generated by the movement of blood in the brain and heart, without exposure to harmful rays. This enables physicians to accurate knowledge of pathological cases.

b- Anomalies in the earth's magnetic survey, which facilitates the discovery of the Mavi ground of ores and oil and water.

c- Electromagnetic radiation frequencies detected in the infrared spectrum (Hz-1013 Hz1011) can be used in High-Discrimination radar and satellite communications industry and the discovery of what is going into outer space [6].

Hovercraft trains that run above the ground as if they were flying, being this train very quickly using magnetic repulsion force over by prompt, as the train containing superconducting materials, while large magnets are available on the road and inside the train cooling device is available and that all necessary terms utilized the power of repulsion with magnets themselves to push the train and run it speeds exceeding 550 km per hour As shown in Figure (1) [7].

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3. Literature survey

He studied researcher R. Awad in 2001 [8] Add silver component of the compound superconducting Agx ($Tl_{0.8}$ $Pb_{0.1}$ $Bi_{0.7}$) Ba_2 Cu_3 O+δ where X (0≤ X≤0.4). And attended a composite manner solid state reaction and found that the addition of the silver component of the compound Tl- 1223 to Aigr quadruple installation because the silver component excludes the installation of the lattice, while the lattice parameters (a, b) less, though adding silver element works to improve the granular size and interdependence between them when X = 0.2 the temperature has improved from 111.5K to 114K and observed that the annealing oxygen serves to reduce the critical temperature of 119K to 111K when X = 0, while annealing oxygen to improve the critical temperature of 114K to 117K works when X = 0.2 because the element silver works to absorb oxygen from Khaznat shipment layer (Tl, Bi, Pb, O) the emergence of any voids (oxygen) and transmits the samples from the case of overkill vaccination to the ideal vaccination.
And researcher Kayed TS and his group in 2003 [9] studied the effect of adding Li by adding different amounts of Li_2 Co_3 to compound Tl1-xBa_2 Ca_2Cu_3 O_{10+} δ and Ahoudoa highest temperature when you add 1% of the atomic weight of lithium Li_2 Co_3 of carbonate, and the data X- ray showed that the sample has a complex four-way place and a high proportion of (Tl - 2223), while the critical temperature equal to (Tc = 125k) as well as the resistance is zero when (Tc = 117K).
The researcher and his group F.Ahmed year [10] 2005 preparing samples of Tl-Ba-Ca-Cu-O system, which has the structural formula (n = 1,2) Tl_2Ba_2 Ca_2nCu_3 + nO δ and then Tldenha under different conditions to study the impact on the formation of phases of superconductors, in this study it was found that all of the samples have been prepared largely 8500C temperature showed dominance phases not excessive conductivity while a sample that was prepared degree 6000C temperature showed formation phase with Tc low system TBCCO (Tc = 80K) and also was determined values for a, b = 3.84A^0, 5.450A^0 .
Attended researcher Abed [11] in 2011 Composite Tl2-xAgxBa2Ca2Cu3O10 + δ superior electrical conductivity for different values لx as 0≤x≤0.5 found that Tc = 134K, 139K, 146K when x = 0.1,0.2,0.3 respectively under conditions ideal (annealing temperature of 1123K and hydrostatic pressure 8 ton/cm2) goes down to Tc (122K, 105K) for the values of x (0.4 and 0.5), respectively, under the same circumstances.
The study Suzan and his group (2012) [12] has included the effect of annealing of thin films of a compound $Bi_{1.6}Pb_{0.4}Sr_2Ca_2Cu_{2.2}Zn_{0.8}O_{10}$ record laser pulses in a manner under different temperatures C° (820, 840,860,880) the availability of oxygen at a rate of 2liter / min and a rate of temperature C / min ° 15, were examined by thin-film (X-Ray defraction) XRD as well as measurements of the electrical resistance and measured manner Four - Probe Technique.

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4. Materials Techniques and Procedures

The following materials were used in the preparation of the samples:

1. High purity chemicals up to 99.999%, which Tl2O3 thallium oxide and copper oxide, CuO and barium carbonate Ba CO3 and calcium carbonate Ca CO3 nitrate Alsnetzoinom (Sr (NO3)) $_2$ and mercury oxide HgO (German origin).
2. Alcohol isopropanol Isopropanol (C3H3O) for the purpose of keeping materials of precipitation is crushed when conducting solid-state reaction.
3. 2. (O_2) oxygen gas has been used to provide air saturated with this gas during the sintering process (Sintring) and the process of annealing (Annealing)

5. Devices used in the preparation of samples

The devices during sample preparation process use of the following

1. Balance sensitive type (G.M.B.A) with a precise amount (0.0001 gm), German origin.
2. Ceramic Boat.
3. Gate mortar.
4. Heat oven with a degree of thermal limits (1423 K).
5. Regulator to high temperatures (Furnace Controlling) oven type lined with clay and pottery.
6. Furnace hydraulic piston Hydraulic
7. Press template for CBS samples.

The weight ratios of the elements of the account

The gravimetric ratios of the materials involved in the complex formation $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10++\delta}$ account +δ by taking molecular weights of these materials relative to the weight of each component of the base material and composite (sample) to be prepared.
And found the following weights of chemicals used in the preparation of table
Different vehicles.

Annealing samples

After obtaining the samples prepared in tablets from the preceding paragraph. Placed in an electric oven and raise the temperature from room temperature to (600˚C) rate (120˚C / hr) and then the sample is kept at this thermal class for a period of 12 hours and is then lifted from the oven temperature (600˚C) to ((850˚C rate (120˚C / hr) and remain at this temperature for 24 hours in an atmosphere saturated with oxygen is then reduced degree of temperature model (850˚C) to (600˚C) rate (30˚ C / hr) and remain at these thermal class also for two (12) hours, after which it is lowering the temperature of the (600˚C) to room

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temperature at a rate of (30˚C / hr) and shape figure (2) shows the annealing of the composite process [13] To make sure that the degree of annealing temperature (850˚C) is the best degree annealing temperatures were prepared several samples (tablets) and varying annealing temperature, different (810˚C, 830˚C, 850˚C, 870˚C, 890˚C.

6. Results & Discussion

Study characteristics of the compound Tl2-xHgxBa2-y Sry Ca2 Cu3 O10 + δ superior electrical conductivity. We have studied the structural characteristics of the compound under the volumetric temperature annealing (850^0C). Under pressure (8 ton / cm^2) it showed X-ray diffraction study of these samples in the preparation of models in different proportions to the values of X. When compensation was valued at X = 0.1 shows regularly in the crystal structure and the emergence of a clear peaks as shown in Figure (3). Through the use of the law in the diffraction Barak was dhkl values are calculated by dhkl law (2d sinϴ = nλ), the distance between the parallel levels and through reflection angles (2ϴ) found Miller transactions (hkl) and using the BASIC language program has been found values the dimensions of the unit cell, as in the table (4). a = b= 5.432 (A°) , c = 35.16 (A°) When increasing the proportion of compensation to 0.2 showed an increase in the values and the regularity with an increase in the dimensions of the unit cell a = b = 5.3899 (A °), c = 36.21 (A °), as shown in Figure (4) has noticed regularly in the crystal structure of the compound when increasing the ratio of compensation and took the boat the best role in the crystal structure as in table (4). While showing a decrease in the intensity of the peaks and clearly when you increase the percentage of compensation to 0.3, as shown in Figure (5), which refers to the case of irregularities that occurred due to the increase in the proportion of compensation on the sample was equal to the dimensions of the lattice a = b = 5.532 (A °), c = 35.98 (A °) with a clear decrease in dimension. It is therefore concluded that the best ratio of compensation that should be used is 0.2 .These results are consistent with previous studies and research [14,15].

Has been shed on the co_2 laser models in order to recognize the effect of the laser on these models showed X-ray diffraction study of these samples in the preparation of models in different proportions to the values of X.

It shows that when increasing the proportion of the value of X to 0.1 notice that the diffraction values and be of rules offer less and be more clear indicating a further improvement of the crystal structure or crystal structure as shown in Figure (6). But it showed an increase in the dimension (c) which indicates an increase in the regularity of the crystal structure and became the values of a = b = 5.411 (A°), c = 36.211 (A°).

When increasing the ratio of compensation to 0.2 increase in values and regularity emerged with an increase in the dimensions of the unit cell a = b = 5.3929 (A °), c = 36.238 (A °), as shown in Figure (7) has noticed regularly in the crystal structure of the compound when increasing the ratio of compensation and took the boat the best role in the crystal structure. While showing a decrease in the intensity of the peaks and clearly when you increase the percentage of compensation to 0.3, as shown in Figure (8), which refers to the case of irregularities that occurred due to the increase in the proportion of compensation on the sample was equal to the dimensions of the lattice a = b = 5.562 (A °), c = 35.71 (A °) with a clear decrease in dimension c as in table (5).

The study of the electrical properties of the compound $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$ superior electrical conductivity. Has been studied the electrical properties of the compound $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$ different rates for (x) as the value of x = 0.1, 0.2, 0.3, as shown in Figure (9). The study showed the models prepared when the ratio of compensation x = 0.1 the critical temperature (138 K), as well as increased critical temperature of the compound when increasing the ratio of compensation to x = 0.2 became critical temperature equal to (142 K) and that this result can be interpreted that the compound taking the role of the perfect crystal structure and the proportion of the compensation led to increase the critical temperature, as shown in the table (6). While we noticed a decline in the critical temperature when it increased the proportion of compensation by = x = 0.3, it has a critical temperature of the compound decreased to 140 K. The reason for the lower critical temperature is due to the decrease in the length of the axis (c), which in turn leads to a reduction in the value of the critical temperature Tc any increase compensation for (x) the biggest in 0.2 is causing a change in the crystal structure of the compound, if this value is consistent with earlier research [16]. These results are interpreted on the basis of high and good regularity in the crystal structure of the compound. The superior electrical conductivity These results coincide with previous research [17,18]. When you shine a CO_2 laser on the prepared forms and at different rates to compensate for the value of X = 0.1 note the increase in critical temperature, where it was found when the ratio of compensation for x = 0 that the critical temperature is equal 140 K pound as well as increased when increasing the ratio of compensation for x = 0.2 became critical temperature equal to (144K) as shown in Figure (10). This result can be explained on the basis that the boat will continue in the case of regularity in the crystal structure and the crystal structure of the growing proportion of oxygen in the compound.
But when increasing the ratio of compensation to x = 0.3 lower critical temperature (143K)
This is due to the lack of regularity in the crystal structure, which in turn led to a decline in the value axis (c) and that this study coincide with previous studies [19].

Table (1): Weights $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$ composite powders when x = 0.1

Powder	Weight/gm	Symbols
Tl_2O_3	0.433	W1
Sr(NO3)$_2$	0.2116	W2
$CaCO_3$	0.2001	W3
CuO	0.2386	W4
HgO	0.02165	W5
Ba CO_3	0.197	W6

Table (2): Weights Tl2-xHgxBa2-y Sry Ca2Cu3O10 + δ composite powders when x = 0.2

Powder	Weight/gm	Symbols
Tl_2O_3	0.411	W1
$Sr(NO3)_2$	0.2116	W2
$CaCO_3$	0.2001	W3
CuO	0.2386	W4
HgO	0.0433	W5
Ba CO_3	0.197	W6

Table (3): Weights Tl2-xHgxBa2-y Sry Ca2Cu3O10 + δ composite powders when x = 0.3

Powder	Weight/gm	Symbols
Tl_2O_3	0.388	W1
$Sr(NO3)_2$	0.2116	W2
$CaCO_3$	0.2001	W3
CuO	0.2386	W4
HgO	0.0649	W5
Ba CO_3	0.197	W6

Table (4): Values axes a,b,c of the samples under temperature annealing 850 ºC for Compound $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$

x	a (A°)	b (A°)	c (A°)	Volume $(A°)^3$
0.1	5.432	5.432	35.16	1050.800
0.2	5.3899	5.3899	36.21	1112.402
0.3	5.532	5.532	35.98	1011.522

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Table (5): Values axes a, b, c of the reticule samples under temperature annealing (850)^{0}C for Compound $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$ after irradiation lazer co_2

x	a (A°)	b (A°)	c (A°)	Volume (A°)^3
0.1	5.411	5.411	36.211	1057.801
0.2	5.3929	5.3929	36.238	1121.407
0.3	5.562	5.562	35.71	1012.922

Table (6): the relationship between the ratio of compensation and the critical temperature and the percentage of oxygen

X	T_C	δ
0.1	138 K	10.26
0.2	142 K	10.30
0.3	140 K	10.40

Table (7): The relationship between the ratio of compensation and the critical temperature and the percentage of oxygen

X	T_C	δ
0.1	140K	10.35
0.2	144 K	10.45
0.3	143 K	10.52

Figure (1): The installation of a train using superconductivity technology

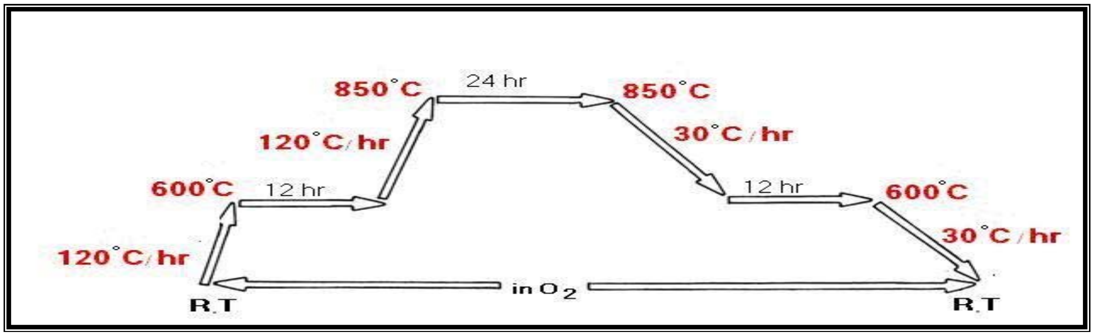

Figure (2): Annealing process of the compound in an atmosphere saturated with oxygen

The purpose of this exercise is to get as much regularity in the crystal structure of the compound for a quadruple installation based Tetragonal.

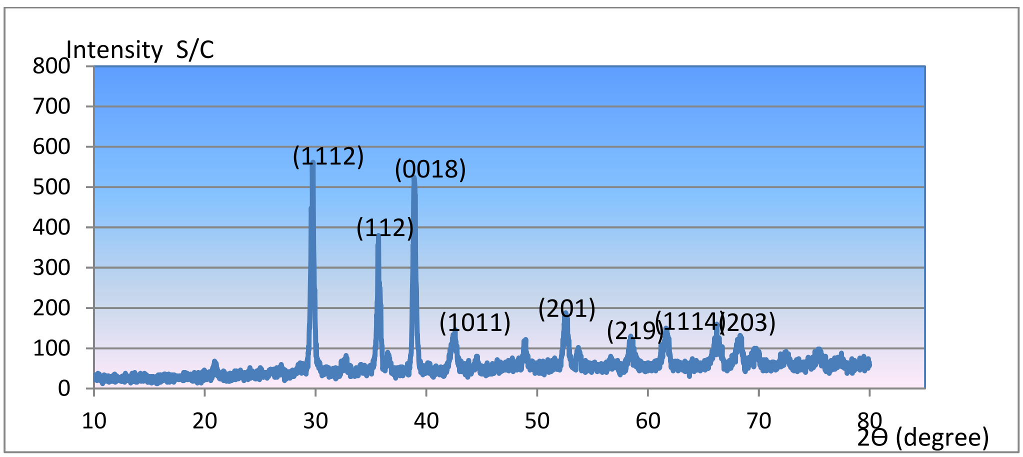

Figure (3): X-ray diffraction for compound $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$ when X= 0.1

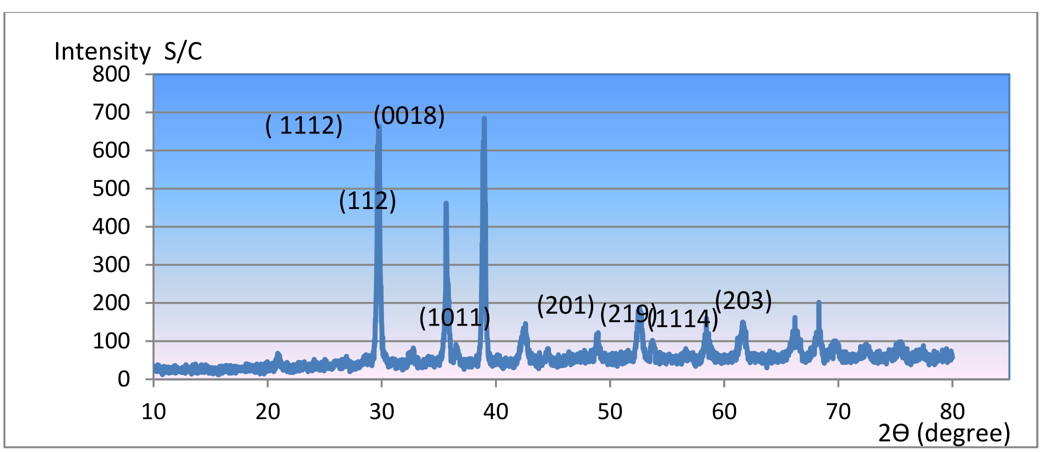

Figure (4): X-ray diffraction for compound $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$ when X= 0.2

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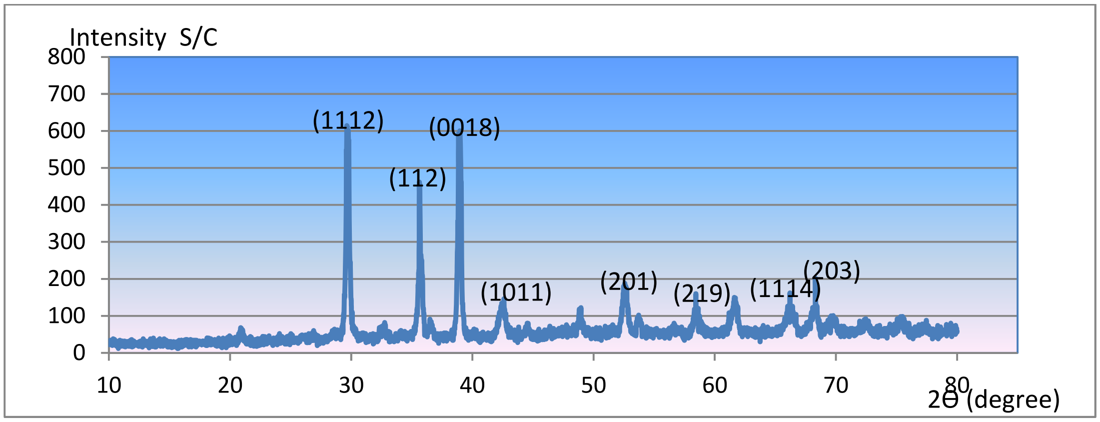

Figure (5): X-ray diffraction for compound $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$ when X= 0.3

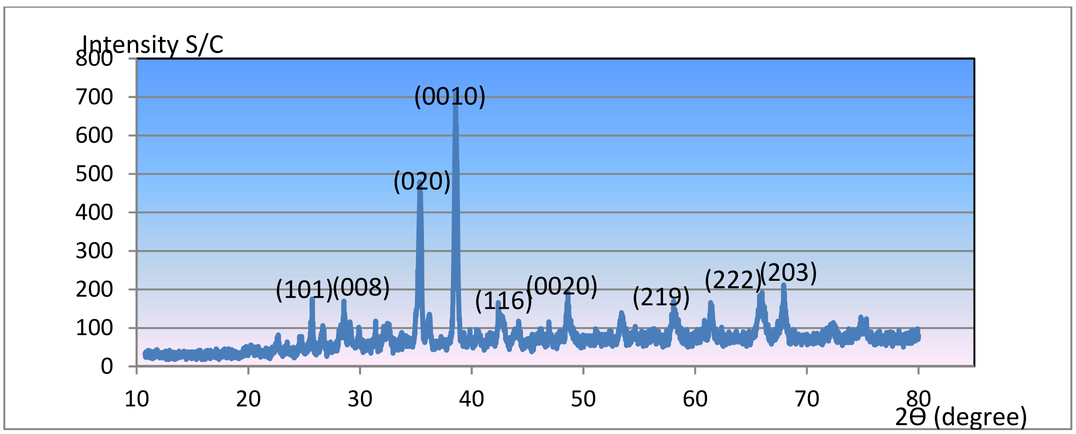

Figure (6): X-ray diffraction for compound Tl_2-xHg_xBa_{2-y} Sr_y Ca_2 Cu_3 $O_{10+\delta}$ after CO_2 laser irradiation when X = 0.1

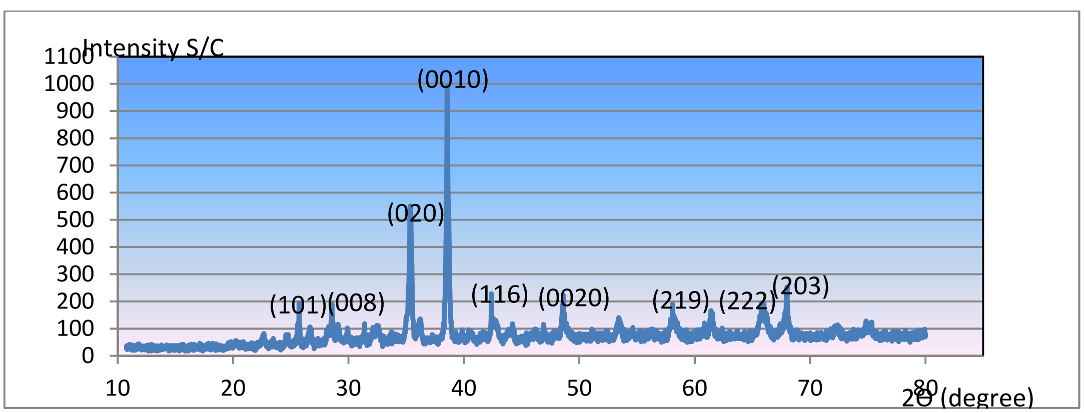

Figure (7): X-ray diffraction for compound Tl_2-xHg_xBa_{2-y} Sr_y Ca_2 Cu_3 $O_{10+\delta}$ after CO_2 laser irradiation when X = 0.2

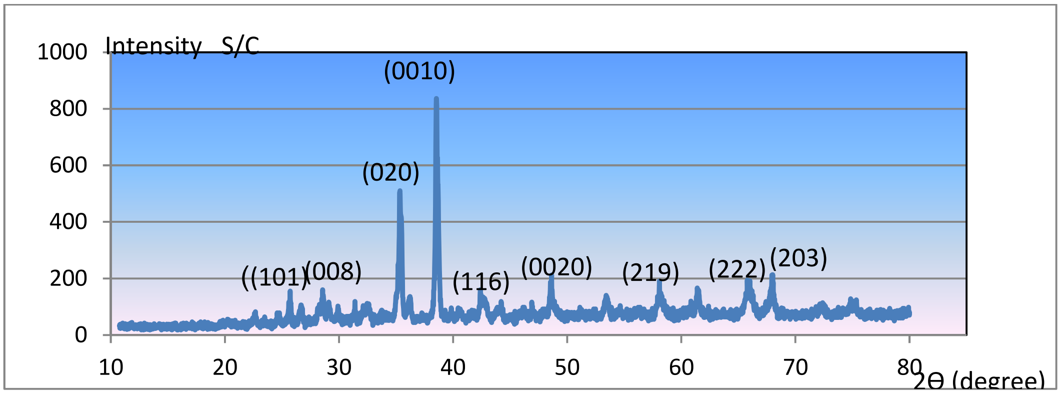

Figure (8): X-ray diffraction for compound $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$ after CO_2 laser irradiation when X = 0.3

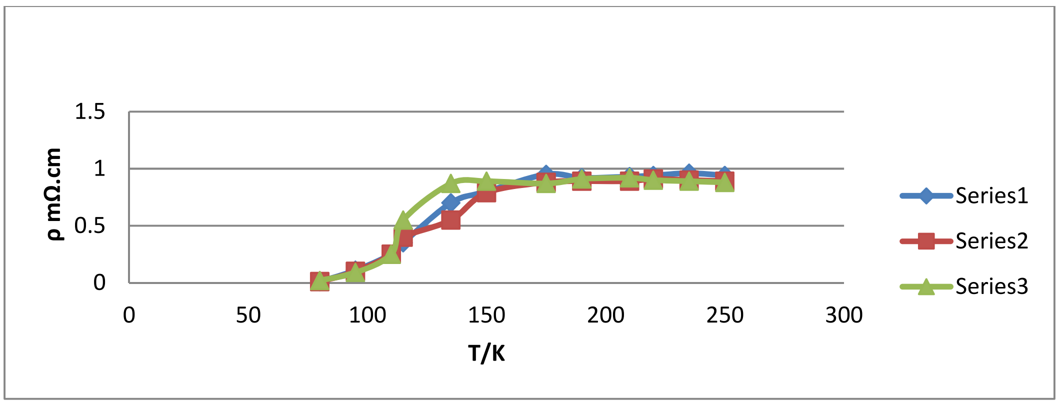

Figure (9): Relationship between the resistivity and the critical temperature of the compound $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3O_{10+\delta}$ when (x) equals x =0.1,0.2, 0.3

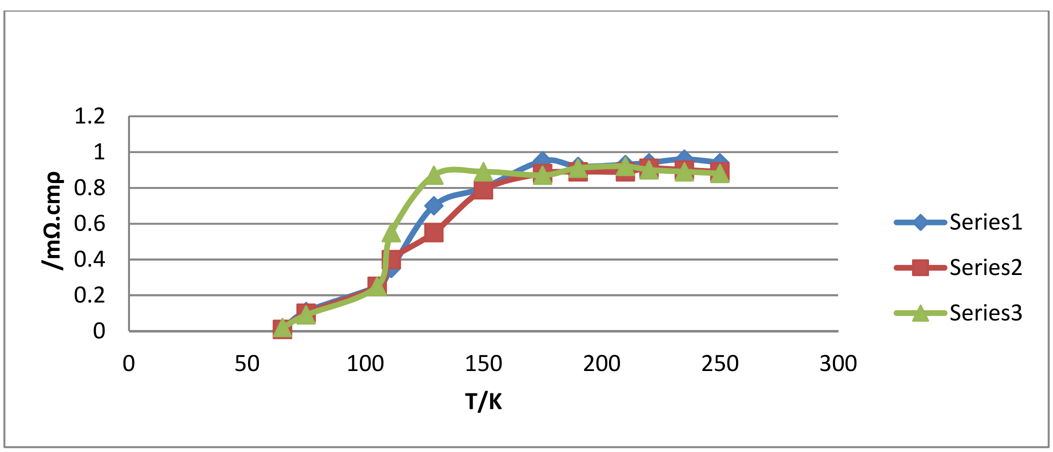

Figure (10): Rrelationship between the resistivity and the critical temperature of the compound $Tl_{2-x}Hg_xBa_{2-y}$ Sr_y Ca_2 Cu_3 $O_{10+\delta}$ when (x) equals x = 0.1, 0.2, 0.3 after irradiation lazer co2

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7. Conclusions

The X-Ray diffraction study of $Tl_{2-x}Hg_xBa_{2-y}Sr_yCa_2Cu_3\ O_{10+\delta}$ showed that the compound had a tetragonal structure and there was an increase in the C axis with an increase in the value of T_c, but the increase decreased with increased mercury inhibition. The samples were then tested by X-Ray after laser irradiation. We found the dimenations of the lattice where the crystalline structure became more uniform and thus obtained a more complete and coordinated crystalline system. This cryslalline arrangement provides secure pathways for cargo carriers. Cooper pairs in superconducting materials.

References

[1]. K.A. Gschneidner, Jr. L. Exring and M.B.Mapale, Hand book on The physics and chemistry of . Rare Earths, Elsevier scince B. V , 30,(2000).

[2]. Hat Field. and J.H. Miller, , Jr. “High Temperature Super Conductor Materials” Marcel Dekker, Inc., 37, (1988).

[3]. R . abd- shukor. ‘‘High-Temperature Superconductors: Materials, Mechanisms and Applications’’ Akdemi Sains Malaysia, (2009).

[4]. V. Z. Kresin& S. A. Wolf,"Fundamentals of superconductivity", ch – 1 , plenum press , New York ,(1990).

[5]. F. Steinmeyer , Siemens , EPO : 947 – 949 A2 , (1999).

[6]. Y. Nakmura , C. J. Hamans& J. E. Mooje : Science 299 ,.1869 ,(2003).

[7]. R. Kleiner& W. Buckel ,"Superconductivity fundamentals & applications", Wiley – Vch , (2004).

[8]. R. Awad, J. E gypt. Sol. ,. 24.. 1, (2001).

[9] .T. S. Keyed , Cryst . Ros. Technal. ,.38,. 11,.946.(2003).

[10] F.Ahmed., A.M.Samadder, H.R.Sultan and M.Abul Hossain and A.H.Khan, Miramare- Trleste , 091, (2005)

[11] Abed. A. M. , M. Sc. Thesis , University of Tikrit ,(2011).

[12] . Suzan malike , Y. Ghazala Hermiz and Mahdi H.Suhail.university of Baghdad . Dep of Physics. Iraq journal of physics no:328,(2012) .

[13]. S.E Jassim., M.Sc., Thesis University of musul, (1996).

[14] . Bian Coni A., Solid State Commune, 65, 1135, (1988).

[15]. M.N. Fathulua, Ph.D. Thesis University of Baghdad (1997)

[16]. R. Beyers, S. S .P. Parkin, V. Y. Lee and Hnawg T. C., 'Appl. Phys.Leet.' , 53, 432,(1988).

[17]. P. Purenr, J. Schaf, 'M. A. Gusmao and Kunzler Physican J.V.C.',.176,.357,(1991).

[18]. R. M. Hazen, 'Phys. Rev. Lett.',.60,.1657,(1988).

[19]. Chesca. B, Annalen der , phys, 8511 , (1990).

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