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Preparation of YBCO superconductor by using PLD technique

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Abstract
The $Yba_2CU_3O_7$ (YBCO) HTSC is prepared by using PLD technique. The YBCO film is grown on different substrates such as $SrTiO_3$ (STO), $LaAlO_3$ (LAO), and MgO with the help of PLD. The grazing incidence X-Ray Diffract meter is use in this process for avoid peaks from the substrates. The YBCO film grown on STO and MgO substrates gives the results high C oriented maximum peak intensity and random orientation. The YBCO film grown on LAO substrates give the high intensity (007) direction present between 20 to 60 degress 2θ range. The XRD patterns of the YBCO film grown on different substrate are recorded. The surface morphology of the YBCO film analysis by using SEM and surfaces of different substrates are give 1000 and 20000 times magnifications. These magnifications give the small size and counting by using the PLD technique.

Keywords: YBCO Superconductor, PLD technique, Substrates STO, LAO, MgO

1. Introduction
Some semiconducting oxides become superconducting at high temperature was discovered by Georg Bedorg and Karl Muller was discovered in 1986. The Oxygen deficiency parvoskite material LBCO provide promising stimulated with high superconducting transition temperature. The YBCO Superconductor was discovered Paul Chu and colleagues and the general formula are $YBa_2Cu_3O_7$. The YBCO crystalline compounds displaying the HTSC.

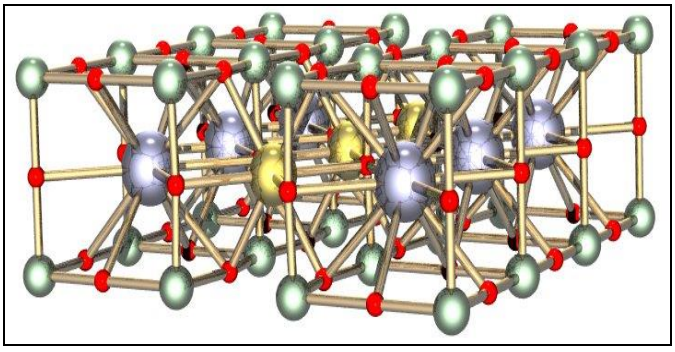


Fig 1: The YBCO structure

The three different metals in YBCO superconductor is in the ratio of 1 to 2 to 3 yttrium to barium to copper. This is known as 123 superconductors. The three pseudo cubic unit cells are in the YBCO unit cell. The each unit cell consists of Ba or Y atom at the centre. The tripping of the parvoskite unit cell leads to 9 oxygen atoms where as the YBCO contains 7 oxygen atoms known as oxygen deficient parvoskite structure. The Critical temperature is maximum ear 90K When x ~ 0.16 and the crystal structure are orthorhombic. The YBCO structure transform from orthorhombic to tetragonal when superconductivity is at x ~ 0.6.The SQUIDs magnetic flux change detection and bolometer for electromagnetic radiation detection. Therefore, it is possible to grow films on different substrates such as $SrTiO_3$ (STO), LAO and MgO by using PLD technique.

2. Experimental process
The PLD is an important technique for thin film grown on different substrates $SrTiO_3$ (STO), LAO and MgO. Cleaned the substrates with acetone and methanol for 15 minutes in an ultrasonic both to prevent organic contamination on substrate surfaces. The YBCO by cold pressure by cold pressing 9grams of YBCO powder and having the density of 6 g/cm^3 in to 1 in die set. The YBCO sintered at 200 ºC for 20h in atmosphere. Consider the target to substrate distance 5cm, 150 motor, O_2 partial pressure, 750 ºC temperature, 9Hz frequency. The substrate heat up to 750 ºC and the chamber pressure is increased up to 150m Torr 99.99% high purity O_2 gass with the mass flow controller. For crystal growth, the shutter growth is used for covering the substrate and the laser fired on the YBCO. After this process the shorter is open and 6000 laser pulses are use for the crystal growth. The temperature reached 400 ºC the oxygen gas given in to chamber and pressure increased to 300 Torr. The samples are annelid in situ at these conditions are at 60 minutes in this experimental procedure. The substrate temperature (Ts) is decreases to 200 ºC with 10 ºC per ramp rate and then naturally cooling. The chamber open and the samples are removed from the chamber after the temperature comes to 90 ºC.

3. Results and discussion
The XRD peaks belongs belong to c oriented (001) YBCO peaks and XRD patterns of YBCO superconductor grown on different substrates such as $SrTiO_3$ (STO), MgO and LAO at the same conditions shown in figure (2).Observe the Experimental results in the below figure (2), the YBCO film grown on STO substrate is maximum peak intensity with

(004).The YBCO film grown on MgO substrate, then the results give random orientation in this experimental process. The YBCO film is grown on LAO substrate give the high intensity in (007) direction with all (00l) direction between 25 to 50 digress (2θ) range. These results will be giving YBCO grown on LAO top crystalline.

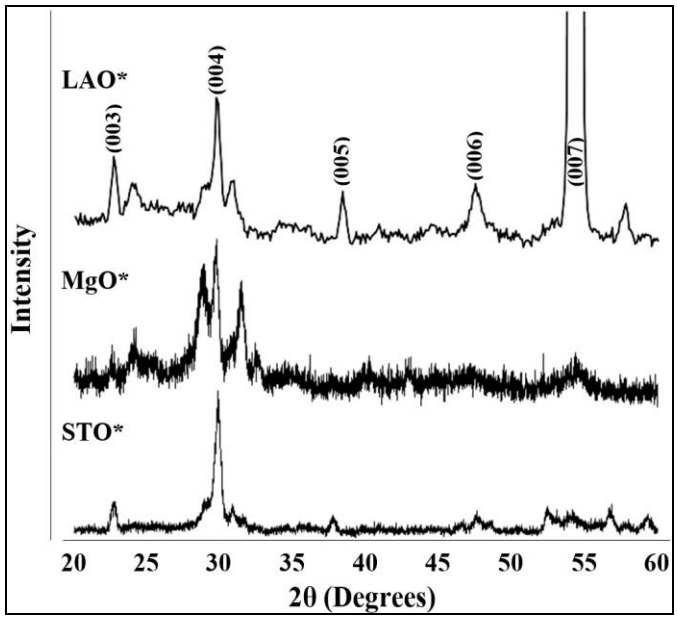
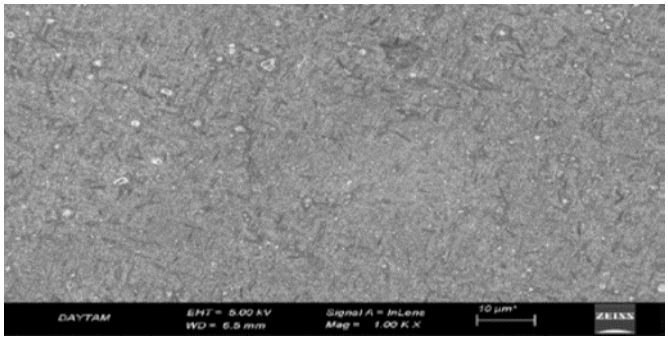
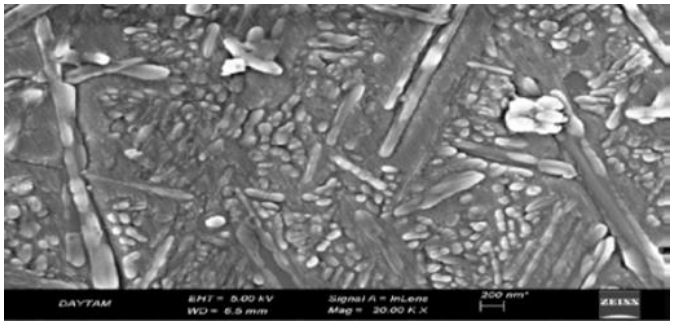


Fig 2: The XRD pattern of YBCO grown on STO, MgO and LAO substrates

The surface morphologies of YBCO are analysis with, surfaces of different substrates are given 1000, and 20000 times magnifications are shown in figures. For this purpose we can grow the YBCO film on different substrates such as $SrTiO_3$ (STO), MgO and LAO. The YBCO film surfaces with 1000 times, 20000 times magnification gives the smallest size and count by using PLD, and the experimental results are clearly explained. First we can grown YBCO film on $SrTiO_3$(STO) substrate, the results are observe in figure 3 (a), here SEM image of YBCO grown on STO substrate 1000 times magnifications is shown In the figure 3(a). The bigger droplets over $SrTiO_3$(STO) substrate compare to the LAO substrate with length of 3 to 4 μm rods. Observe the SEM image results of YBCO grown on $SrTiO_3$ (STO) 20000 times magnifications is shown in figure 3(b). Those rods STO substrates 100 to 250 thickness observed in figure 3(b).

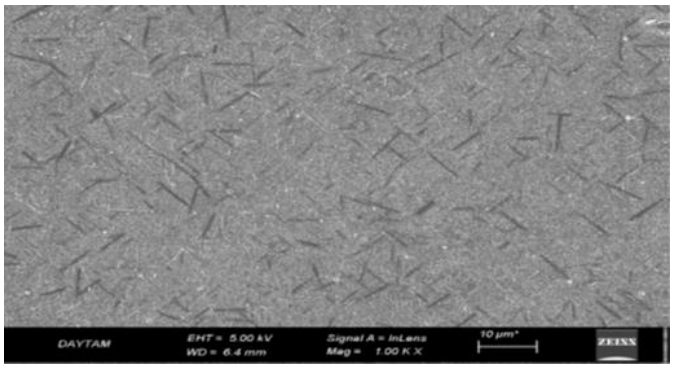


(a)

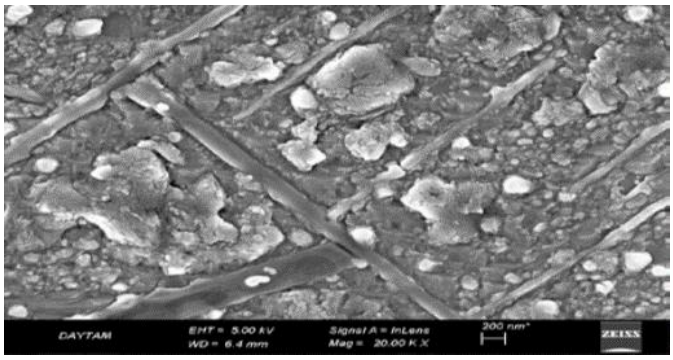


(b)

Fig 4: The SEM images of YBCO film on (a) MgO (1000) (b) MgO (20000) times magnifications.



(a)



(b)

Fig 5: The SEM images of YBCO film on substrate (e) LAO (1000) (f) LAO (20000).

The SEM images of YBCO film grown on MgO substrate (a) 1000 and (b) 20000 times magnifications are shown in the figure (4).Observe the experimental results in figure 4(a),the YBCO film grown on substrate MgO gives the results the rods are small and random in MgO substrate. The holes and more droplets over the surface are represented in the figure 4(b). The SEM images of YBCO film grown in LAO substrate (a) 1000 and (b) 20000 times magnifications are shown in figure (5).The YBCO film grown on LAO substrate give length of the rod in LAO substrate vary between 5 to 10 µm in figure 5(a) with 100 to 300 thicknesses in figure 5(b).

4. Conclusion

The YBCO film grown STO, MgO and LAO substrates at same conditions by the PLD technique and the samples are in

situ annealed. The XRD patterns of YBCO film grown on $SrTiO_3$(STO) and LAO have the c high orientations. These Orientations have very high intensity in LAO (007) and high intensity in STO (004) peaks. The XRD patterns of YBCO film grown on MgO do not have orientations. The comparison of SEM images of YBCO film represents the film grown on LAO substrate has the small droplets on the surface.

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