IRJSE International Research Journal of Science & Engineering
Int. Res. J. of Science & Engineering, 2017; Special Issue A1 : 179-182 SJIF Impact Factor 4.11
ISSN: 2322-0015 UGC Approved Journal No. 63628
RESEARCH ARTICLE **OPEN ACCESS**

Synthesis and Characterization of TI- 2223 Superconducting Film by Electrocrystalization Technique

Bobade DH[1*], Patil SA[2], Mane TR[3] and Nikam VR[4]

[1]Chandmal Tarachand Bora College, Shirur (M.S.), [2]Madansinh Mohite-Patil Science College Mangalwedha (M.S.), [3]Sangola College, Sangola (M.S.), [4]S.P.H.Arts, Commerce and Science College, Nampur (M.S.)
*Corresponding author: Bobade DH, Email id: bobadedh@gmail.com | 9975397077

Manuscript Details
Available online on http://www.irjse.in
ISSN: 2322-0015

Editor: Dr. Arvind Chavhan

Cite this article as:
Bobade DH, Patil SA, Mane TR and Nikam VR. Synthesis and Characterization of TI- 2223 Superconducting Film by Electrocrystalization Technique, *Int. Res. Journal of Science & Engineering,* December 2017; Special Issue A1: 179-182.

ABSTRACT

One of the most important requirements in the field of Superconductivity is to develop the ceramic superconductors for the application in storage; transmission distribution of electrical energy. The electro-deposition technique is noval technique for the deposition of relevant metallic cations from the deposition solution. To overcome high temperature requirement electro-deposition technique is used at room temperature. The HTSc films are oxygen sensitive. The alloyed films were characterized by XRD and Scanning Electron Microscopy (SEM).X-ray was used as a main tool for identification of phases. XRD is done by microcomputer-controlled Phillips PW-3710 diffractometer with CuKα radiations The oxidized films were tested for electrical property by using Four Probe method. The SEM micrograph of TI-Ba-Ca-Cu alloyed films electrochemicaly oxidized for 28 min. These films were found to be uniform very dence and pore free. The magnification above 10000× was found to form blured image may be due to crystallite size.By using Cyclic Voltametry we investigate reactivity of chemical species is recorded. The EDAX pattern of TI-2223 film deposited on silver substrate were studied. The pattern shows the Ti-Ba-Ca-Cu alloy deposited is in 2:2:2:3 ratios.

Key words: electrodeposition, phases, Phillips PW-3710, Voltametry

INTRODUCTION

In 1911 the Dutch scientist Heike Kammerlingh Onns at University of Leiden has observed the remarkable disappearance of all electric resistance in the mercury. He gave the name to the phenomenon of vanishing electric resistance at low temperature as superconductivity [1]. The temperature at which the resistance disappears is known as critical temperature Tc. Right since Onnes discovery different phenomenological and therotical concepts were developed to understand the mechanism behind the superconductivity and various attempts were made to rise superconducting transition temperature. However, the highest Tc remain at 23.2K for thin film of Nb3Gediscovered in 1973 [2]. All the superconductors with a Tc above the liquid Nitrogen boiling point of 77K are cuprates.The Tc has risen rapidly to the current record of 133K in Hg-1223 systems at ambient pressure.

To synthesize Ag/ Ti-2223 hetrostructures by electro-crystallisation technique. To optimize the preparative parameters to obtain the stoichiometric Ti-Ba-Ca-Cu alloy by electro-crystallization method. To vary the thickness of film by varying the no. of cycles. To study the low temperature resistivity measurements.

METHODOLOGY

The electro-deposition technique is noval technique for the deposition of relevant metallic cations from deposition solution. All the techniques requires high temperature but the electrodeposition techniqueis carried out at room temperature. This method is easy and inexpensive [3]. It has fast deposition rate.It is isothermal process mainly controlled by electrical parameters such as deposition potential and current density which are easily adjusted. To monitor the film thickness morphology this method operates at low temperature. The electro-deposition system contains electrochemical cell and energizing unit. The electrochemical cell contains electrolytic bath, substrate, working electrods, counter electrode. Electrolyte is an ionically conductive solution used as a medium in electrochemical measurement and conductive of an electrolytic bath. Water works as a best solvent. Substrate should be stable in the electrolytic bath. Surface of substrate should be smooth. The substrate has good mechanical strength. Counter electrode serves as a source or sink for electron to enable current to measurement [4]. The negative terminal of D.C. sources is connected to cathode and positive terminal is connected to anode. When both the electrodes are immersed in the plating bath and potential is applied between two electrodes then the metal ions flow towards the anode. Electrons flow from anode to battery and leave positively charged metal ion which gets dissolved in the deposition bath [5]. The electrons arriving at negative electrode from the battery neutralize positive charge and convert them to metal atoms. These atoms are adhesive to cathode and removed from solution. Thus, electrical energy supplied by battery to cause chemical change in the deposition bath. The net result is that a metal is deposited on cathode from solution of metal ion.

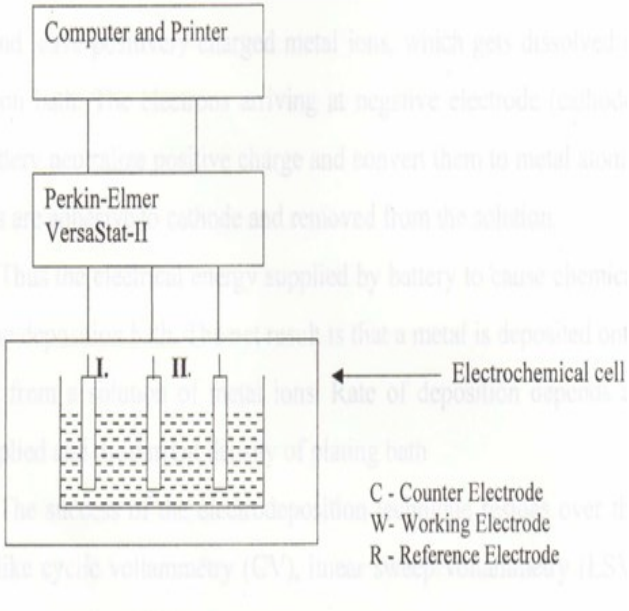

Fig.1 Electro-deposition set up

RESULT AND CONCLUSION

There are variety of superconducting phases of Ti-Ba-Ca-Co system like 2201,2212,2223,2234, 1212, 1223,1234 with there different Tc values ranging from 90K to 125K.[6] The highest Tc of 125K is observed in

Ti-2223 phase with tetragonal structure having its lattice constant a=3.85 $A^0$and c=35.71A^0. The synthesis of this high Tc phase material in the form of thin film has been studied [7]. The cyclic voltamogram for these different substrates are shown from fig.2a-d. The film deposited by electrochemical technique has been characterized by XRD.The typical XRD pattern of TI-2223 deposited on Ag are shown in fig.3 [8,9].

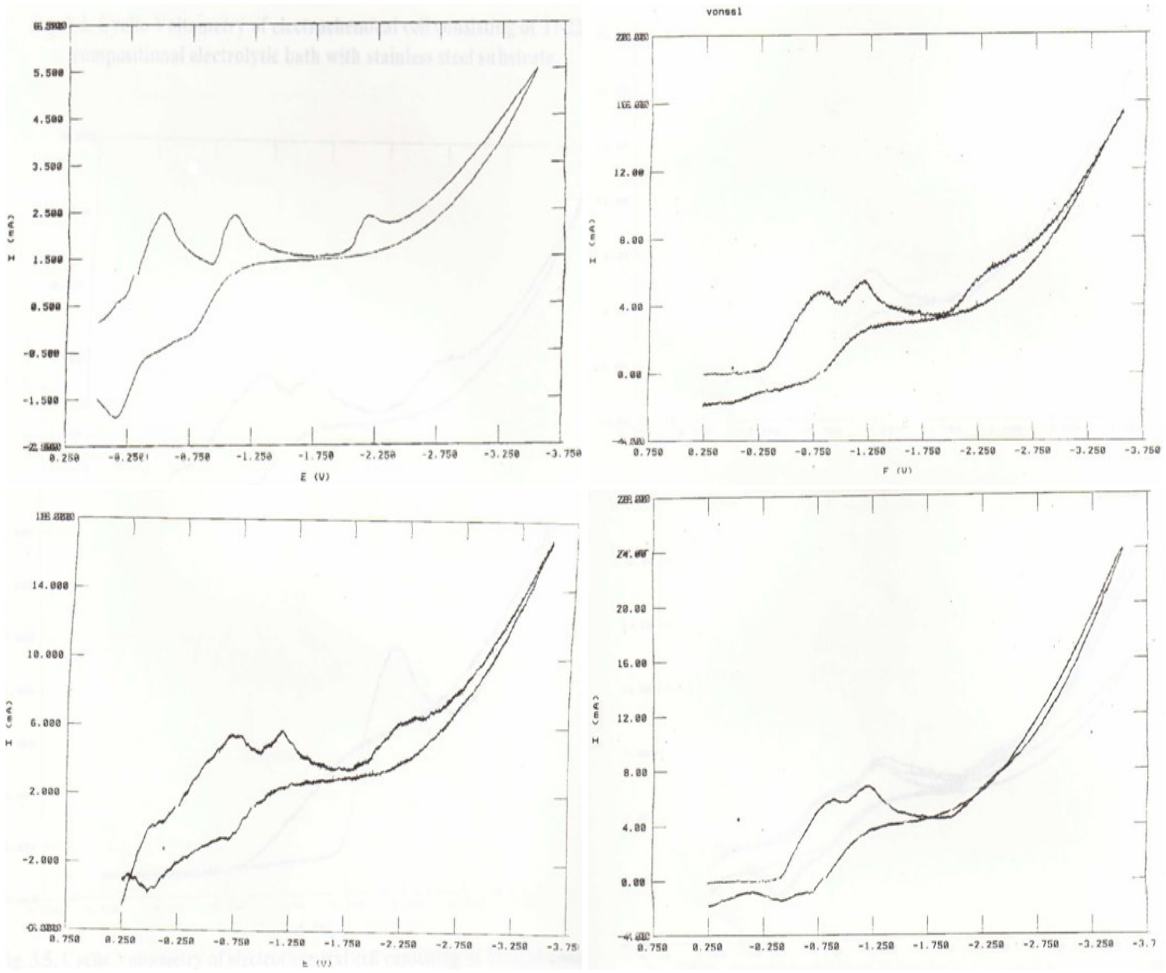

Fig. 2 Cyclic Voltmetry of electrochemical cell consist of TL-2223 compositional electrolytic bath with different substrates **(a)** Silver **(b)** Stainless steel **(c)** Copper **(d)** aluminium

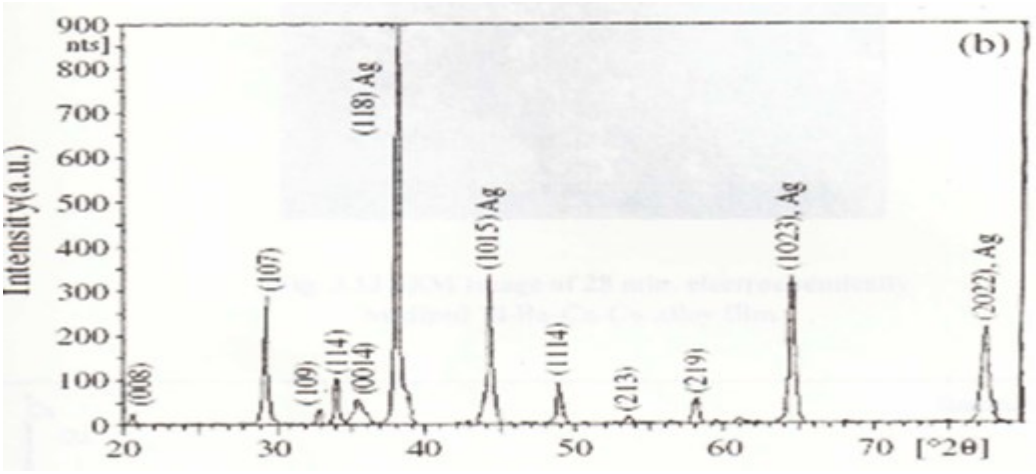

Fig. 3. XRD of the Electochemically oxidized Tl-Ba-Ca-Cu alloyed Films

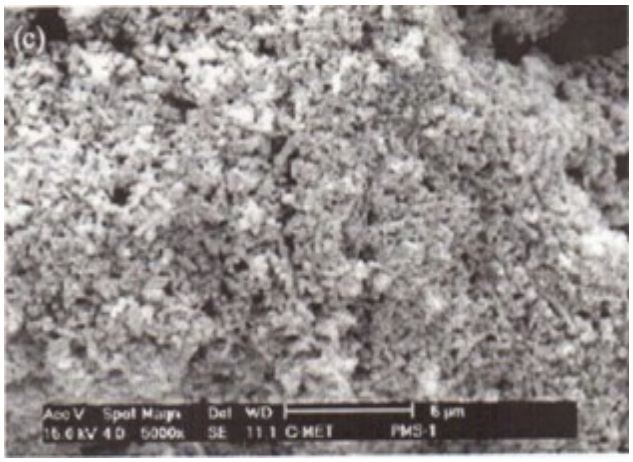

Fig. 4 SEM Image of 28 min. electochemically oxidized Tl-Ba-Ca-Cu alloyed Films

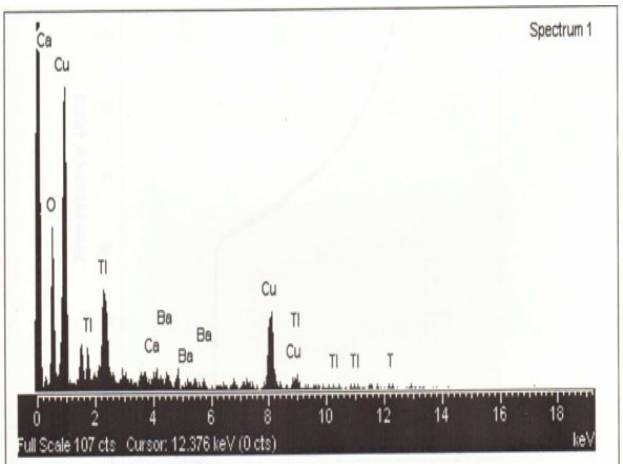

Fig. 5: EDAX for TI 2223

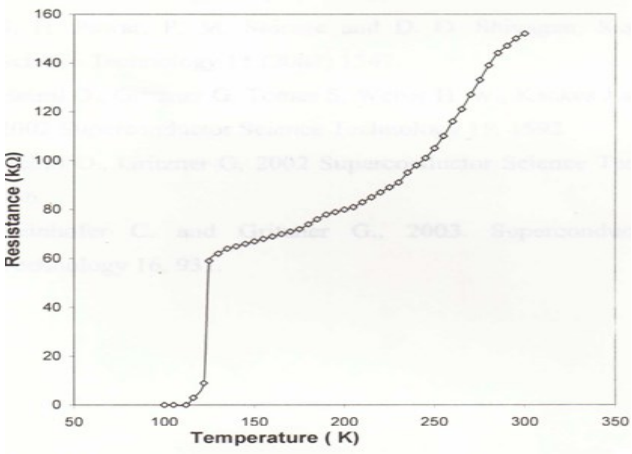

Fig. 6: Low temperature Resistivity measurments

The XRD pattern of Ag/TI-2223 shows the presence of polycrystalline singal phase TI-2223. The planes (008) (107)(109)(114)(0014)(213)(219) observed in XRD pattern confirms the formation of TI-2223 plase sample [10]. The SEM micrographs of the TI-Ba-Ca-Cu alloyed film electrochemically oxidized for 28 min. is shown in fig.4 [11]. These films were found to be uniform very dense and pore free. The EDAX pattern of TI-2223 film deposited on Ag substrate and electrochemically oxidized to the optimized time period of 28 min. The pattern shows the TI-Ba-Ca-Cu alloy deposited is in 2:2:2:3 ratio. shown above fig.5. For measurement of Tc standard Four-probe method is used. By using silver plate the best contact were made. The zero resistivity state is obtained at 112K shown in fig.6 [12, 13].

REFERENCES:

1. Onnes HK, leiden comm. 1911:124
2. Gavler JR,Applied Physics,Lett.. 1973;23:480
3. Belnorz JG,et al. Physics B64 1986:189
4. Bardeen J, et al, Phys. Rev. 1957:106.
5. Ekal LA, et al, Thin solid films, 2001;397:249.
6. Pawar SH, et al, Phill, Mag, Litt ,17(5).
7. Shirage PM, et al, Superconductor Science and Technology. 2004.
8. Shivagan DD, et al. Physica C. 2003;378:53.
9. Jadhav AB, et al ,Superconductor Sci Technol 2003;16:752.
10. Mamm CK, Electronal, chem 1969;3:57.
11. Pawar SH, et al, Modern Physics, Letter, B, 2004;18:505
12. Ekal LA et al, Bull, Matter SCI. 1999;22:775.
13. Shirage PM, et al, Superconductor Sci, Technology 2004;17:853.