PRECURSOR FILMS DEPOSITED ON SINGLE AND POLYCRYSTILLINE SUBSTRATES FOR THE SYNTHESIS OF $TlBa_2Ca_2Cu_3O_y$ PHASE. Ana-B Soto(1), Roberto-T. Hernández(2), Leticia Pérez(3), Alejandro Morales(1), Milan Jergel(1), Ciro Falcony(1). (1)Departamento de Física del CINVESTAV-IPN, Apdo. Postal 14-740, C.P. 07000, México D.F.; (2)Departamento de Materiales, UAM-Azcapotzalco, C.P. 02200 México D.F.; (3)CICATA-IPN, Miguel Hidalgo 11500, México, D.F. E-mail: cfalcony@fis.cinvestav.mx

Among the superconducting materials suitable for power applications such as magnetic energy storage systems and electrical power transmission lines the $TlBa_2Ca_2Cu_3O_y$ phase is one of the best candidates because its critical temperature higher than 77 K and its irreversibility curve characteristics that indicate good magnetic flow pinning (1). Ceramic material however are in general mechanically fragile and therefore their synthesis require special care(2). In particular many techniques have been develop to obtain films deposited on both single and polycrystalline substrates such as metals and alloys. In this case the idea is to use the mechanical properties of the substrates to improved the overall response of the ceramic superconductor. Among the deposition techniques, ultrasonic spray pyrolysis (USP) is a relative simple low cost the deposition techniques that is suitable for large scale industrial applications. In this case the synthesis of the $TlBa_2Ca_2Cu_3O_y$ is performed in two steps; first a precursor film is deposited by the USP technique and in a second step thalium is thermally diffused into the film a temperatures in the range of 850 y 900ºC(3). The quality and properties of the synthesised material depend on the morphological and chemical composition characteristics of the precursor film, which in turn depend on the type of substrate and pyrolysis reaction processes that the reactive materials suffer during the USP deposition process. In this work the results for precursor films deposited by the USP technique on sapphire, MgO, and Ag after its subsequent thalium diffusion process are presented and compared among themselves. The profilemetry studies on surface roughness on this type of surface indicates low roughness characteristics in all cases. The precursors film were deposited under similar conditions using acetylacetonates of Ba, Ca and Cu in an N,N-dimetylformamide solution(4). The chemical composition obtained by energy dispersion spectroscopy (EDS) was in average 28.6% at. Ba, 28.6% Ca, 42.8% at. Cu ($Ba_2Ca_2Cu_3Ox$). The scanning electron macroscopy images shown in Fig. 1a, 1b and 1c show very homogeneus and dense distribution of two phases; a dark phase rich in cooper oxide and a lighter rounded phase rich in Ca and Ba oxides. The films deposited on silver show in general higher roughness and they are thinner in general. The diffusion of thallium is performed in a semi-closed two zones furnace using in continuous flow of oxiden. The thallium sources (0.1gr pellet) was placed in the first zone at 750ºC to produce Tl_2O vapour phase which was carried to the second zone, about 25 cm downstream where the precursor film was heated at 850ºC. EDS and x-ray studies indicate the presence of the $TlBa_2Ca_2Cu_3O_y$ phase on the films deposited on silver. For the case of films deposited on sapphire and MgO a mixture of the $Tl_2Ba_2Ca_2Cu_3O_y$ phase is also observed. Figure 2 show a micrograph of the superconductor film surface in which plate like formations of several microns in diameter are observed. X-ray diffraction measurements show that the films have the c-axis oriented perpendicular to the substrate surface (Figure 3). In the case of sapphire and MgO substrates, the presence of the $Tl_2Ba_2Ca_2Cu_3O_y$ its probably associated with the requirement or higher diffusion temperatures in this cases(5).

References

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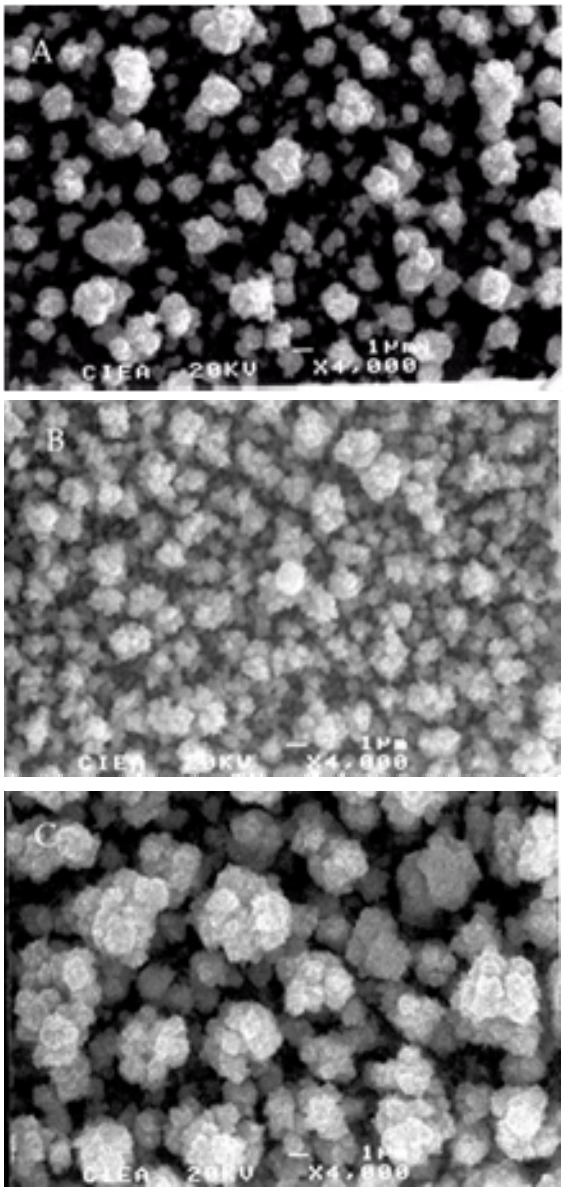

Figure 1. Micrographies at 3000X of the precursors films deposited on the substrates; A) Sapphire, B) MgO and C) Ag

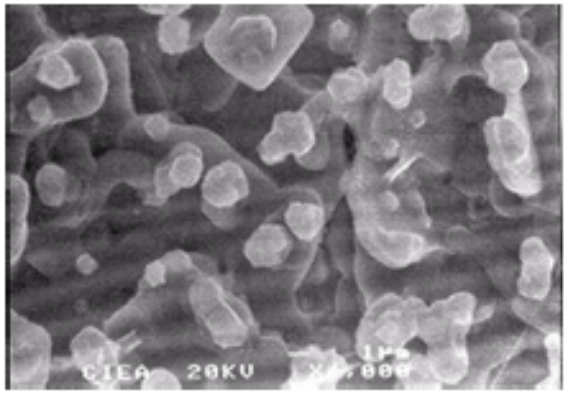

Figure 2. Superconductor phase micrographie to 3000X.

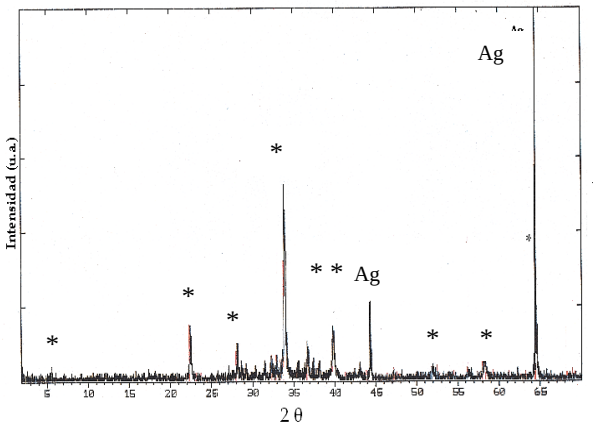

Figure 3. $TlBa_2Ca_2Cu_3O_y$ DRX pattern; the (*) correspond to parallel planes to (002).