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Effects of Calcinations Time on J_c of $YBa_2Cu_3O_{7-\delta}$ HTSC with nano-CaO Addition

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ABSTRACT

The effects of calcination time on critical current density, J_c of $YBa_2Cu_3O_{7-\delta}$ superconductor system prepared via co-precipitation method were investigated. In this work, the calcination time was varied for 12 hours and 24 hours. This work also studies on different amount addition of nano-CaO with $(YBa_2Cu_3O_{7-\delta})_x$ (x= 0.2wt%-1.0wt%). The results shows that $(YBa_2Cu_3O_{7-\delta})_x$ (x= 0.5wt%) at 24 hours calcination time exhibit the best performance of J_c (~5.5864 A/cm^2). The results indicate that an introduction of appropriate amount of nano-CaO at optimum time of calcination can effectively improve the flux pinning by performing the best value of J_c .

Keywords: *Calcination, co-precipitation method, critical, current density, J_c, flux pinning, $YBa_2Cu_3O_{7-\delta}$, Nano-CaO*

Introduction

Calcination is a pre-heated treatment processing technique used in the production of density-controlled material from ceramic powder under thermal energy. Based on previous studies calcinations treatment involved microstructure grain size, shape, size and agglomeration. Previous studies have examined the effects of calcinations process and temperature treatment. In this report we present a study of the effect of different pre-heated or calcinations time of $YBa_2Cu_3O_{7-\delta}$.

Experimental Method

The precursor powder were prepared via co-precipitation method by mixing $Y(OOCCH_3)_3$, $Ba(OOCCH_3)_2$, $Cu(OOCCH_3)_2$ and dissolve it in acetic acid (Solution A). Meanwhile, a mixture of distilled water and isopropanol was dissolved in the oxalic acid (Solution B). Then Solution B is slowly poured into Solution A. The precipitation solution then undergoes filtration and left over night for drying process. After thorough precipitation, the mixture was preheated or calcinated for 12 hours and 24 hours at 900 °C. Calcined powder $(YBa_2Cu_3O_{7-\delta})$ $(nano\text{-}CaO)_x$ with x = 0.2 wt%,0.5 wt%, 0.7wt%, 1.0wt% were grinded and then added to $YBa_2Cu_3O_{7-\delta}$ precipitate and nano-CaO powder with diameter 50nm according to the appropriate ratio. The preheated powder with appropriate amount of addition were made into pellet then sintered at 920 °C for 24 hours. Finally it was cooled down to room temperature.

We measure the weight percentage (wt. %) dependence of critical temperature T_c of samples. The measurement of J_c was obtained at 77 K. The phase formation and morphology microstructure of samples was examined by X-ray diffraction (XRD), scanning electron microscopy (SEM) and EDX.

Results and Discussion

Figure 1, the T_c dependencies on various wt% addition of nano-CaO are shown for both different pre-heated treatment. For both cases, 12 hours and 24 hours calcinations treatment we can observe

that the T_c decreasing as the amount of nano-CaO is increased.

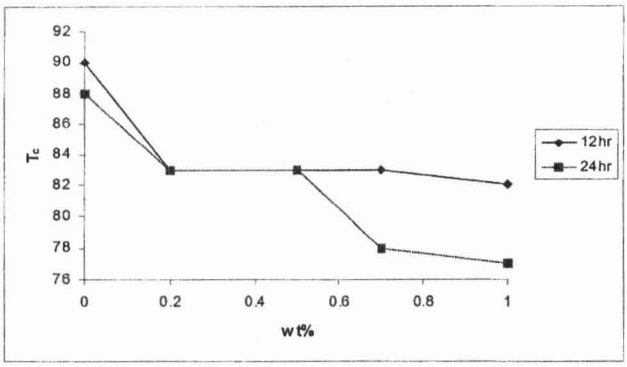
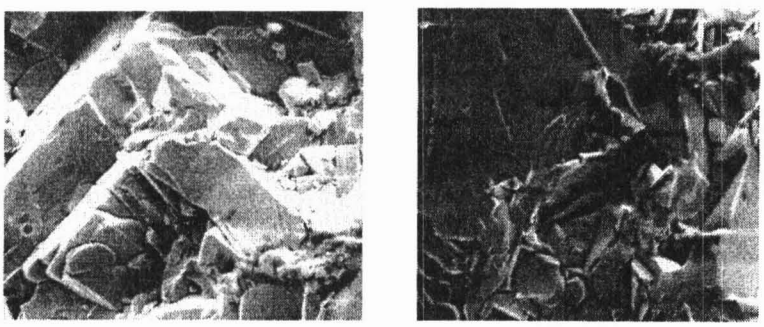


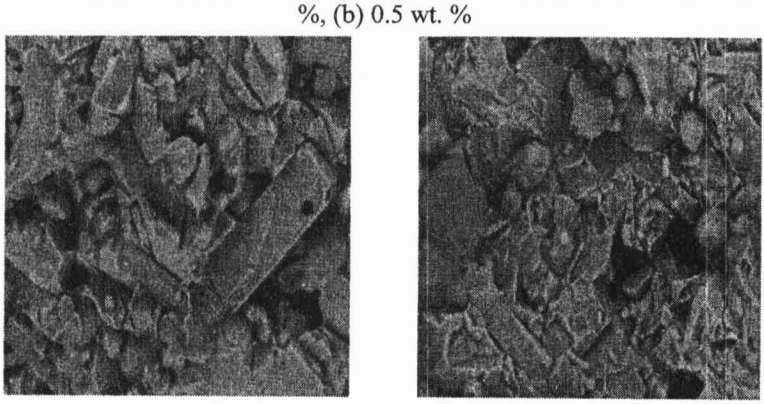
Figure 1: Graph of T_c Dependencies on Various wt. % Addition of nano-CaO

In Figure 2(a) and 3(a), it was found by SEM that, the co-precipitation method produce homogeneous product of $YBa_2Cu_3O_{7-\delta}$. Figure 2(b) and 3(b) shows that the nano-CaO addition disperses homogeneously in the superconductor matrix. In Figure 2(b), we can observe many pores appear in the SEM. This contributes to the lower performances of J_c for the appropriate amount of nano-CaO. In Figure 4, EDX images also shows that nano-CaO inlay in the matrix of YBCO superconductor. It is believed that optimum calcinations time with addition nano particle in YBCO superconductor acts as a flux pinning in the sample.



(a) (b)

Figure 2. SEM micrographs for the sample calcinations at 12 hours containing nano-CaO; (a) 0wt. %, (b) 0.5 wt. %



(a) (b)

Figure 3. SEM Micrographs for the Sample Calcinations at 24 hours Containing nano-CaO; (a) 0wt. %, (b) 0.5 wt. %

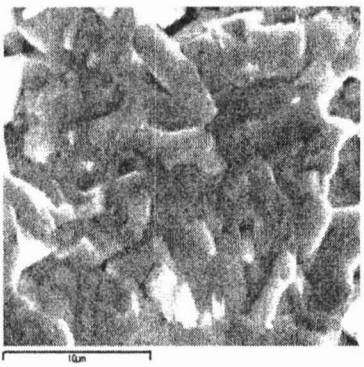


Figure 4: Nano-CaO Distribution under EDX

We analysed the J_c performance for both cases of bulk sample of ($YBa_2Cu_3O_{7-\delta}$) (nano-CaO)$_x$ (x = 0.2 wt. %,0.5 wt. %, 0.7wt. %, 1.0wt. %) at 77 K, as shown in Figure 5. This graph shows that calcinations at 24 hours with 0.5 wt. % addition give the best performance of J_c equal to 6.1728 A/cm^2. According to this fact we can infer that optimum time of calcination helps in the growth of microstructure and addition nano-CaO at appropriate amount will enhance the performance of J_c.

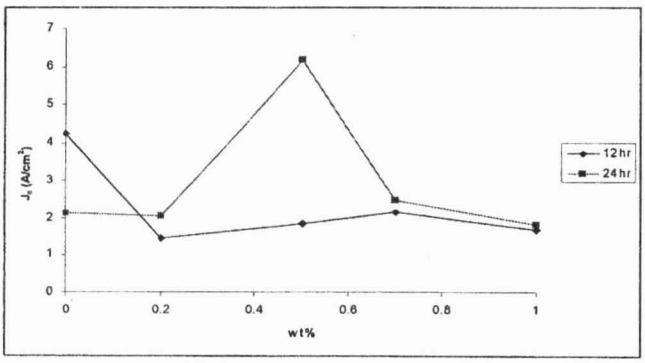


Figure 5: Graph of J_c (A/cm^2) Dependencies on the Various wt. % Addition of Nano-CaO

Conclusion

Addition (nano-CaO)$_x$ with x = 0.5 wt%) and 24 hours calcination time performs the highest value of J_c observed at 77 K. Increasing the amount nano-CaO results in lowering the J_c. It is believed calcinations at 24 hours with nano-CaO in appropriate addition amount play a dominant role in enhancing the J_c in the material. The EDX images illustrate the morphology of the fine YBCO product and homogeneous
disperse of nano-CaO in the sample.

Acknowledgement

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References

Abd-Shukor, R. (2002)..*Solid State Science and Technology* 10, 14-21.

Abd-Shukor, R. and Hamid, N.A. (2000). *Journal of materials science* 35, 2325-2329.

Abrikosov, A.A. and Gor'kov, L.P. (1961). *Soviet Physics, JETP* 12, 1243-1253.

Chen, Q., Fang, M., Jiao, Z., Zhang, Q., Wen, H., and Zhao, Z. (1997).. *Physica C* 277, 113-118.

Chen, S.K., Lau, K. T. and Abd-Shukor, R. (2002).. *Solid Science and Technology* 10, 22-29.

Haruta, M., Fujiyoshi, T., Sueyoshi, T., Miyahara, K., Ikegami, T., Ebihara, K.,Miyagawa, R.,Ishikawa, N., Awaji, S. and Watanabe. K. (2004).. *Phsyica C* 421-414, 511-514.

Joo, J., Kim, J-G. and Nah, W. (1998). *Superconductor Science Technology* 11, 645-649.

Matsushita, T., Suzuki, A., Kishida, T., Okuda, M. and Naito, H.(1994). *Superconduct. Sci. Technol.* 7, 222-226.

Mellekh, A., M.Zouaoui, F. Ben Azzouz, M. Annabi (2007) *Physica C* 460-462

10. Muhammad-Salleh, F., Yahya, A.K., Hamadneh, I. and Abd-Shukor, R. (2002)..*Solid State Science and Technology* 10, 30-36.

Sheahen, T.P. (1994).. *Introduction to High Superconductor* 243-259.

Shao, B., Liu, A., Zhou, Y., Zhang, J. and Wang , J. (1989).. *Materials Research Bulletin* 24, 1369-1373.

Sobha, A., Aloysius, R.P., Guruswamy, P., Warrier, K.G.K.and Syamaprasad, U. (1998).*Physica C* 307, 277-283.

Su X.D, Z.Q. Yang, Y.Z. Wong, H.Tang, C. Zheng, C. Hua and G.W Qiao (1997) *Physica C* 282-287

Tarascon, J.M., Le Page, Y., Barboux, P., Bagley, B.G., Greene L.H., McKinnon, W.R., Hull G. W., Giroud, M. and Hwang D. M. (1988). *Phys. Rev. B* 37, 78-82.

Zhao, B., Wan, X., Song, W., Sun, W. and Du, J. (2000). *Physica C* 227, 138-144

Zheng, X.G., Matsui, H., Tanaka, S., Suzuki, M. and Xu, C. (1997).. *Physica C* 282-287, 2581-2582.

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