UNIVERSITI TEKNOLOGI MARA

EFFECTS OF MAGNETIC NANOPARTICLES DYSPROSIUM OXIDE (Dy_2O_3) ADDITION ON ELECTRICAL PROPERTIES OF (Bi,Pb)-2223 HIGH T_C SUPERCONDUCTORS

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Candidate's Declaration

I declared that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledge as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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ABSTRACT

In this study, co-precipitation technique has been performed in preparation of $Bi_{1.6}Pb_{0.4}Sr_2Ca_2Cu_3O_{10}$ ceramic superconductor. In order to change the electrical properties of the superconductor powder, magnetic nanoparticles Dy_2O_3 were added with nominal composition ranging from x=0 to x=0.10 wt% at different sintering time. The ultrafine superconductor powder produced by co-precipitation method has increased the diffusion reaction and shortened the heat treatment procedure for the sample preparation. These lead to better superconducting properties as compared to the samples prepared by conventional solid state technique where its diffusion reaction requires a high temperature and long sintering hour, it is laborious, time intensive and contaminated products may be occurred. Co-precipitation method has proved it high T_c at 102 K when sintered for 24 hours. Absolutely, this time taken probably unachieved at same sintering time to solid state technique probably its taken more longer time to have the same T_c. From this study the resistivity measurement has been done for all samples, and showed that $T_{c(R=0)}$ from 100-109 K and $T_{c\text{-onset}}$ 108-117 K. The T_c achieved showed the high T_c when it is more than 100 K. From XRD analysis, samples showed that the grain and formation of phase is more dominated by Bi-2223 phase rather than Bi-2212 when varied of wt% addition magnetic nanoparticles Dy_2O_3 to all samples. Results from XRD shows the peak of Dy_2O_3 was not detected. It implied that the magnetic nanoparticles of Dy_2O_3 was incorporated in the crystalline structure, However in EDX shows the distribution of magnetic nanoparticles Dy_2O_3 so it showed the existed of Dy_2O_3 in samples. From SEM analysis, showed also the large flaky of (Bi,Pb)-2223 structure was randomly distributed. The effect of magnetic nanoparticles Dy_2O_3 addition on superconducting materials will alter the electron pairing mechanism and affected the flux pinning strength. With prolonged the sintering time, it shows an improvement in superconducting electrical properties. The optimum sintering time is 48 hours, where the highest J_c was obtained at 18.82 ± 0.86 A/cm^2 at 30 K.

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CHAPTER 1

INTRODUCTION

1.1 What is Superconductors?

Superconductor is a material with having an experience of a fantastic phenomenon, it also exhibits no resistance to electrical current and no energy loss when carrying a direct current. In superconductor perfect diamagnet is other important properties besides having a zero resistance. Properties of superconductor on critical transition temperature, T_c all the resistance in superconductor drops abruptly to zero when the material is cooled below the T_c, superconductor will undergo a transition from normal conductivity to superconductivity at a certain temperature until the material completely experienced the superconducting state.

Superconductor has different characteristics in comparison to a conductor. In fact, the best of the normal conductors, such as copper and gold it shows a non-zero resistance and superconducting phenomenon was not occurred to these materials. Furthermore, it will not become superconductor at any of temperature and this vice versa when the ceramics superconductors such as BSCCO and YBCO are actually good insulators when ceramics are not low enough temperatures to be in superconducting state.

Superconductor can be classified into two cooled condition that are low temperature superconductor or commonly known as conventional superconductor and another is high temperature superconductor. The conventional superconductor is a part describes the present-day on which high temperature superconductor is striving to compete. Soon after much research has been done and getting new finding, superconductor achieved the high T_c on it temperature that is the high temperature superconductor.