

Comparison-Comparing of the effects of Nb, Pb, Y, and La replacement on the structural, electrical and magnetic characteristics of Bi-based superconductors

<https://www.osti.gov/biblio/22773593-comparing-effects-nb-pb-la-replacement-structural-electrical-magnetic-characteristics-bi-based-superconductors>

Abstract

In this study, the effects of Pb, Nb, La, and Y replacement were investigated on the Bi-based superconducting materials. In preparing the samples, we used a method which is called solid-state reaction method. The patterns of the X-ray diffraction of all samples indicated the presence of Bi-2212 and Bi-2223 phases. The -Obtained results obtained from XRD, indicated-revealed that with increasing of the melting point of substitution elements, the (Bi-2223) phase decreases-decreased, and while the (Bi-2212) phase and impurity phases of samples increase-grow. From the electrical resistivity measurements using the four-probe method, it has been-was found that sample A with Pb and sample B with La replacements had the maximum and minimum critical temperature of 111.4 K and 81.6 K, respectively. From-Based on hysteresis loop (M-H) measurement by using Bean's model, estimating-estimation of critical current density (J_c) showed that sample A with Pb and sample B with La substitution had the maximum and minimum values respectively. These results may be due to the melting point of these elements with amounts-values of 888 °C, 1512 °C, 2315 °C, 2425 °C for PbO, Nb₂O₅, La₂O₃ and Y₂O₃ respectively. These elements were substituted-instead of-replaced by Bi₂O₃ with a melting point of 817 °C. In this study-From this, the samples were prepared at the temperature of 845 °C. It seems at this temperature, these elements not only dissolve within the main matrix and participate in the formation of the (Bi-2212) phase during the sintering process, but they also participate in the appearance-development of the variety of the impurity phases which-is confirmed by XRD results. In the BSCCO system, for further formation of the (Bi-2223) phase, the partial melting point of the composing elements must be close to the sintering temperature of the samples of BSCCO system.

Keywords

Bi-based superconductors, Volume fraction, Critical temperature, Four-point probe method, Lattice parameters, p parameter

1. Introduction

Addition or substitution-substitution in Bismuth-based superconductors as a probe is used for determining whether they exhibit better superconductivity properties or not. From-Since the time of Bi-based superconductors have been discovered [1], a lot-great deal of research has been done by researchers from all over the world [2-10]. The researchers are-have been trying to improve the superconductive properties and make-better understanding of the structural characteristics of the superconductors. Activities such as substitution and addition of a variety of elements have been done by researchers, so that determine-determine whether the superconductivity properties of this type of HTSC gets-better-improve or worse-worsen. BSCCO is the abbreviations of the Bi-based superconductors which is defined by the Bi₂Sr₂Ca_{n-1}Cu_nO_{2n+4+y} general composition, where n is the number of CuO₂ layers in the crystal structure. In this composition, the values of n are 1, 2 and 3. Regarding the values of n , Bi-based superconductors are characterized by three phases, named-called Bi-2201 phase, Bi-2212 phase and Bi-2223 phase with the critical amount-temperatures of 20, 85, and 110 K-critical-temperatures, respectively [11-13]. Smrckova *et al.* showed-indicated that the (Bi-2223) phase with the chemical formula of Bi₂Sr₂Ca₂Cu₃O_{10+y} is suitable for the-practical-use-to be used practically in superconducting devices with liquid nitrogen temperature ($T > 77$ K) [14]. In spite of many attempts and works to reach the Bi-2223 single phase, preparation-preparing of Bi-based superconducting system leads to the symbiosis of Bi-2223 and Bi-2212 and some-of-along with some-the impurity phases. On-In a BSCCO system, the superconductive characteristics, depend on the characteristics of the elements in the structure of the crystal. Researchers have found that Lead-lead (Pb) replacement improves the superconductive characteristics of the BSCCO system, -it-It means that Lead-lead is the most significant replacement element among the-other elements. The presence of Lead-lead (Pb) in the BSCCO system helps the reaction kinetics of Bi-2223 phase. The results of Pb-substitution-substituting Pb with Bi in preparing of BSCCO system with the formula of Bi_{2-x}Pb_xSr₂Ca₂Cu₃O₈ by the minimum amount of Pb (x); have indicated that $x = 0.3$ to $x = 0.4$. For this reason, a-lot-of-many researchers have selected Pb content (x) with an amount of 0.4 for preparing

Commented [WU1]: اصولاً نیازی به این جمله در چکیده نیست. این بیشتر شبیه به جملات بخش discussion هست. نظر ما این است که حذفش کنید. البته خودتان بر حسب مقالاتی که در ژورنال های حوزه تخصصی تان خوانده اید بهتر می دانید.

Formatted: Indent: First line: 0"

Formatted: Highlight

Formatted: Highlight