



Synthesis and characterization and pelletization pressure effect on the properties of $\text{Bi}_{1.7}\text{Pb}_{0.3}\text{Sr}_2\text{W}_{0.2}\text{Ca}_2\text{Cu}_3\text{O}_{10+\delta}$ superconductor system

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ABSTRACT

The solid-state reactions technique is considered as one of the most important and useful methods adopted to prepare the superconductors ceramics samples. This method was used in the current work to prepare $\text{Bi}_{1.7}\text{Pb}_{0.3}\text{Sr}_2\text{W}_{0.2}\text{Ca}_2\text{Cu}_3\text{O}_{10+\delta}$ samples, with different pelletization pressures ranged between 0.2 and 1.0 GPa sintered at 850 °C for 140 h. WO_3 nanoparticles were added to the BSCCO system with 0.2% in order to improve the connectivity between the grain boundaries and then to increase the dc electrical resistivity and oxygen content. X-ray diffraction, SEM and Vickers microhardness measurements were adopted to characterize the samples. Considering the electrical, structural affected by high pelletization pressure. Both of the critical temperature T_c and oxygen content δ were enhanced dramatically at different pressures, so they reach to the optimum values of 130 K and 0.224 respectively, at a pressure of 0.4 GPa. The orthorhombic crystal structure has been seen by the XRD analysis which presented both high Bi-(2223) and low Bi-(2212) phases that exist in the samples. SEM showed common microstructures and features of plates-like grains that were randomly distributed across all samples. On the other hand, the mechanical properties were noticed to be improved with increasing the pressure from 0.2 to 0.8 GPa. The microhardness, Young modulus and yield strength demonstrated a drop when the pressure was increased up to 1.0 GPa.

1. Introduction

Superconducting ceramics have a noticeable high T_c together with containing no any elements of rare earth [1–4]. Raising of the transition temperature (T_c) of superconductors was attracted researchers' attention and their sustained effort in superconductivity research ever since its discovery due to the scientific challenges and technological promise that superconductivity at higher temperatures can offer [5]. The keys of rising T_c in HTSCs are Pressure and doping which play an important role in developing it in superconductors such as BSCCO [6,7]. Where the Pressure was played a fateful role in the advancement and development of HTSCs due to its simplicity in modifying the basic parameter of solid materials, the interatomic distance, without altering the chemistry of the compound. The close relationship between pressure and doping has been demonstrated experimentally and explained theoretically [8,9].

However, the fracture of bulks occasionally belongs to the thermal stress which applied on the freezing procedure or the force of electromagnetism throughout the magnetization. Thus, the understanding and improvement of the mechanical properties of the bulks are essential for

the practical applications [10].

In this regards, M. Ersin Aytakin et al. [11] have studied the effects of high pelletization pressure on the structural and magnetic properties of $\text{Bi}_{1.8}\text{Sr}_2\text{Ca}_{1.1}\text{Cu}_{2.1}\text{O}_y$ samples. They found that the resistivity of the samples decreases with increasing the pelletization pressure at room temperature. The microhardness values as well as J_c values have been enhanced due to the strong couplings between the grains in comparison with other samples.

Özkurt, B [12] studied the effect of addition nano-sized WO_3 (40 nm) on the some physical properties of Bi-2212 superconductors. The structure results indicated that the number and type of non-superconductor phases change with increasing WO_3 content. The critical temperature decreases and the resistivity value for sample $\text{W}_{0.25}$ significantly increases. The critical current density (J_c) of the all doped samples was lower than that of the pure sample. In addition, the obtained microhardness values in this work indicated that the all samples have the typical indentation size effect behavior.

W. Abdeen et al. [13] investigated the consequence of the fractional substitution of $\text{Bi}_{1.8}\text{Pb}_{0.4}\text{Sr}_2\text{Ca}_{2.1-x}\text{Ho}_x\text{Cu}_{3.1}\text{O}_{10+\delta}$ set by solid-state

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