The Effect of Sm \rightarrow Ca Substitution on Mechanical Properties of BSCCO Superconductors

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In order to investigate the effects of Sm substitution on the mechanical properties of Bi-Pb-Sr-Ca-Cu-O, $\mathrm{Bi_{1.6}Pb_{0.4}Sr_2Ca_{2-x}Sm_xCu_3O_y}$ superconductors with $x=0.0,\,0.0005,\,0.001,\,0.005,\,0.01,\,0.1,\,0.5,\,1.0,\,1.5$ were prepared by standard solid-state reaction methods. The mechanical properties of these compounds have been investigated by measuring the Vickers hardness, yield strength, porosity, and SEM. These measurements showed that the Vickers hardness, yield strength, and porosity increased gradually with increasing Sm concentration.

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I. INTRODUCTION

In recent investigations on superconducting ceramics, the Bi-Pb-Sr-Ca-Cu-O (BSCCO) superconducting compound has received much attention because of its high critical temperature. On the other hand, BSCCO has been characterized by a wide variety of techniques. Many studies of doping into superconductor oxide ceramics have been made in order to improve their properties. Engineering applications of high critical temperature (T_c) superconducting ceramics are generally restricted because of their brittleness. For several years, various reinforced superconducting ceramics have been envisaged [1], such as ceramics enveloped by metallic shells (tubes) or granular ceramics in which additions are inserted. The plasticity and strength of BSCCO can be severely affected by numerous defects, dislocations, twins, ordering defects, micro cracks, and pores. Therefore, improvement of the mechanical properties of BSCCO is a major research objective, which is very important for their practical applications and high performance as quasi-permanent magnets, current leads, etc. It is possible to suppress the intrinsic brittleness of superconducting ceramics and reveal clear plastic flow with dislocation generation both by deforming at elevated temperatures [2, 3] and with the application of hydrostatic pressure at room temperature [4].

In our previous works, we studied the structural and physical properties of Sm doped BSCCO superconductors [5] and Vickers hardness measurements [6]. In the present work, the effects of Sm addition on the mechanical properties of BSCCO ceramics have been investigated. In addition, X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM) measurements were performed to investigate the surface microstructure and surface