Superconducting properties for $\text{Ba}_{1-x}\text{K}_x\text{Bi}_{1-y}\text{Na}_y\text{O}_3$

by hydrothermal reaction

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INTRODUCTION

Perovskite type $\text{BaBiO}_3$, so called valence skipper compounds, had attracted much attentions for interesting physical properties such as ferromagnetism and ferro-electricity. The electrical properties of $\text{Ba}_{1-x}\text{K}_x\text{BiO}_3$ (BKBO), K substituted $\text{BaBiO}_3$, changes into metallic (superconductor) from semiconductor with increasing values of $x$ [1]. The highest superconducting transition temperature ($T_c$) is 32 K with $x = 0.4$ for $\text{Ba}_{1-x}\text{K}_x\text{BiO}_3$ [2]. In contrast, $\text{BaBi}_{0.75}\text{Na}_{0.25}\text{O}_3$, replaced Na with Bi site of $\text{BaBiO}_3$, is the double perovskite structure of $\text{Bi:Na} = 3:1$ and does not show the superconducting properties [3].

Recently, Rubel et al. reported a new double perovskite superconductor using $\text{Ba(OH)}_2$, $\text{NaBiO}_3$ and KOH as starting materials [4]. This superconductor is possibly Na doped BKBO type superconductor because of its XRD peaks in accord with $\text{Ba}_{1-x}\text{K}_x\text{Bi}_{1-y}\text{Na}_y\text{O}_3$. Here we try to synthesize Na doped BKBO by a hydrothermal reaction and investigate the composition ratio of new superconductor.

EXPERIMENT

We synthesized $\text{Ba}_{1-x}\text{K}_x\text{Bi}_{1-y}\text{Na}_y\text{O}_3$ by a hydrothermal reaction. KOH, $\text{Ba(OH)}_2$ and $\text{NaBiO}_3\cdot8\text{H}_2\text{O}$ were used as the starting materials. These materials putted into an autoclave with a few amount of ultra pure water. After heating around 200°C, the powder products were obtained. To remove KOH, these samples were filtrated and sonicated. Then obtained samples were dried by an oven at 70°C for 6 h.

The products were identified by X-ray powder diffraction analysis using Cu Kα radiation. And the magnetic susceptibility of samples were measured by SQUID.

RESULTS

Some synthesized samples show superconductivity with $T_c$ of 28.7K and superconducting volume fraction of 15 %. However, since Na or K content of the sample is inhomogeneous, it is not clear BKBO whether contribute to the superconducting signal. Consequently, we performed the fabrication of four terminal to single particle by Focused Ion Beam (FIB) and electrical resistivity measurement to investigate the relation between the content of Na or K and the superconducting properties.