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전력용 Nanocomposite의 열화학 특성

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Thermal Properties of Ploymide Nanocomposite

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Abstract - We have fabricated superconductor ceramics by chemical process. A high Tc superconductor with a nominal composition of $Bi_2Sr_2Ca_2Cu_3O_y$ was prepared by the organic metal salts method. Experimental results suggest that the intermediate phase formed before the formation of the superconductorphase may be the most important factor. The relation between electromagnetic properties of Bi HTS and external applied magnetic field was studied. The electrical resistance of the superconductor was increased by the application of the external magnetic field. But the increase in the electrical resistance continues even after the removal of the magnetic field. The reason is as followsthe magnetic flux due to the external magnetic field penetrates through the superconductor and the penetrated magnetic flux is trapped after the removal of the magnetic flux.

1. 서 론

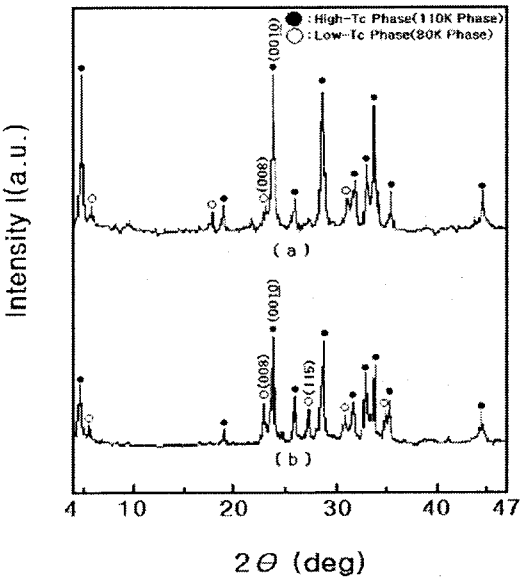
Since the discovery of high Tc oxide superconductors with transition above liquid nitrogen temperature[1-4], many efforts have been focused on improving the fabricability of ceramic superconductors and increasing the critical current density of the systems. Recently severaleffective methods, which could fabricate ceramic superconductors into a wire or a tape shape with high Jc, have been successfully developed for the BiSrCaCuO system. The discovery of superconductivity in the BiSrCaCuO system with two superconducting temperatures, significant effort has been directed towards developing high current superconducting wire technologies. Compared with the earlier developed YBaCuO superconductor, this oxide system contains no rare earth element and has greater chemical resistance against moisture, but the critical current density, Jc, is lower and requires prolonged annealing to form the high Tc and other phase. So far, much effort has been devoted to the fabrication and application of this superconducting oxide system. Generally the preparation of superconducting oxides by conventional solid state reaction relies upon the repeated milling and sintering of an oxide and carbonate mixture, with such a process, the time required to obtain acceptable homogeneity is very expensive and serious contaminations may be introduced during the milling process. On the other hand, chemical solution methods are much more efficient in the production of mixtures of high homogeneity.

2. 본 론

The high Tc superconductor of Bi system with the nominal composition of $Bi_2Sr_2Ca_2Cu_3O_y$ precursor was prepared from mixed powders of Bi_2O_3, $SrCO_3$, $CaCO_3$, and CuOby the organic metal salts method. A mixture of nitrate salts in a suitable molar ratio with total weight 50gm was dissolved in 150ml distilled water. The nitrate solution was then vigorously stirred with a few drops of 60wt% HNO_3 solution added to assist the dissolution. After a clear solution was obtained, powered citric acid and ethylene glycol were added. The resulting solution of light blue was magnetically stirred and heated at 80?.A vigorous reaction occurred and enormous amount of N_2 gas evolved during this procedure. When aliquid began to set into a gel, the gel was dehydrated at 120? for 12 hours, while the color of the gel changed from blue to green, and finally a solid precursor material of a brownish yellow color was obtained. The solid precursor was ground with mortar and pestle. The powered precursor was then transferred into an alumina crucible and placed in an air furnace. It was slowly heated to 400? for 10 hours. The furnace temperature was then slowly raised to 850?, and calcination was performed at this temperature for 5 hours followed by furnace cooling to room temperature. The calcined powder was ground with mortar and pestle into powders. After grinding the calcined cake, the powder mixtures were pressed into pellets under 300 kg/cm^2, followed by sintering at 850℃ for 50 hours.

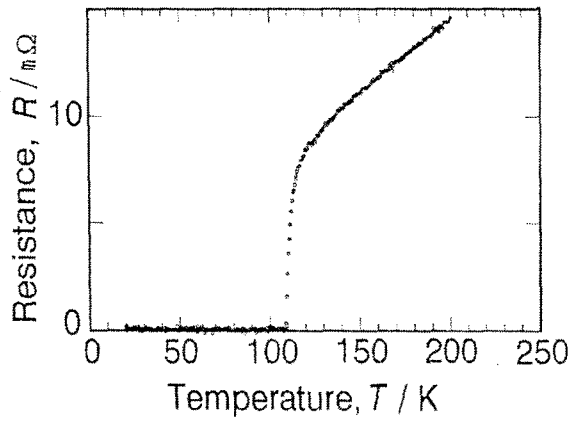
3. 결과 및 고찰

Fig.1(a) shows an XRD pattern of an 5 wt% Ag_2O doped BiSrCaCuO superconductor, while Fig.1(b) is an XRD pattern of an undoped sample, where (?) and (?) denote the peaks of 110K phase and 80K phase, respectively. Fig.1 shows the structure of superconductor crystalline state. From XRD patterns, the presence of the superconducting low Tc phase (80K phase) was confirmed in the undoped sample because of the presence of the (115) diffraction peak. In order to investigate the reaction between Ag_2O and the superconducting phases, powder X-ray diffraction analysis was carried out on the calcined powder. The high Tc superconducting phase ($Bi_2Sr_2Ca_2Cu_3O_{10}$, 2223 phase) is the main phase but a small amount the low Tc phase ($Bi_2Sr_2Ca_1Cu_2O_8$, 2212 phase) remained.



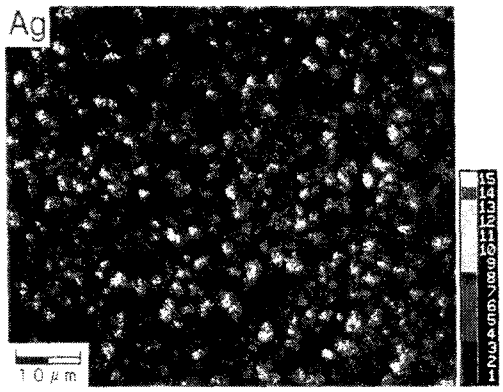
<Fig.1> The X-ray diffraction patterns of powered supercondu cting BiSrCaCuO superconductor, (a) is the case of Ag_2O doped superconductor, (b) is undoped superco nductor ; ? and ? denote high Tc phase (110K phas e) and low Tc phase (80K phase), respectively.

Fig.2 shows the R-T curves of the sintered pellets with their XRD patterns shown in Fig.1. Their zero -resistance temperatures, Tc(0), was found to be 105K. Transition temperature Tc of all specimens tested were shown to be 105K. The presence of Ag in the doped sample is attributed to the reduction of Ag_2O in oxide ceramics during reaction sintering, similar to those observed in the Ag_2O doped YBaCuO superconductor[4].



<Fig.2> The resistance-vs-temperature curves of the pellets sintered 850℃ for 50 hours.

In our experiments, the Ag_2O doped samples were showed high Tc (about 105K) as well as sufficient formation of the 2223 phase. The lattice parameters of the 2212 phase and the 2223 phase for our samples were calculated from the XRD patterens. At constant sintering time, the parameter is nearly constant at 0.55 nm, while the c parameter reduced from 3.10 nm to 3.09 nm. But this variation is very small. It means that the variation of the lattice parameter is not a function of Ag_2O content. The EPMA pattern in the 5% Ag_2O doped sample in Fig.3 showed a uniform dispersion of Ag particles.



<Fig. 3> EPMA image of the BiSrCaCuO superconductor with Ag_2O addition.

4. 결 론

Although the precursor material prepared in this work was not in the amorphous state as expected, volume fraction of the high Tc phase was obtain at 850? for a short time. From the experiments, it has been found that the memorized superconductor can detect both magnitude and polarity of the coming magnetic flux. The knowledge from this principle shows that the same polarity of the coming external magnetic flux and the memorized magnetic flux will cause to decrease the resistance of the superconductor, that is, the voltage across the superconductor is decreased. Furthermore, the different polarity of the coming external magnetic flux and the memorized magnetic flux will cause to increase the resistance value of the superconductor, that is, the increasing of voltage across the superconductor.

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