

Protective Effect of Ag Coated on Textured YBCO Surface

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Abstract

Ag coating on the textured YBCO was prepared by means of a Ag₂O brushed coating method. The contact between Ag coating and textured YBCO was examined by sharp knife cut and by the observation of SEM. The critical current densities of different textured YBCO samples, which included YBCO with and without Ag coating, and YBCO with Ag coating after hot moist test, were compared. The Ag coating does not influence the oxygen absorption of textured YBCO, but Ag coating can protect YBCO well from moisture and CO₂.

Key words : Textured YBCO, Ag₂O, Ag coating, Moist test, Critical current density

1. Introduction

The YBCO superconductor can react with H₂O and CO₂ in air, which reduce the superconductivity and makes the YBCO material powdered [1,2]. In the laboratory conduction, especially in the humid summer the reactions expand from the surface into the inside of YBCO via grainboundary. The corroded grains of a well oriented YBCO will obviously become convex on the surface of YBCO. After the reactions the oriented YBCO will cleave in grain boundary and become powdered. In order to protect the corrosion of YBCO from humid air and CO₂, someone of authors have already tried making protective film on the surface of YBCO material. M.Chen^[3] deposited a BaF₂ film on the YBCO superconductive film to protect the H₂O. C.Zhang^[4] made a organic film to protect the water and moisture. Both of BaF₂ film and organic film are insulator which can not diffuse the heat from the inner of YBCO superconductor and can not make a electrode on the YBCO surface. In the paper, the silver coatings on the textured YBCO surface were prepared and the protective examination of the coatings was taken place in the hot humid moist conduction. The comparison of critical current densities (J_c) was taken place for the textured YBCO samples without Ag coating, with Ag coating and after hot moist test.

2. Experiment

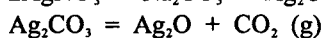
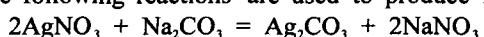
2.1 Preparation of textured YBCO Samples

The 10×5×2mm³ samples were cut from the highly oriented YBCO bulk, which was made by MTG^[5]. After the oxygen absorption at 450°C, under O₂ flow for about 24 hours, the samples of textured YBCO became 90K zero resistance superconductors. The orientation of YBCO was checked by X-ray diffraction. The hysteresis loops were measured by a vibrating Sample Magnetometer at 77K and the J_c was calculated by means of Bean's model.

2.2 The preparation of silver coatings on the surface of textured YBCO

The electric plate and chemical plate could not be used in the Ag coating process because they are both aqueous solution which will react with YBCO. Here Ag coating was made by a Ag₂O brushed coating method on the textured YBCO.

The following reactions are used to produce Ag₂O powder



Ag₂CO₃ produced is yellow color powder, which is heated and decomposed into Ag₂O and CO₂. The mixture of Ag₂O and welding flux and some organic agent was ground to the

paste, which was put in a sealing bottle, its time limit for using was 48 hours. The Ag_2O paste was brush on the surface of textured YBCO homogeneously, and it was dried at room temperature, and then it was placed in the furnace and heated at 500°C for 2 hours. After the treatment, Ag_2O paste was decomposed to metal Ag which was firmly contacted onto the surface of YBCO.

2.3 The moist test for the Ag coated YBCO

The sample of Ag coated YBCO was placed in top part of a glass container, the water at the bottom of the container was heated at 60°C , its humidity in the container was 98%, the hot moist test was lasted for 24 hours.

2.4 Oxygen absorption of textured YBCO samples

The oxygen absorption of the textured YBCO samples with Ag coating and without Ag coating was taken place under O_2 at 400°C for 96 hours. The oxygen atoms can easily penetrate the Ag coating by means of oxygen diffusion although the Ag coating is homogenous and porous free.

3. Results and Discussions

3.1 The examination of Ag coating on the surface of YBCO superconductor

The Ag coating was metallic bright, homogenous, and was difficult to cleave off from the textured YBCO by a sharp knife, which was a normal method to examine the firmness between coating and substrate. SEM observation of Ag coating on textured YBCO is shown in Fig.1. Fig.1.(a) is the surface morphology of Ag coating, which is formed by the Ag flats with side of $2\sim 8\mu\text{m}$ and without pores. Fig.1(b) is the break of Ag coated YBCO sample. The boundary between Ag coating and YBCO is very smooth, the thickness of the Ag coating is about $8\mu\text{m}$.

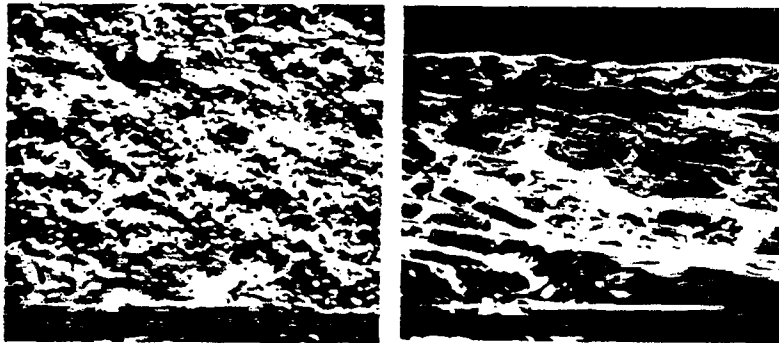


Fig.1 SEM photos of Ag coating on textured YBCO
(a)the surface morphology of Ag coating (b)the break of the Ag coated YBCO

3.2 Comparison of J_c for YBCO with Ag coating, without Ag coating and after hot moist test

Fig.2 shows the hysteresis loops of YBCO superconductors without Ag coating(A), with Ag coating (A_1, B_1), with Ag coating after the hot moist test (A_2, B_2). It is seen that the hysteresis loops of sample A, A_1 and A_2 are very close, the hysteresis loops of sample B_1 and B_2 are almost overlapped. For the samples A_1 and A_2 , B_1 and B_2 , the J_c values are almost same before and after hot moist test, it means that the Ag coatings have very well protective effect in moisture and CO_2 .

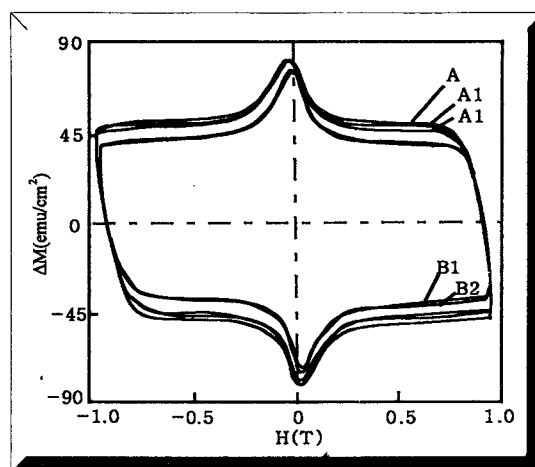


Fig.2 The hysteresis loops of textured YBCO without Ag coating(A),with Ag coating(A₁,B₁), with Ag coating after hot moist test(A₁,B₂)

4. Conclusions

Ag coating can be made on the YBCO by a simple Ag₂O brushed coating method. The Ag coating contacts with textured YBCO firmly. The Ag coating doesn't influence the oxygen absorption of textured YBCO and its superconductivity. The Ag coatings have very well protective effect for the textured YBCO from moisture and CO₂.

Acknowledgements

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