ホットプレス(Ba, K)Fe_2As_2銀シース線材の磁場中磁気顕微観察

In-field Scanning Hall Probe Microscopy of Hot-pressed Ag-sheathed (Ba,K)Fe_2As_2 Tape

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1. Introduction

Iron-based superconductors have a great potential for high field applications because of its superior in-field current transport characteristics with high irreversibility fields and low anisotropy. Recently, promising value of critical current density, J_c, was obtained by use of hot-pressing process [1], and even 100-m-class long length tapes has already been demonstrated [2]. Nevertheless, current limiting mechanism is not yet fully understood. In this study, we investigated J_c distribution in a hot pressed Ag-sheathed (Ba,K)Fe_2As_2 tape by use of in-field scanning Hall-probe microscopy (SHPM).

2. Experiment

After measuring critical current by use of the four probe transport method, we selected the region between voltage terminals to be investigated by the in-field SHPM. Photographs of the sample including cross-section are shown in Fig. 1. The width of the tape is 6 mm and the length is 18 mm. Red square in the figure indicates the scanned area for the magnetic measurement. During the measurements, sample temperature was kept at 5 K, and external magnetic field was applied by a superconducting magnet up to 4 T.

3. Results and Discussion

Fig. 2 shows the magnetic images taken under external magnetic fields of 0, 2, and 4 T. Note that please we succeeded in obtaining remanent field signal even in such high back ground field as 4 T. Even though the tape contains a single flat core as can be seen in Fig. 1, we observed two parallel filamentary structures. Namely, the central region of the filament decoupled each other most probably because of the pressing process. In the longitudinal direction, we also observed inhomogeneity.

Fig. 3 indicates sheet current density for the magnetization current derived from the magnetic field image shown in Fig. 2 by solving inverted Biot-Savart law. In such a case where the magnetic moment has spatial distribution, the present method is powerful to derive local J_c, because it is impossible to derive J_c only from magnetic moment of the whole sample. The amplitude of the magnetization current is equal to that of J_c. The position of low J_c region is coincide with that of soldering for the voltage terminal. At this moment it is not yet clear the reason of lower J_c in this position. By integrating the current density across the width direction, we can estimate critical current, I_c, of the tape. The value of I_c is estimated to be around 400 A. This shows very good agreement with the results of the transport measurement. We also noticed that the field dependence of I_c is very small. This suggests strong flux pinning of the tape. In the presentation, more detailed analysis including flux creep will also be presented.

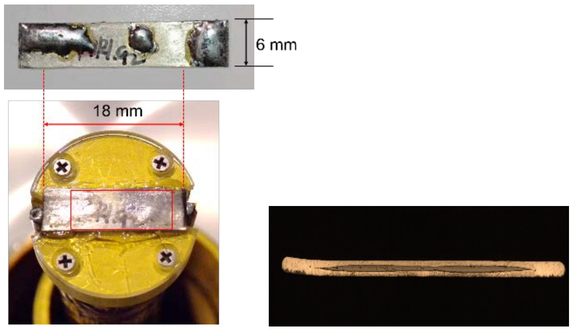

Fig. 1. Photograph of the sample mounted on the scanning stage. The red square, 5 mm in width and 13 mm in length, is the scanned area for the imaging. Cross-section of the tape is also shown.

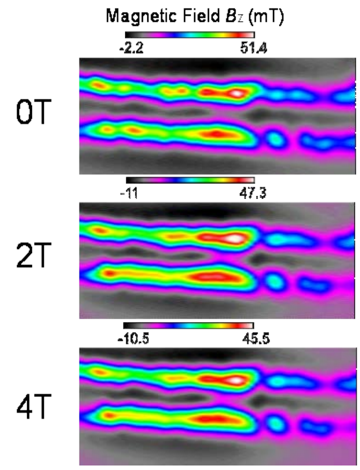

Fig. 2. Perpendicular component, B_z, of the remanent field distribution under external magnetic fields of 0, 2, and 4 T at 5 K. Note that the background field was subtracted.

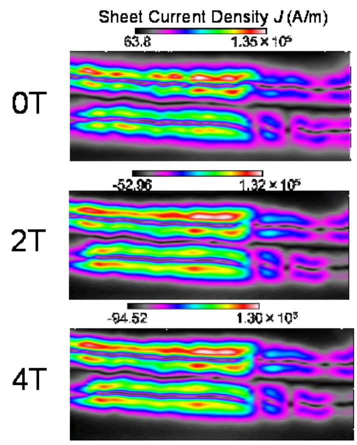

Fig. 3. Magnetization current distribution obtained from the magnetic image shown in Fig. 2.

Acknowledgements

This study is supported by JSPS and CAS under the Japan-China Research Cooperative Program.

References

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