磁界中磁気顕微法を用いた磁化緩和計測による Bi-2223 多芯テープ線材の電流輸送特性評価

Characterization of Current Transport Properties in Multi-filamentary Bi-2223 Tape Based on Magnetic Moment Relaxation Measurement by In-field Magnetic Microscopy

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1. Introduction

Bi-2223 tapes are used to wind superconducting magnets such as cryocooler cooled high field magnet and MRI magnet. It has been pointed out that a large value of magnetic moment induced in the tape strand causes several issues in the magnet applications. Namely, in-field behavior of such magnetic moment in the tape strand should be relevant as a base of magnet applications. The measurement of magnetic moment relaxation is also important as a method to evaluate critical currents especially at high current region. However, it is not yet clearly understood the influence of coupling between the filaments in multifilamentary Bi-2223 on the magnetization relaxation. Here we investigate whether the Bi-2223 filaments are decoupled at high magnetic fields by performing local magnetization relaxation measurements

2. Method

The sample was a 16 mm-long section cut from a commercial long-length DI-BSCCO tape of width 4.5 mm. Local magnetization relaxation was measured using a scanning Hall probe microscope (SHPM) with the external field applied perpendicular to the tape surface. After magnetizing the sample at a particular field, successive line scans are performed by scanning the Hall probe across the tape width to obtain the distribution of the vertical trapped magnetic field B_z. From the relaxation line scans we extract the electric field (E) and current density (J) of the tape and compare with the E-J characteristics from transport measurement.

3. Results

Fig. 1 shows the relaxation of the B_z distribution at 50 K after applying a field of 1 T. Up to long wait time we observe single triangular distribution across the tape width which is due to coupling of filaments. We obtain similar triangular B_z distribution up to high fields. This implies that the filaments always remain coupled. Fig. 2 shows the E-J characteristics at 50 K calculated from magnetization relaxation (set of curves at lower electric field range). We find the E-J characteristics obtained by SHPM exhibit a continuation of the transport E-J characteristics.

4. Conclusion

We measured the in-field magnetization relaxation in Bi-2223 using SHPM. Remanent field distribution clearly shows filament coupling during the relaxation.

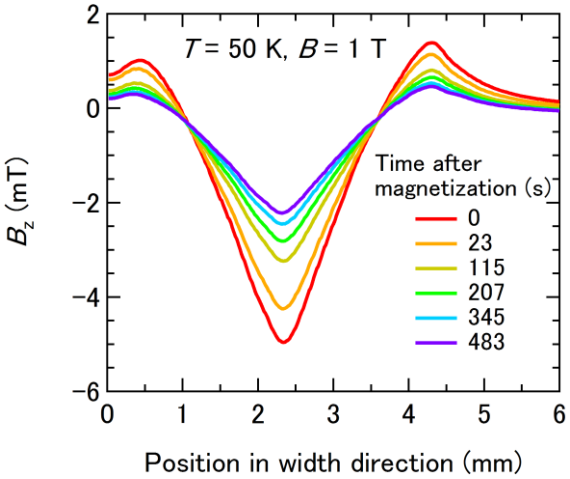

Fig. 1 Decay of field distribution in a 16-mm long Bi-2223 tape after applying external field of 1 T at 50 K.

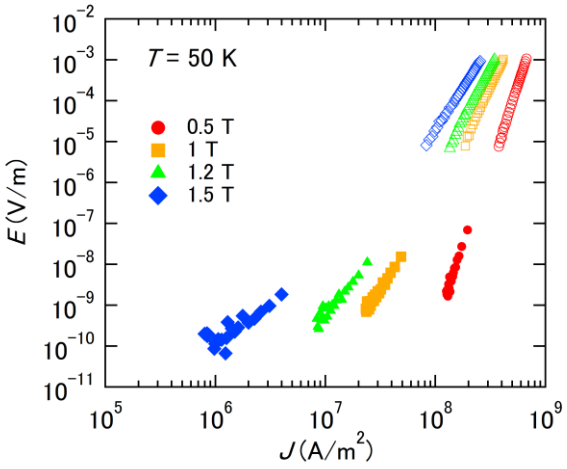

Fig. 2 E-J characteristics at 50 K obtained from transport measurement (top curves) and SHPM measurement (bottom curves) for different fields.